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Food and disturbance effects on Arctic benthic biomass and production size spectra

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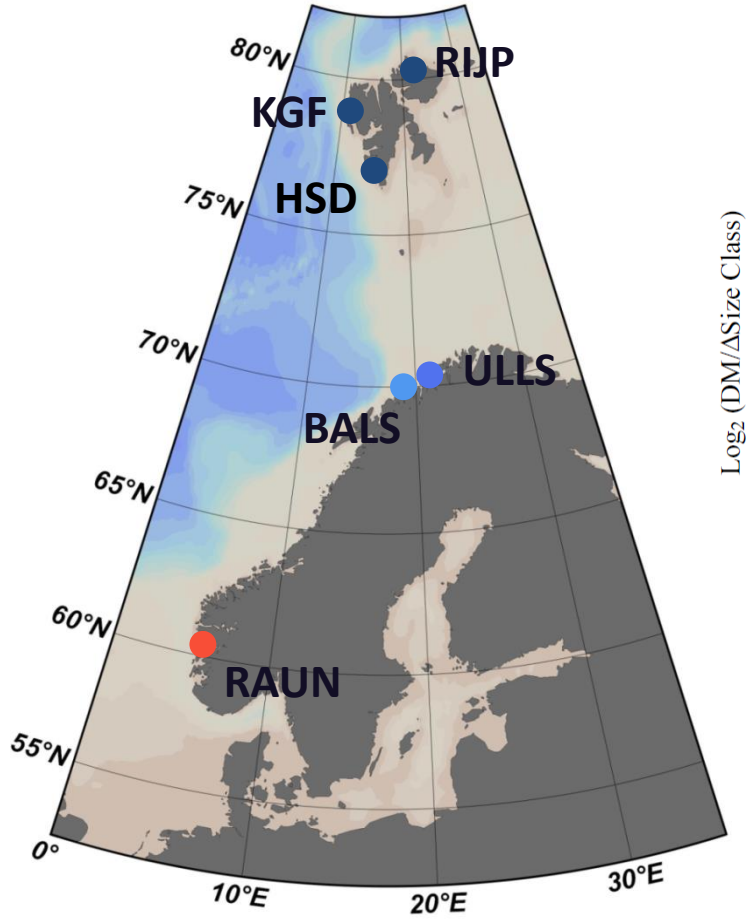
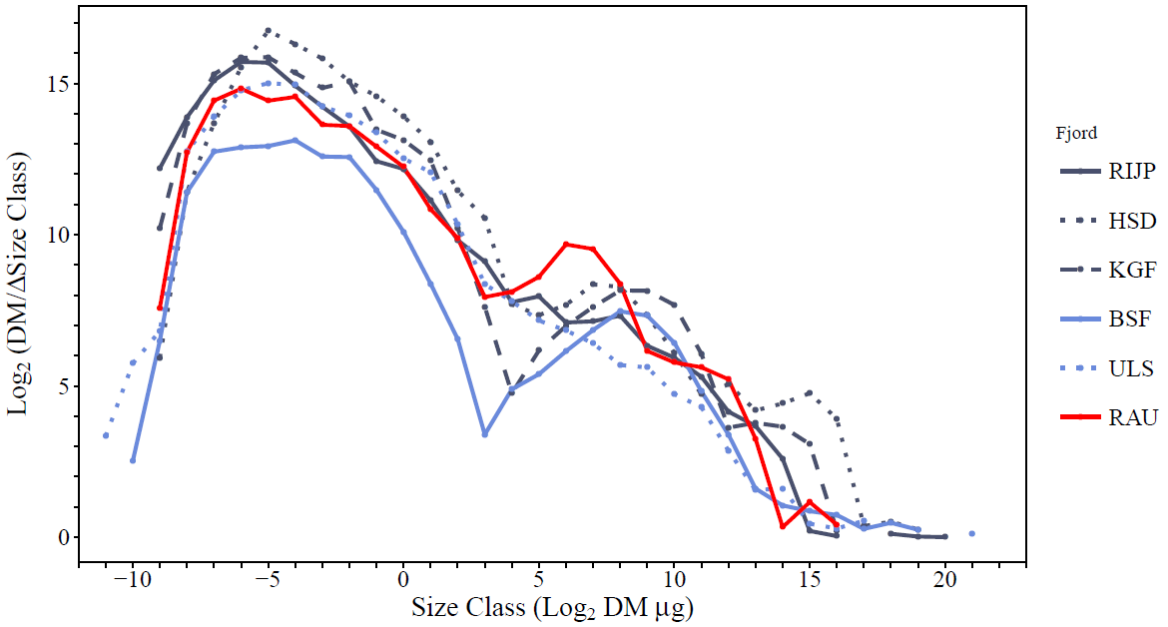
DWARF large scale survey - consistency of benthic communities size structure at a regional scale

