Polish-Norwegian Research Programme

Narodowe Centrum Badań i Rozwoju

norway grants

"This project is funded from Norway Grants in the Polish-Norwegian Research Programme operated by the National Centre for Research and Development"

Centre for Polar Studies

Arctic Benthic Biomass Size Spectra in response to climate changes

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SIZE matters!

‚SIZE is a supreme regulator of all biological matters' – Bonner, 2006 – determines rates of an organism basic processes (metabolism, generation time, longevity, locomotion speed, …)

SIZE structure in communities and populations shapes ecosystem functioning (e.g. energy flows in food-webs, bioturbation)

PROCEEDINGS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

Warming alters community size structure and ecosystem functioning

Matteo Dossena, Gabriel Yvon-Durocher, Jonathan Grey, José M. Montoya, Daniel M. Perkins, Trimmer and Guy Woodward

Proc. R. Soc. B 2012 **279**, doi: 10.1098/rspb.2012.0394 first published online 11 April 2012

SCIENTIFIC REPORTS

OPEN

SUBJECT AREAS:
BIOGEOCHEMISTRY
COMMUNITY ECOLOGY
BIODIVERSITY
ECOSYSTEM ECOLOGY

Size matters: implications of the loss of large individuals for ecosystem function

Alf Norkko[1,2], Anna Villnäs[1], Joanna Norkko[1], Sebastian Valanko[1,2] & Conrad Pilditch[3]

[1]Tvärminne Zoological Station, University of Helsinki, FI-10900 Hanko, Finland, [2]Marine Research Centre, Finnish Environment Institute, PO Box 140, FI-00251 Helsinki, Finland, [3]Department of Biological Science, University of Waikato, Private Bag 3105, Hamilton, New Zealand.

