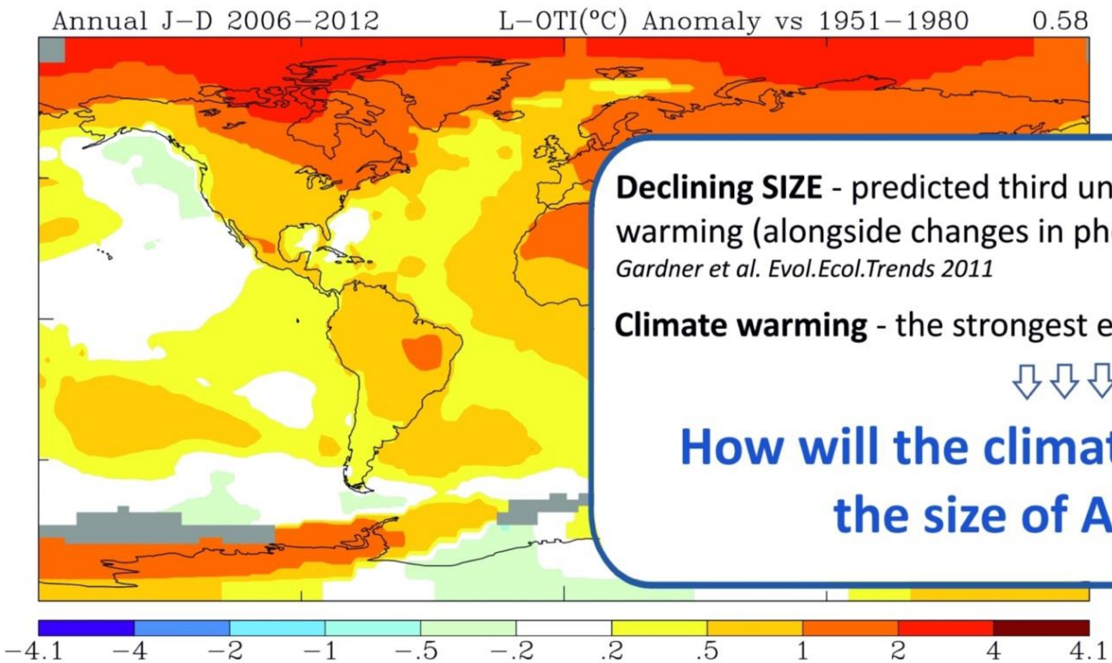
"This project is funded from Norway Grants in the Polish-Norwegian Research Programme operated by the National Centre for Research and Development"

The size response of zooplankton to various temperature regimes across latitudinal gradient from 60°N up to 80°N

Emilia Trudnowska
Katarzyna Blachowiak-Samolyk
Slawomir Kwasniewski

INSTITUTE OF OCEANOLOGY
POLISH ACADEMY OF SCIENCES
Sopot, Poland

Hypothesis:



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?

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

E. Trudnowska, IOPAN Poland

SIZE matters!

SIZE is a supreme regulator of all biological matters
It determines rates of an organism physiological functions (metabolism, generation time, longevity, locomotion speed, …)

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

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, Mark 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.

nature climate change

PERSPECTIVE

PUBLISHED ONLINE: 16 OCTOBER 2011 | DOI: 10.1038/NCLIMATE1259

Shrinking body size as an ecological response to climate change

Jennifer A. Sheridan* and David Bickford*

Temperature Size Rule

Warming-induced reductions in body size are greater in aquatic than terrestrial species

PNAS

Jack Forster[a], Andrew G. Hirst[a,1], and David Atkinson[b]

[a]School of Biological and Chemical Sciences, Queen Mary University of London, London E1 4NS, United Kingdom; and [b]Institute of Integrative Biology, University of Liverpool, Liverpool L69 7ZB, United Kingdom

Edited by James H. Brown, University of New Mexico, Albuquerque, NM, and approved October 2, 2012 (received for review June 22, 2012)

Most ectothermic organisms mature at smaller body sizes when

sensitive to warming than is aerobic metabolism, and later in on-

Functional Ecology

British Ecological Society

Functional Ecology 2011, **25**, 1024–1031 doi: 10.1111/j.1365-2435.2011.01852.x

How do organisms change size with changing temperature? The importance of reproductive method and ontogenetic timing