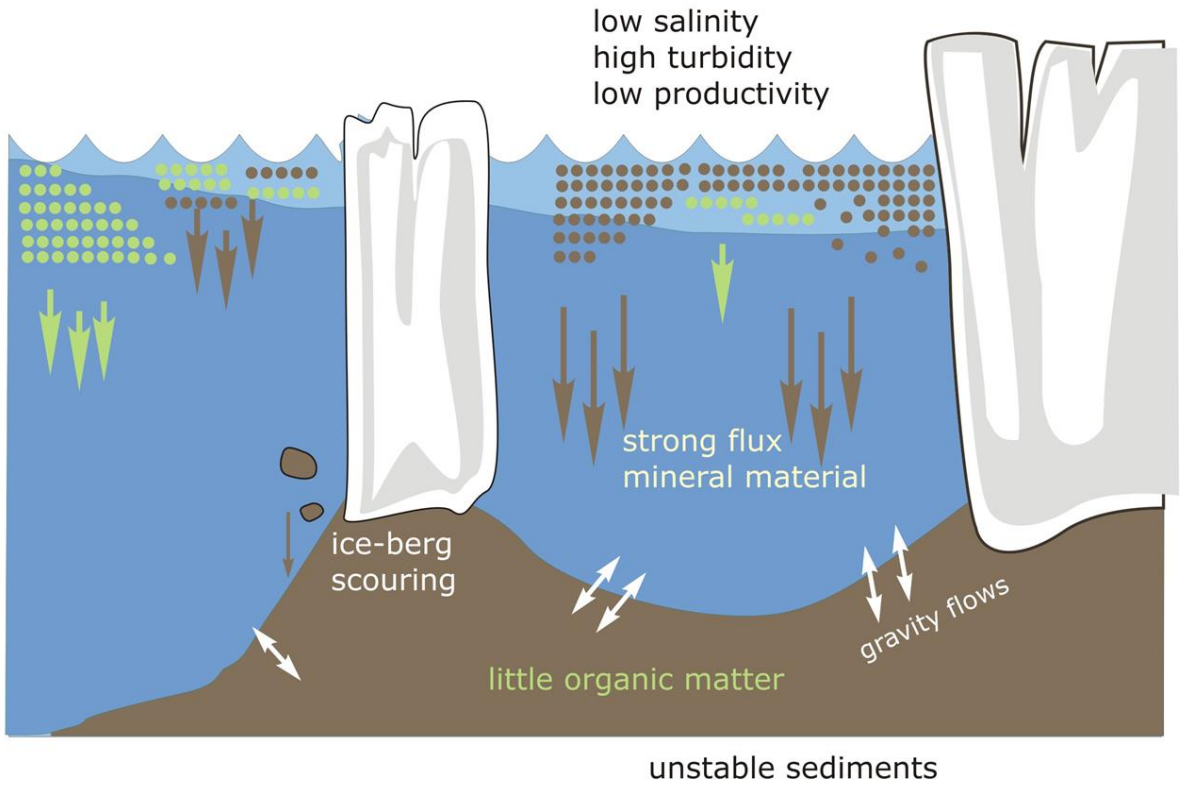




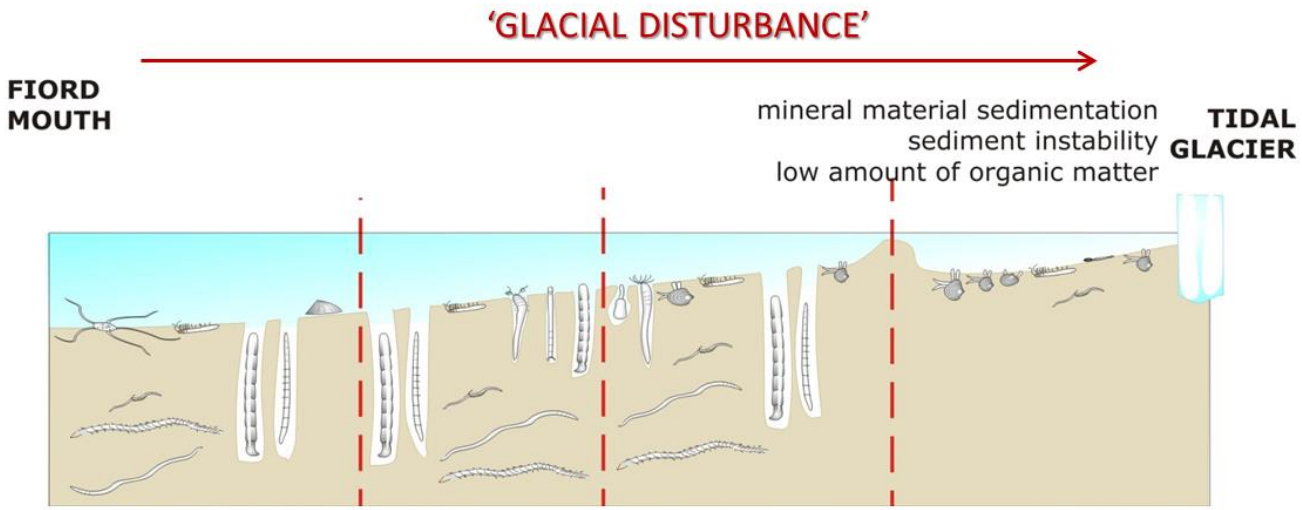
local variability?