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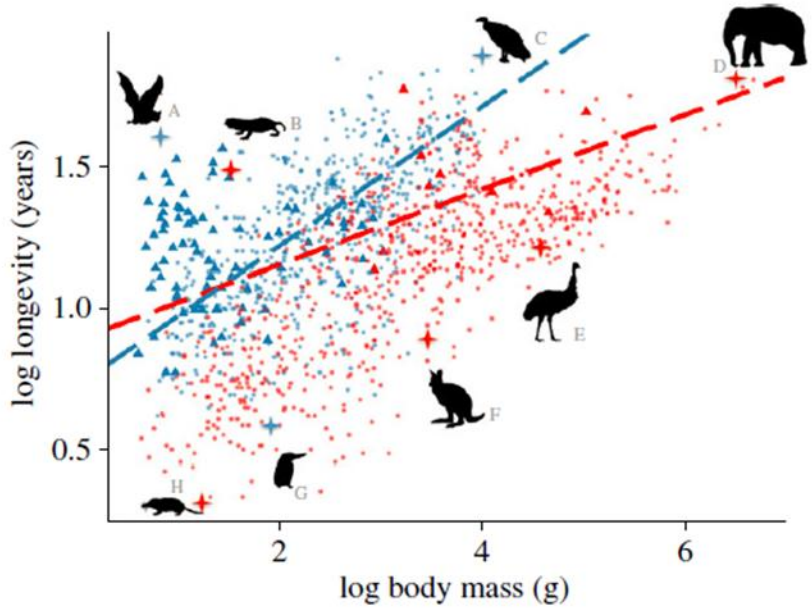
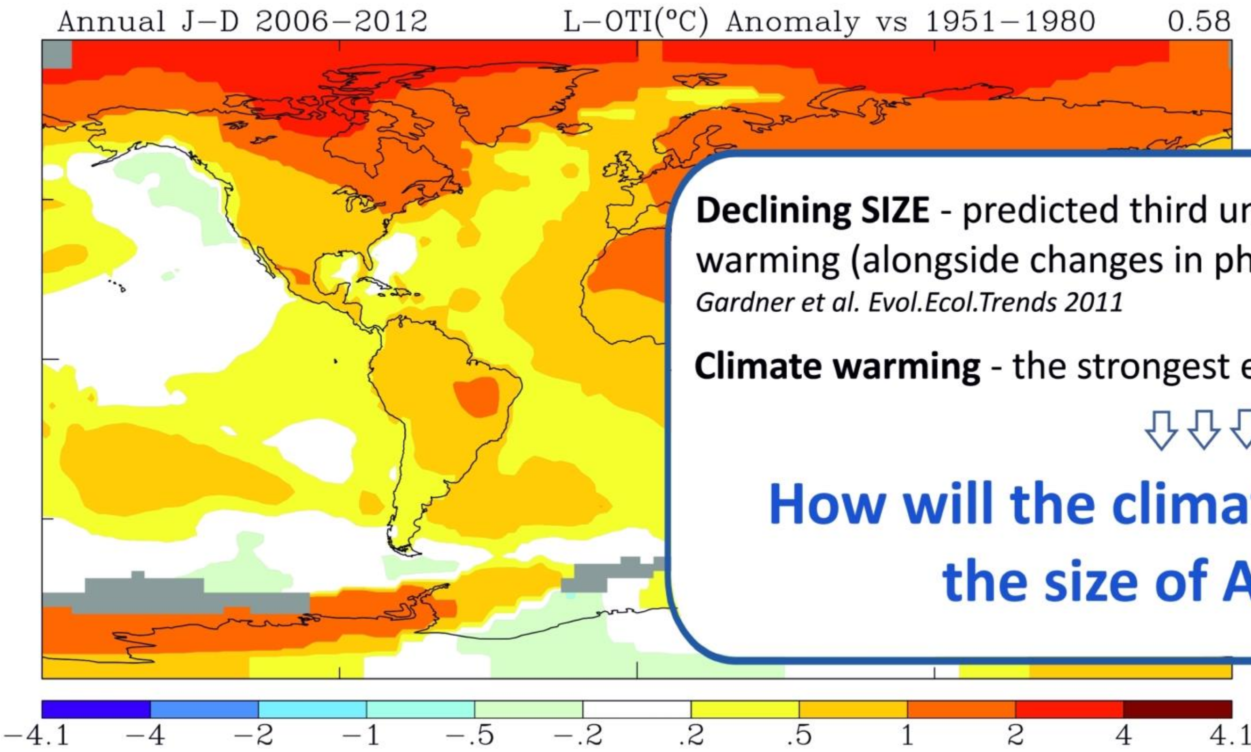


(Healy et al. 2014)



Average surface temperatures from 2006-2012 compared to a base period of 1951-1980.
courtesy of ***NASA Goddard Institute for Space Studies***