Jack Forster[1], Andrew G. Hirst[1]* and David Atkinson[2]

[1]*School of Biological and Chemical Sciences, Queen Mary University of London, London, UK; and* [2]*Institute of Integrative Biology, University of Liverpool, Liverpool, UK*

Latitudinal gradients

Ecology Letters, (2007) **10**: 127–134 doi: 10.1111/j.1461-0248.2006.01009.x

LETTER

Diversity–stability relationship varies with latitude in zooplankton

Jonathan B. Shurin,[1]* Shelley E. Arnott,[2] Helmut Hillebrand,[3] Allyson Longmuir,[1] Bernadette Pinel-Alloul,[4] Monika Winder[5] and Norman D. Yan[6]

Abstract

Analyses of temp
more diverse co
generality indicat
species composit
zooplankton tim

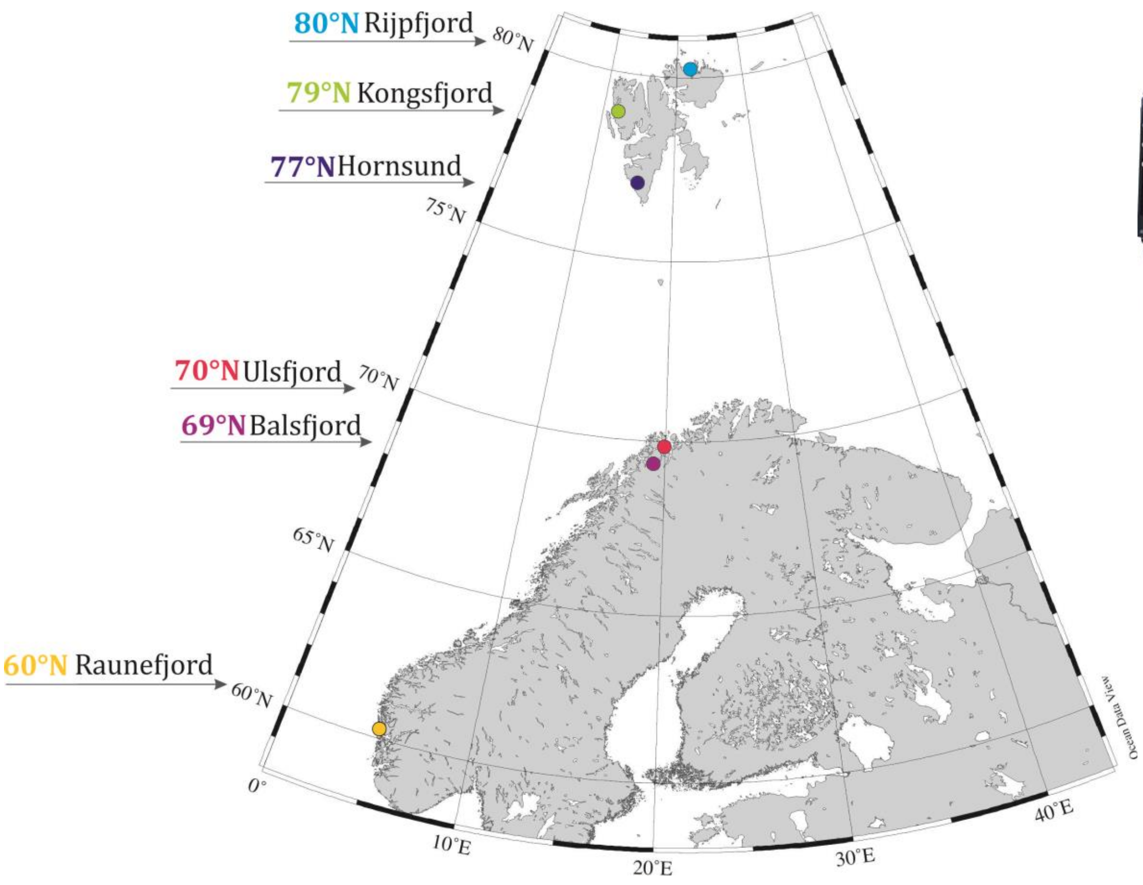
VOL. 163, NO. 2 THE AMERICAN NATURALIST FEBRUARY 2004