- BBSS are insensitive to differences in grain size or salinity (Duplisea & Drgas 1999, Warwick 1984, Dolbeth et al. 2014)
- no response to organic enrichment in salmon aquacultures (Duplisea & Hardgrave 1996), or increase of large size classes in eutrophic site (Vanreusel, 1995)
- Decline of larger organisms in response to disturbance - anoxia (Quiroga et al. 2005), trawling (Queiros et al. 2006)

food availability and disturbance gradients in Arctic glacial fjords



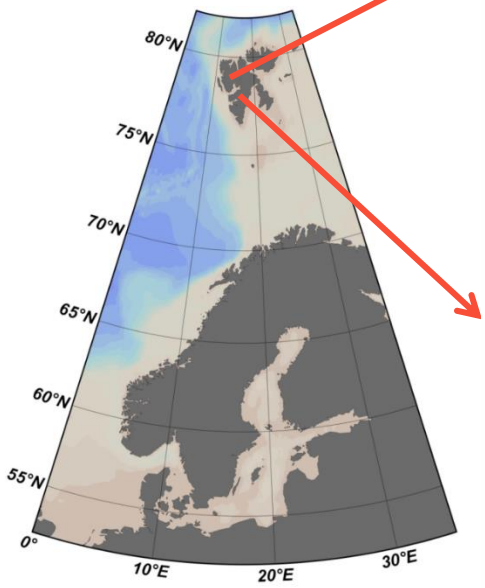
benthic response to glacial disturbance gradients

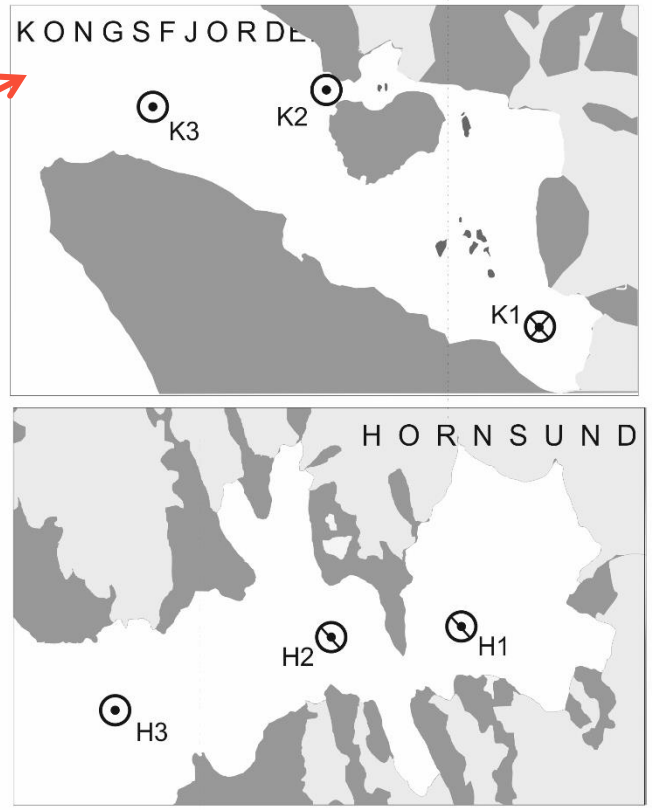


- change in species composition
- decrease in biomass, average animal size, density
- decrease in species richness and evenness
- simplification of community 'physical structure' - smaller animals, keeping close to sediment surface, no tube-dwellers in glacial bays
- simplification of functional diversity - suspension feeding and sedentary fauna depressed, fauna dominated by one functional guild (mobile surface deposit feeders) in glacial bays

Włodarska-Kowalczuk & Pearson 2004, Włodarska-Kowalczuk et al. 2005

food and disturbance in Arctic glacial fjords - response in benthic size structure?