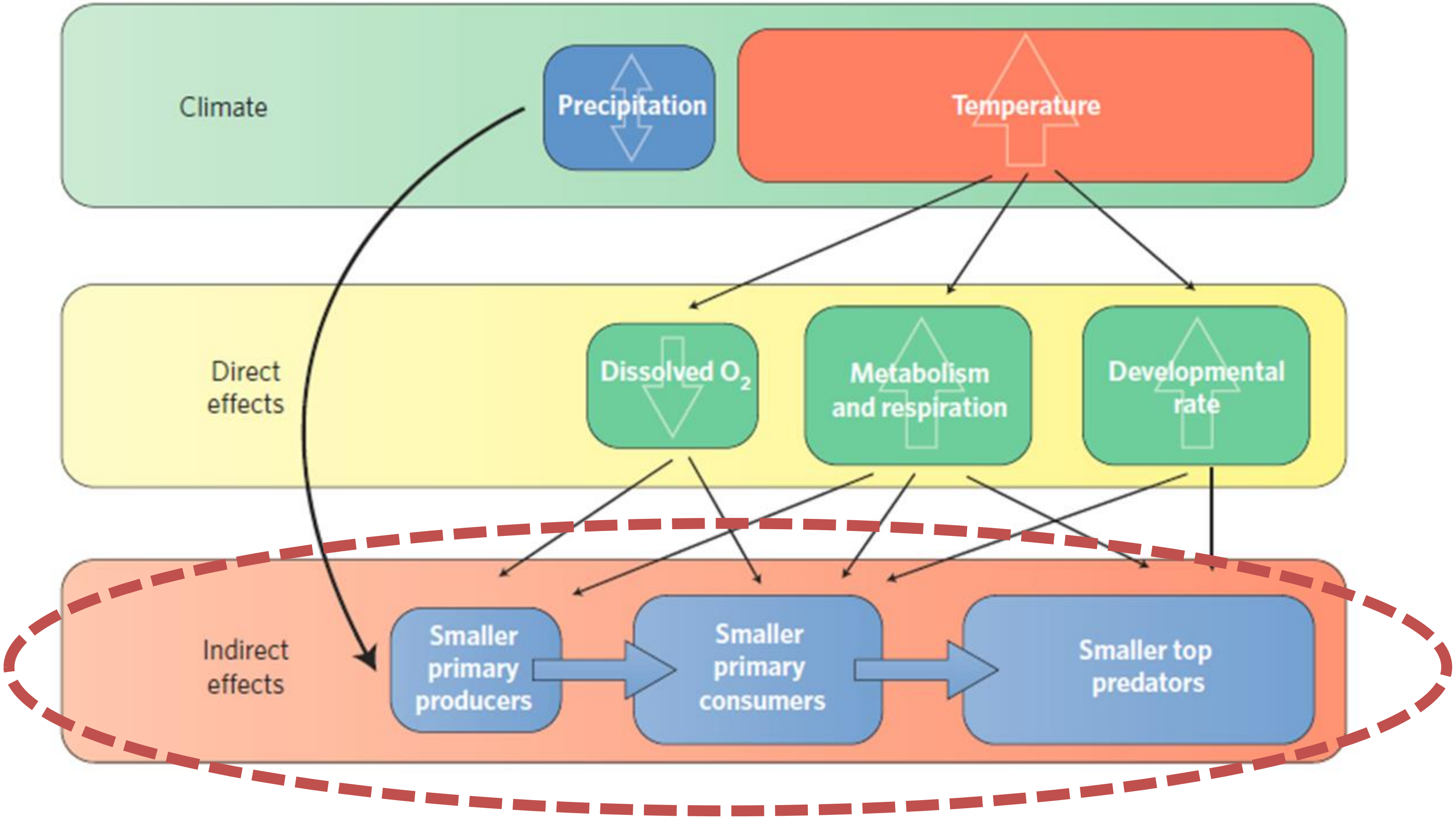
Declining SIZE - predicted third universal response to climate warming (alongside changes in phenology and species distributions)
Gardner et al. Evol.Ecol.Trends 2011

Climate warming - the strongest effects in **Arctic regions**

⇩⇩⇩

How will the climate warming affect the size of Arctic biota?

Direct and indirect effects of temperature

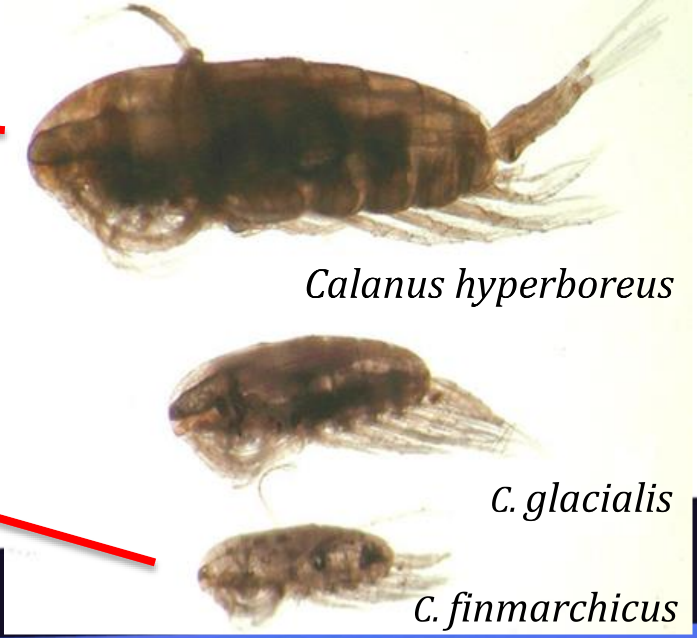


(Sheridan & Bickford 2011)

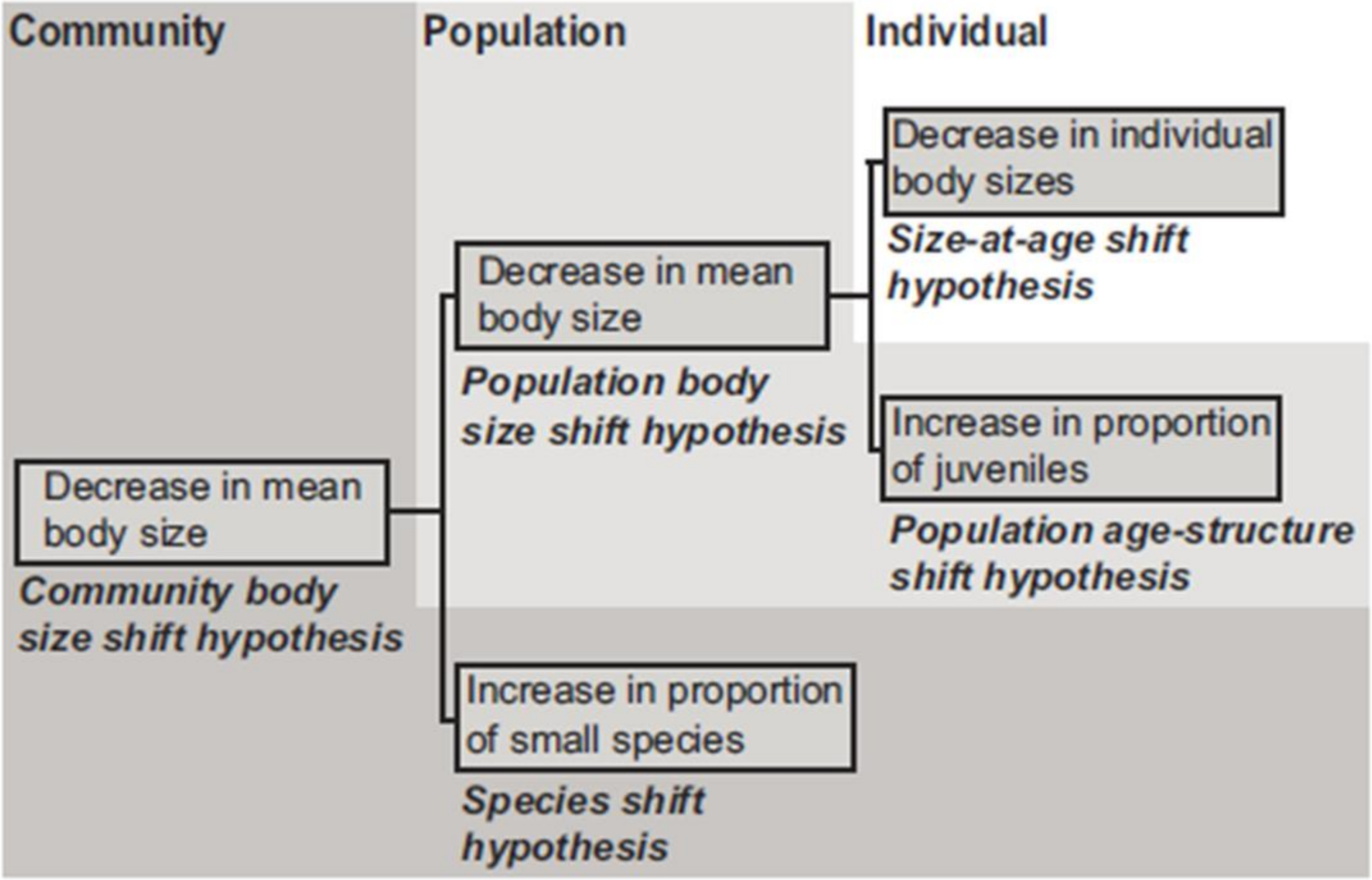
DWARF

Some ecological rules:

1. Bergmann's rule = body size increase towards colder areas (In ectotherms often called Bergmann clines)
2. Temperature-size rule (TSR) = ectotherms grow larger if kept at lower temperatures
3. James rule = within a species, populations with smaller body size are generally found in warmer environments



Hypotheses regarding impact of global warming on body size at different biological scales:



(Daufresne et al. 2009)

DWARF project structure:

WP 1 TERRESTRIAL FAUNA

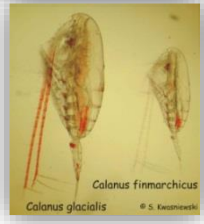
- Springtails (Collembola) and true insects

WP 2 LIMNETIC FAUNA

- Freshwater fish – Arctic char *Salvelinus alpinus*
- Crustaceans eg. *Lepidarus arcticus, Mysis relicta*

WP 3 MARINE PELAGIC FAUNA

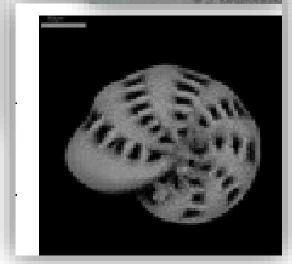
- Mesozooplankton



WP 4 MARINE BENTHIC FAUNA

- Soft bottom fauna – meio- and macrozoobenthos
- Hard bottom , encrusting fauna - Bryozoa