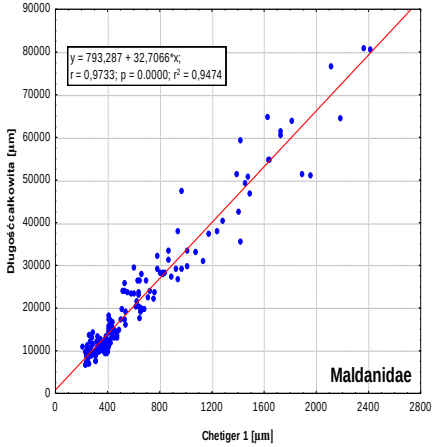


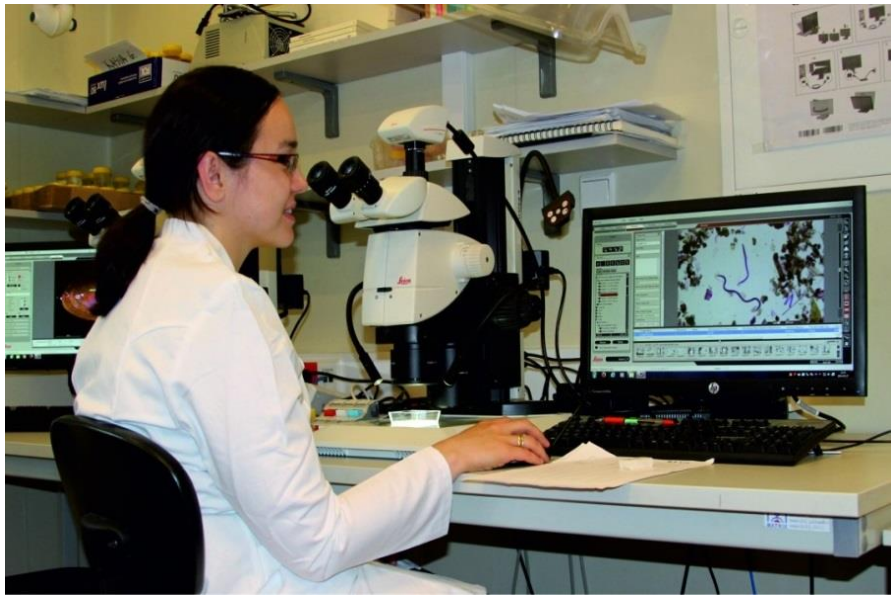
⊙ High Food ← chlo *a* in sediments > 2.5 ug cm^{-3}
Low Disturbance ← sediment accumulattion rate < 0.7 cm y^{-1}

⊗ Low Food ← chlo *a* in sediments < 1 ug cm^{-3}
Low Disturbance ← sediment accumulattion rate < 0.7 cm y^{-1}

⊗ Low Food ← chlol *a* in sediments < 1 ug cm^{-3}
High Disturbance ← sediment accumulattion rate > 2.5 cm y^{-1}