WP 5 Paleontological record of Size Distribution in Foraminifera



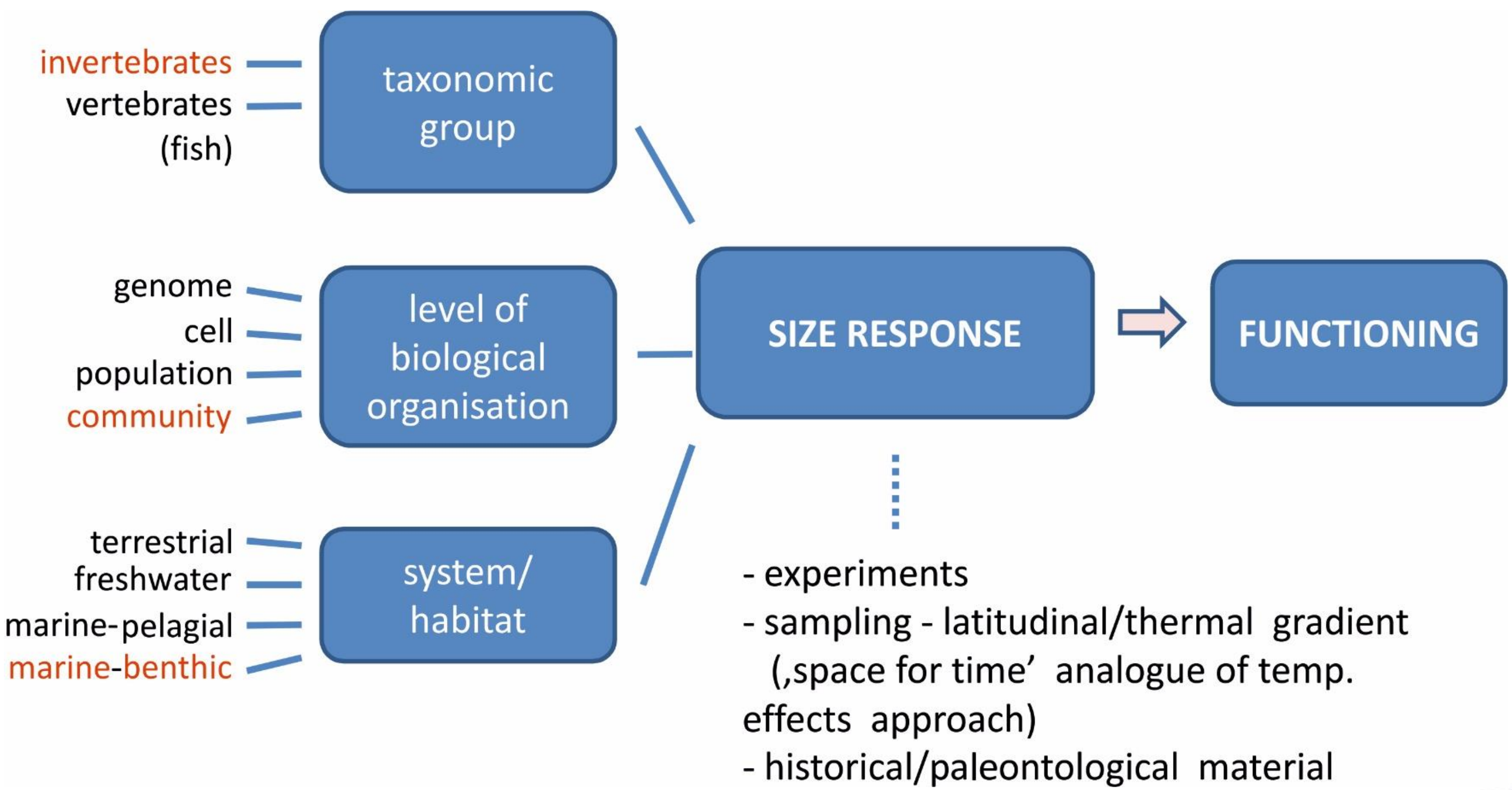
WP 6 DATA BASE & LITERATURE SURVEY

WP 7 Synthesis of the Results, Transfer of knowledge, Public Outreach

- Publications
- Conference presentations
- Social media: Facebook, Blog

Declining size – a general response to climate warming in Arctic fauna? (DWARF)

Hypothesis: elevated temperatures will induce size reductions in large range of high latitude ectotherms



Main assumptionsof my studies

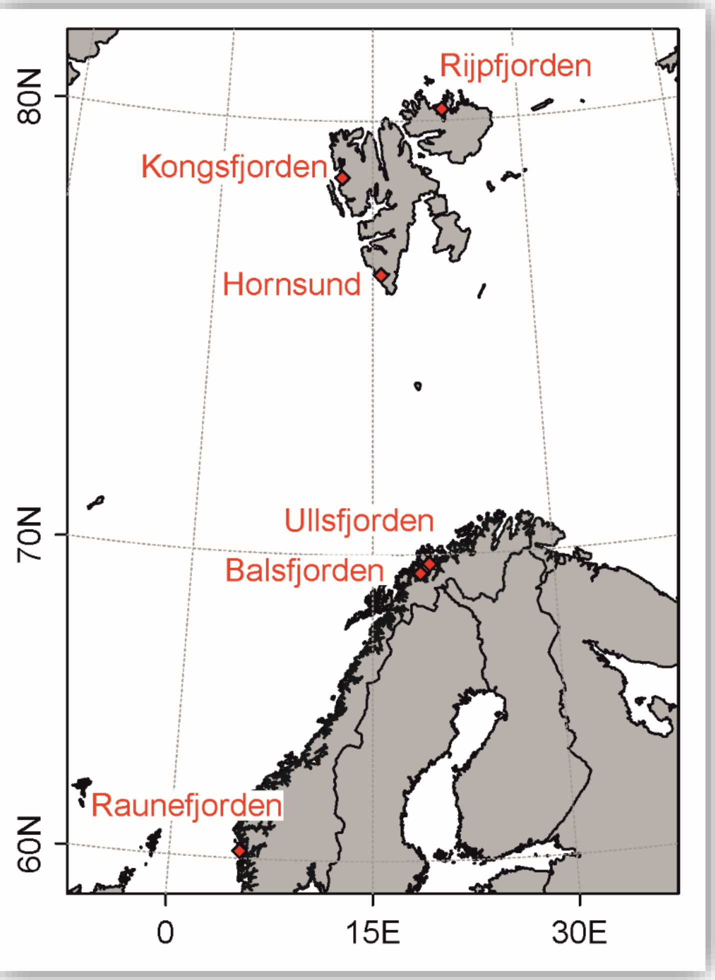
GOAL: to determine how the size structure of populations and communities of benthic marine invertebrates dwelling at high latitudes will change in response to shifts in environmental conditions.

- How does the community size structure change along a gradient of thermal regimes observed off the Norwegian coasts?
- Are changes in size structure documented at community level driven by shifts in species composition (e.g. a shift in dominants towards species of smaller size) or by changes in sizes of individuals of dominant species
- Is there any seasonality regarding communities size spectra
- What are the environmental controls of benthic species size structure?
- What are the implications of change in size structure

?

DWARF

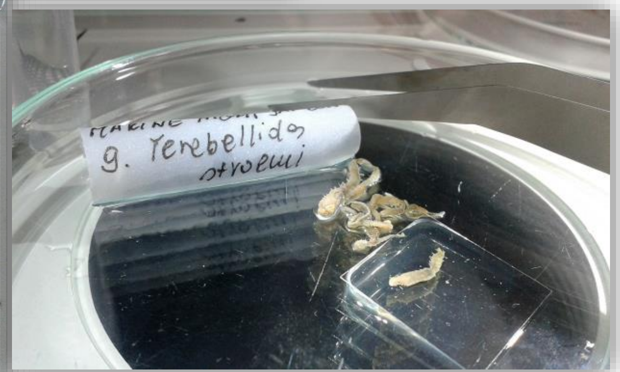
DWARF - benthic communities size structure - large scale survey ‚space for time' analogue approach to study temp. effects