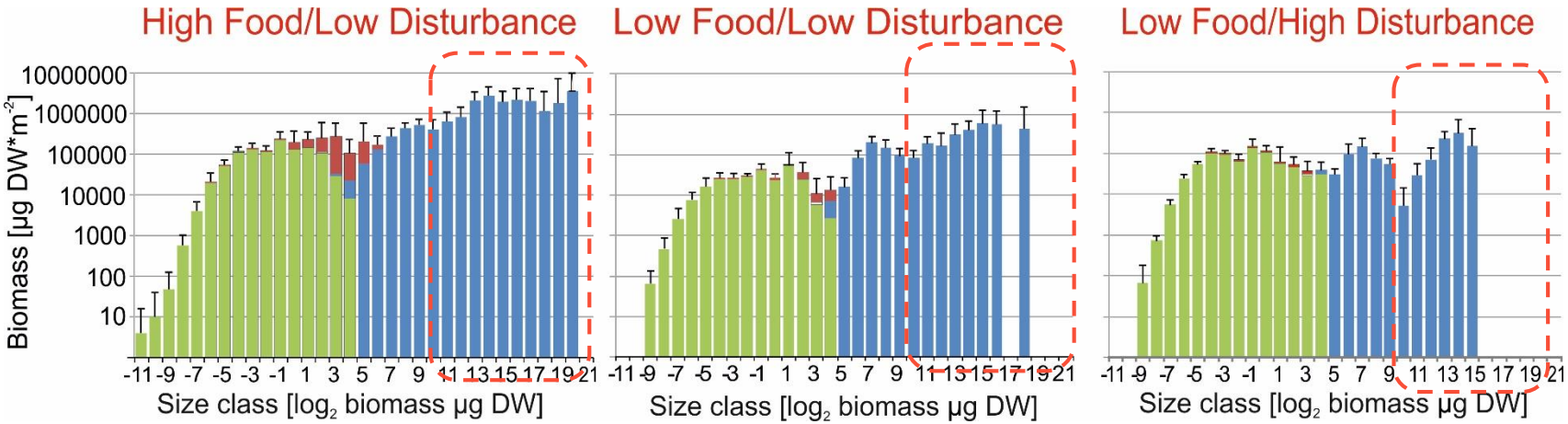
benthic biomass size spectra - methods





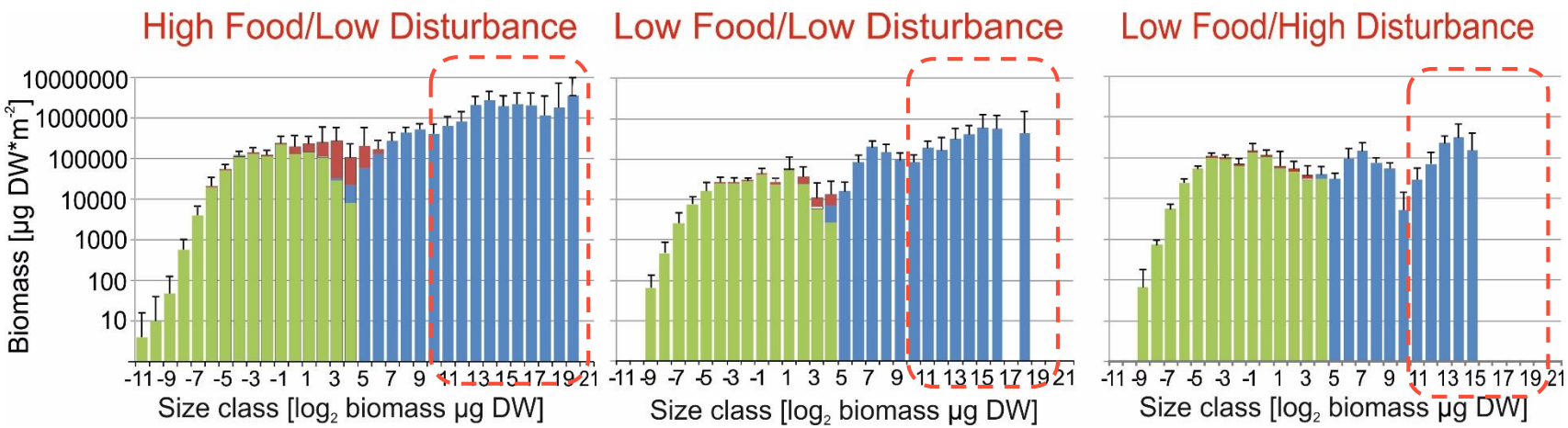
meiofauna + macrofaunal nematodes + macrofauna
measurments of individual
size → biovolume → biomass size spectra

biomass size spectra

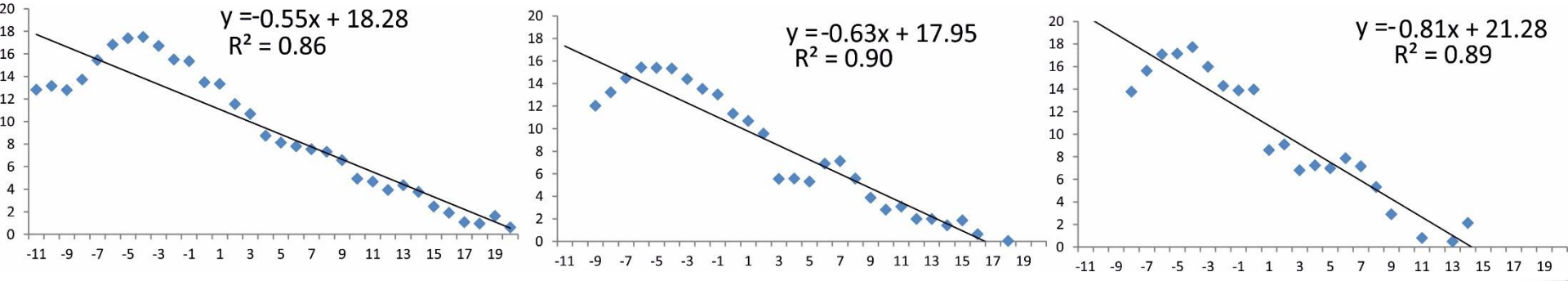


photos: Matthew D. Hooge, Rick Hochberg
http://hooge.developmentalbiology.com/meiofauna