R/V Oceania

R/V Helmer Hanssen

Methodology



Measurements of individual size

↓

Biovolume calculations

↓

Biomass of each specimen

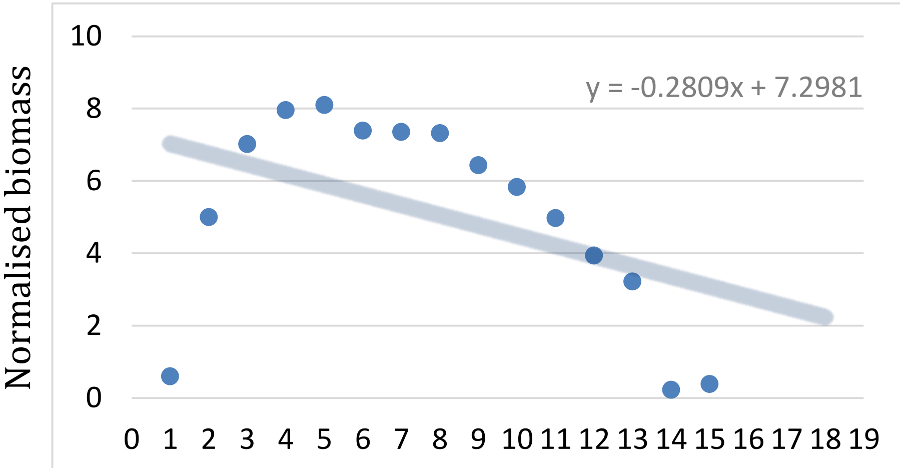
↓

Benthic Biomass Size Spectra

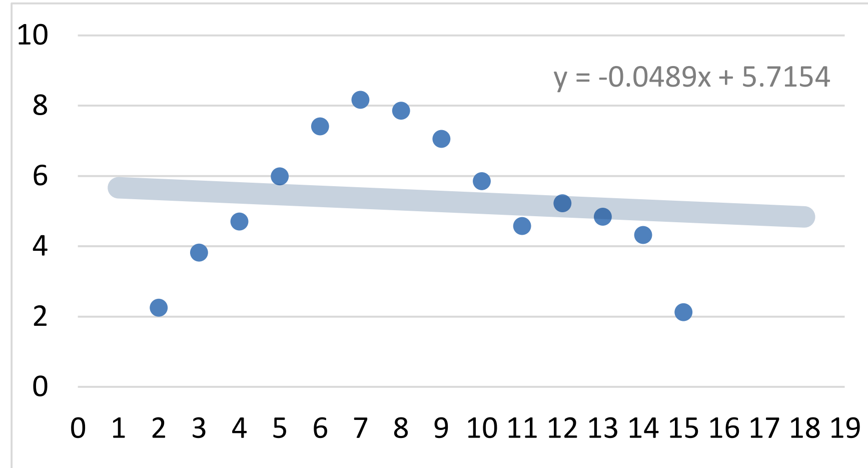
Secondary production estimations

Normalised biomass size spectra

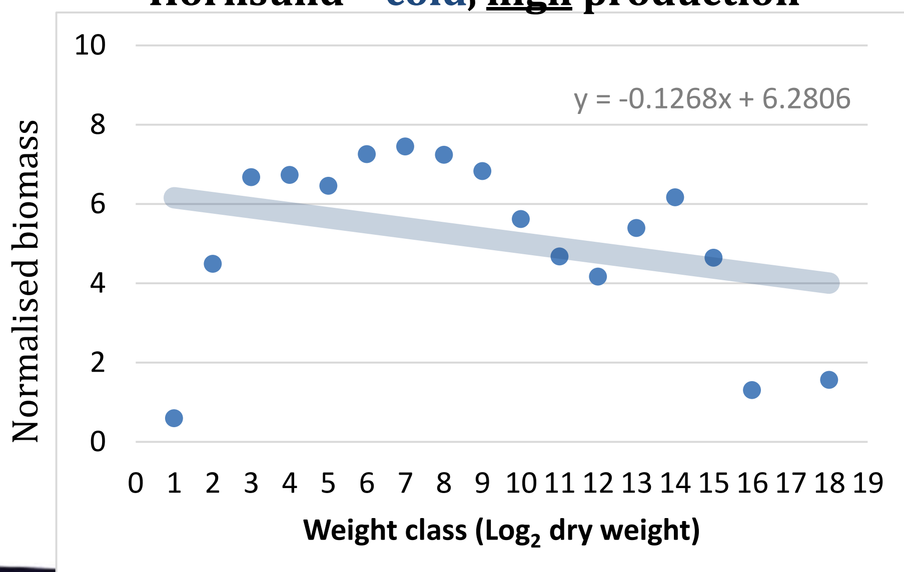
Rijpfjord – cold, low production



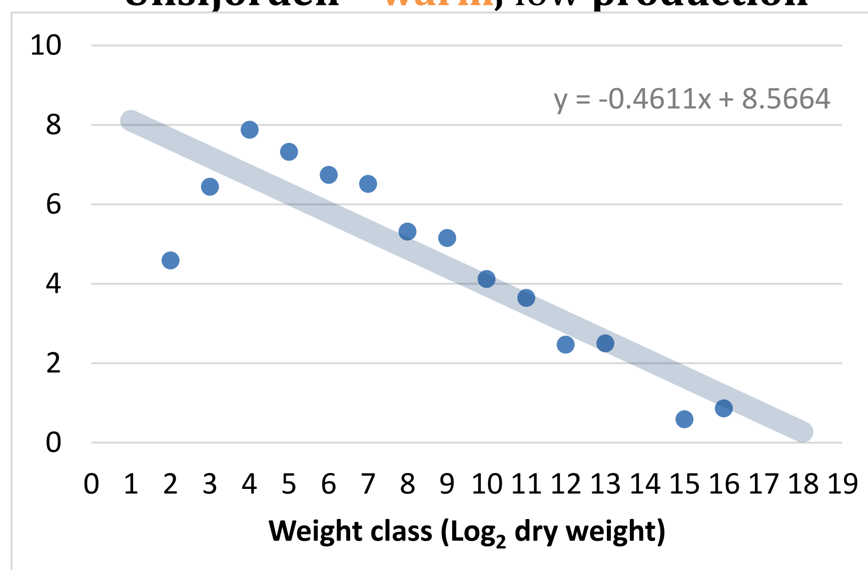
Kongsfjorden – warm, high production



Hornsund – cold, high production



Ullsfjorden – warm, low production



Thank you