benthic biomass size spectra

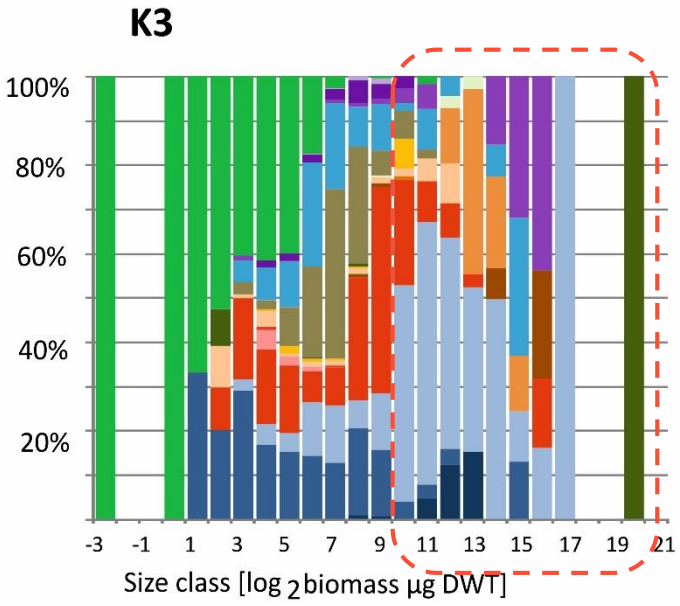


normalised BBSS

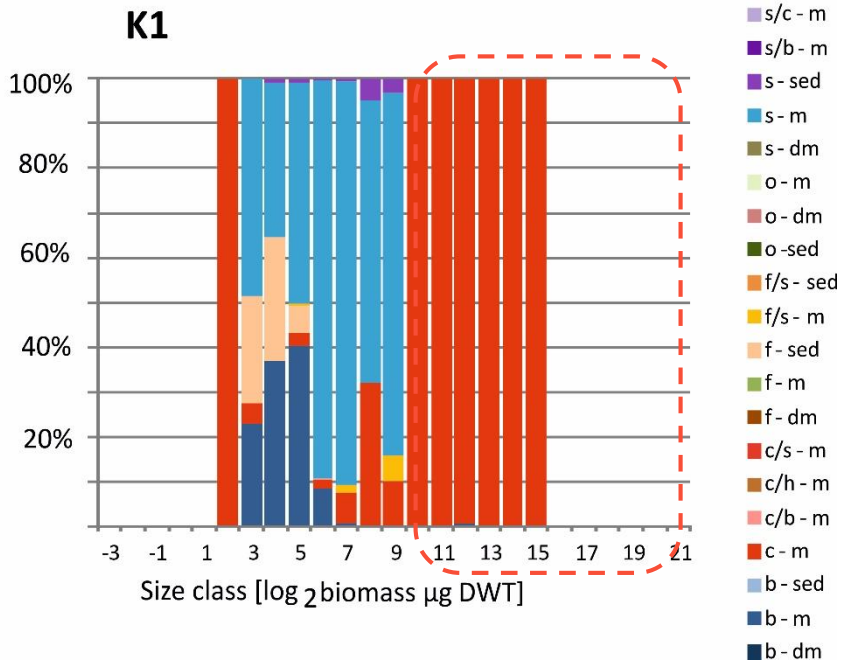


functional groups in macrofaunal size classes

HIGH FOOD/LOW DISTURBANCE



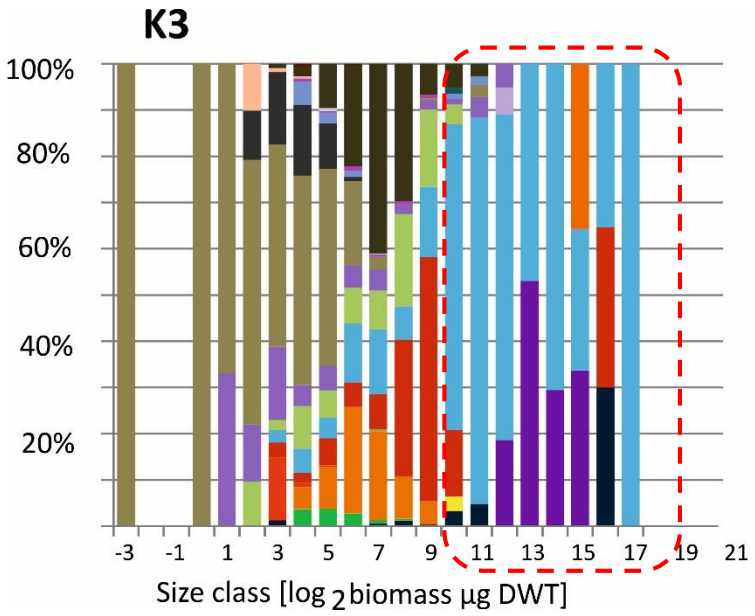
LOW FOOD/HIGH DISTURBANCE



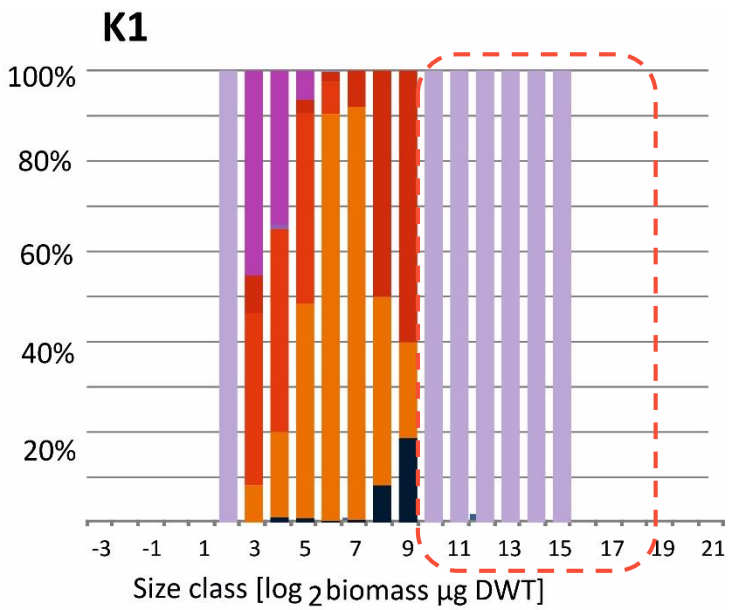
b- subsurface deposit feeder; c – carnivorous; h – herbivorous; f – suspension feeder; o – omnivorus; s – surface deposit feeder; m – motile; dm – discretly motile; sed - sessile

Polychaeta families in size classes

HIGH FOOD/LOW DISTURBANCE



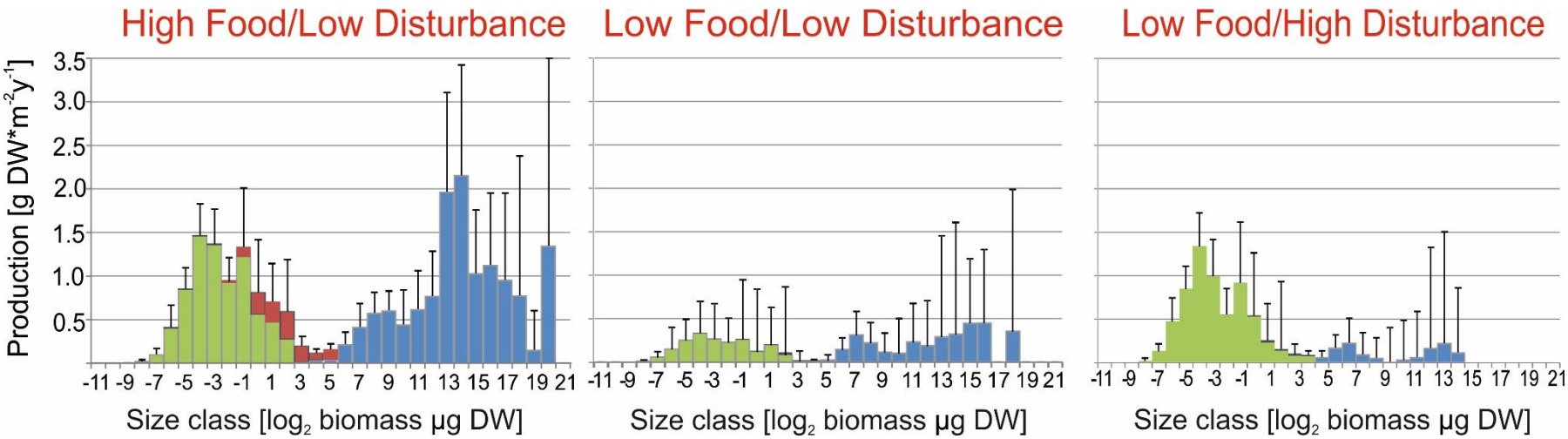
LOW FOOD/HIGH DISTURBANCE



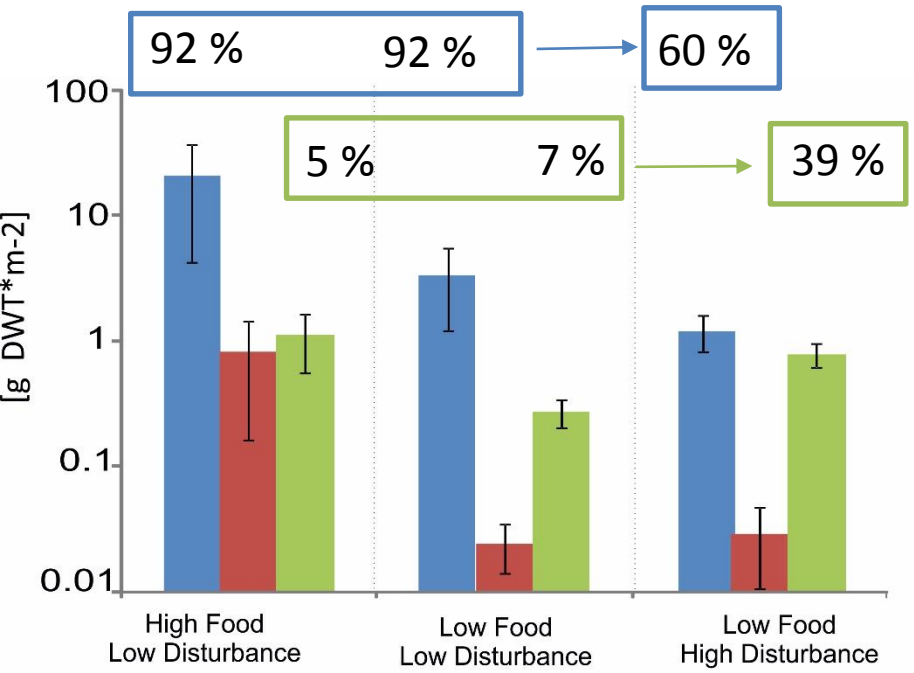
- Ampharetidae
- Apistobranchidae
- Capitellidae
- Chaetopteridae
- Cirratulidae
- Cossuridae
- Dorvilleidae
- Flabelligeridae
- Glyceriidae
- Lumbrineridae
- Maldanidae
- Nephtyidae
- Onuphidae
- Opheliidae
- Orbiniidae
- Oweniidae
- Paraonidae
- Pectinaridae
- Pholoidae
- Phyllodocidae
- Polynoidae
- Sabellidae
- Scalibregmidae
- Serpulidae
- Sphaerodoridae
- Spionidae
- Spirorbidae
- Syllidae
- Terebellidae

production in size classes

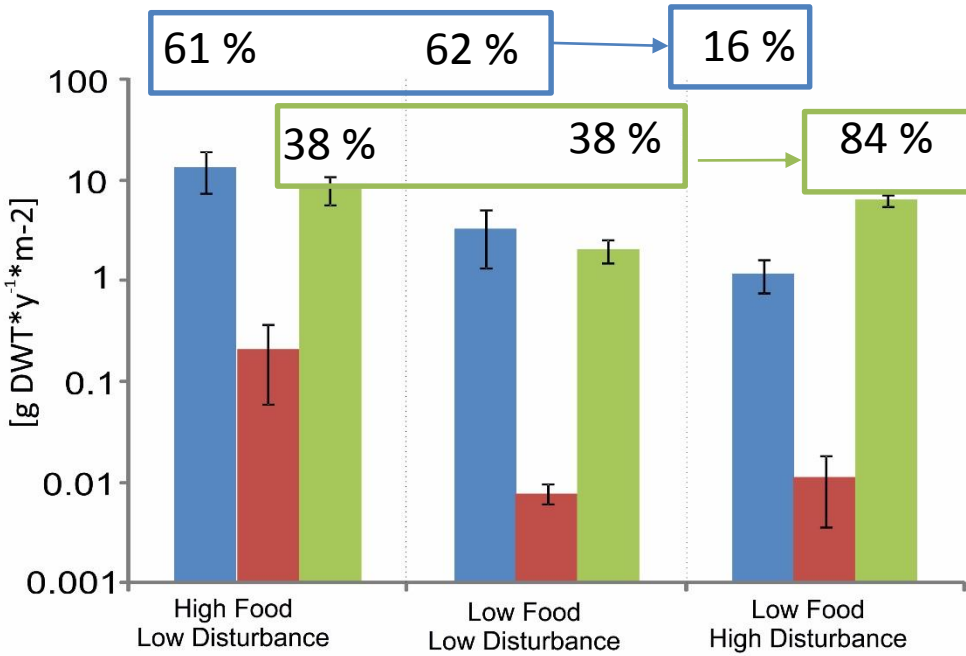
- **meiofauna - estimated based on individual biomass (Schwingamer et al., 1986)**
- **macrofauna - estimated based on individual biomass, temperature, depth, taxon, feeding & mobility type (Brey, 2012)**



biomass



production



macrofauna big nematodes meiofauna

DWARF

Conclusions

- food availability and disturbance control the total biomass and production and their partitioning among the size classes
- lower food availability suppress the biomass and production across the whole spectrum
- disturbance reduces biomass in medium/large macrofaunal size classes, meiofauna takes over the role of the metazoan key-player in terms of secondary productivity and organic matter processing in sediments
- ‚macrofaunal nematodes' make a significant part of benthic infaunal biomass and production, but only in undisturbed sediments with high organic matter content

Thank you

Gorska B., Włodarska-Kowalczuk M., 2017, Food and disturbance effects on Arctic benthic biomass and production size spectra. Prog in Oceanogr 152, 50-61