On the Generality of the Latitudinal Diversity Gradient

Helmut Hillebrand*

Sampling

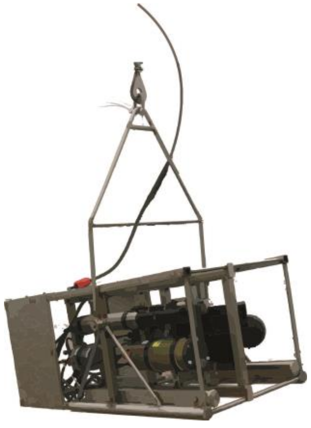
summer
2014/2015



MPS
180 µm

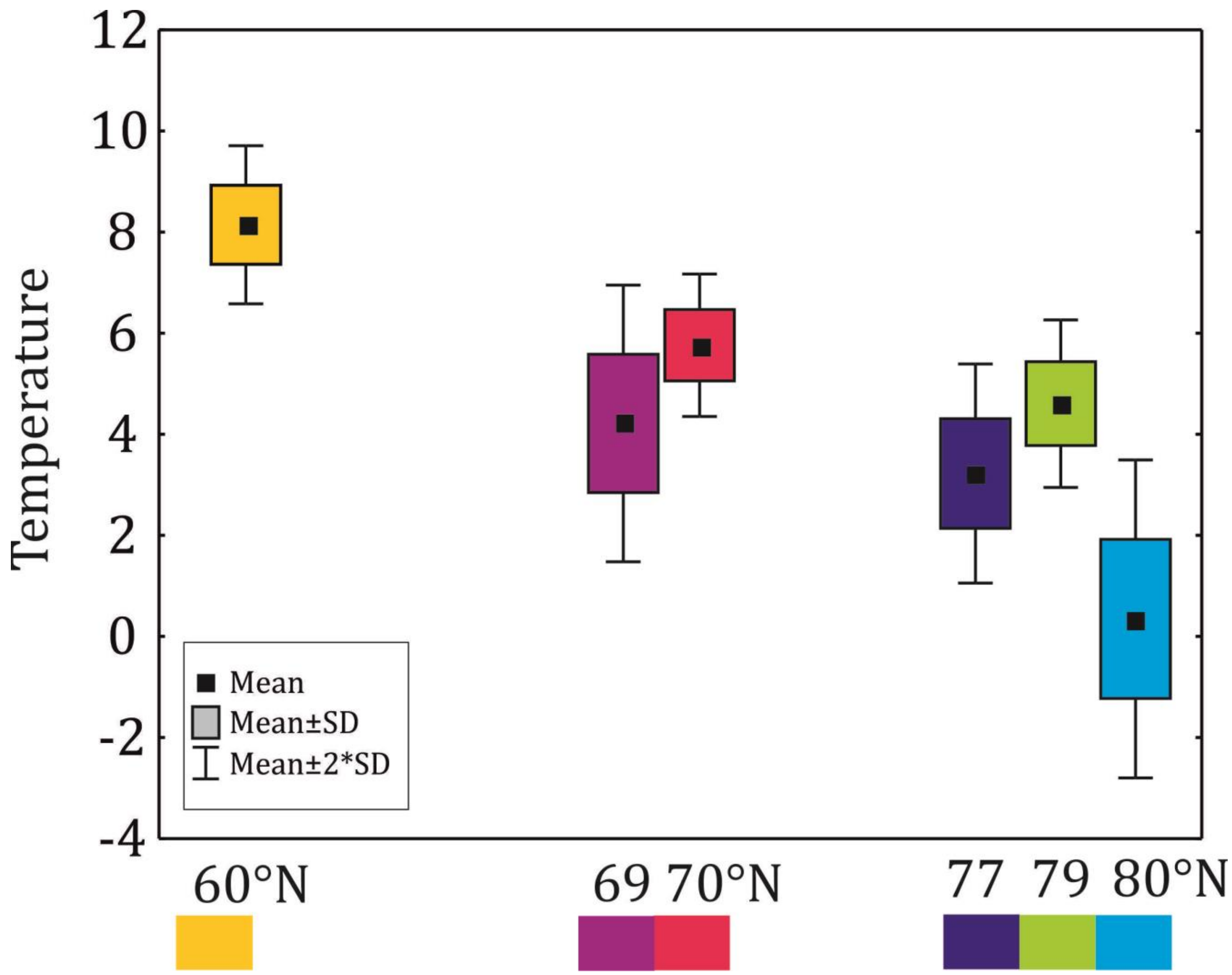
WP-2
60 µm

LOPC
Laser Optical Plankton Counter
100 – 3 500 µm



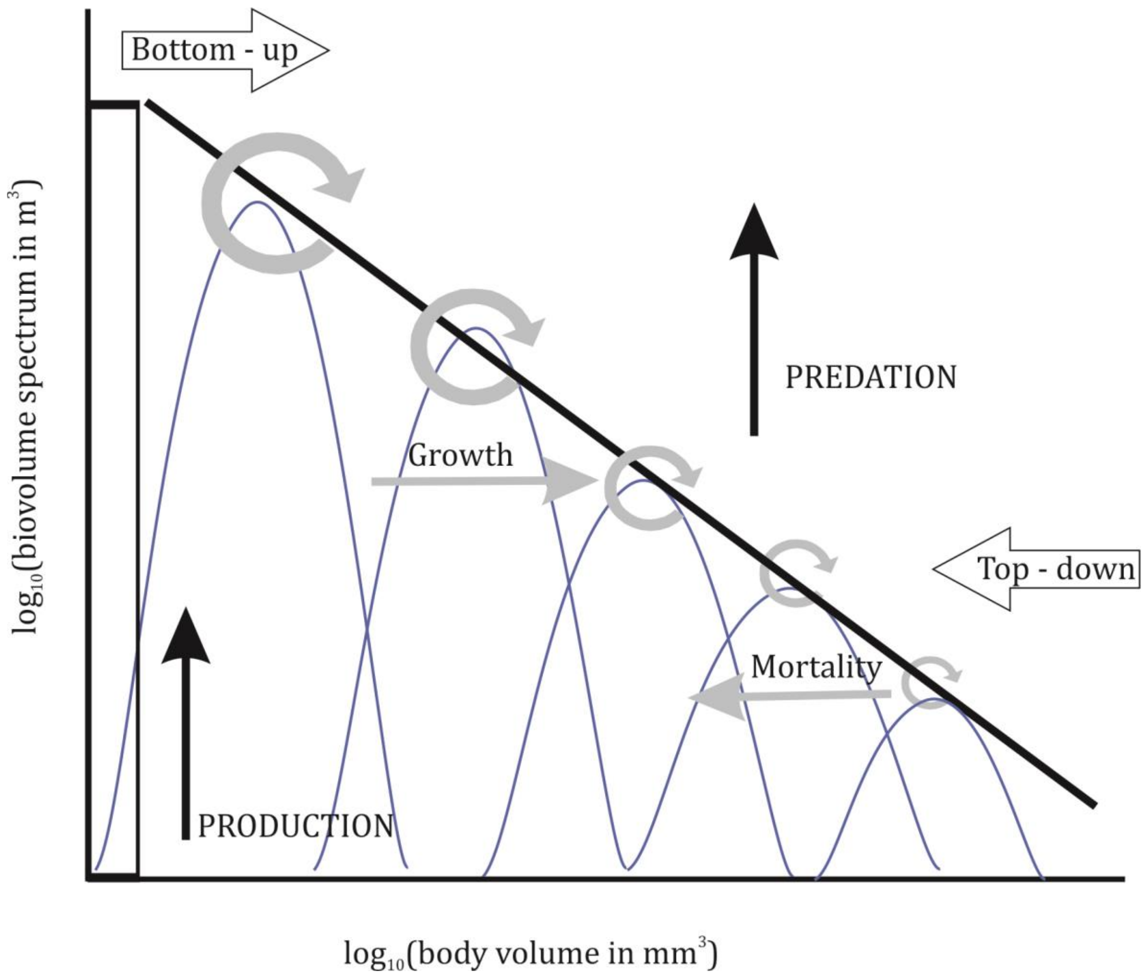
E. Trudnowska, IOPAN Poland

Temperature regimes

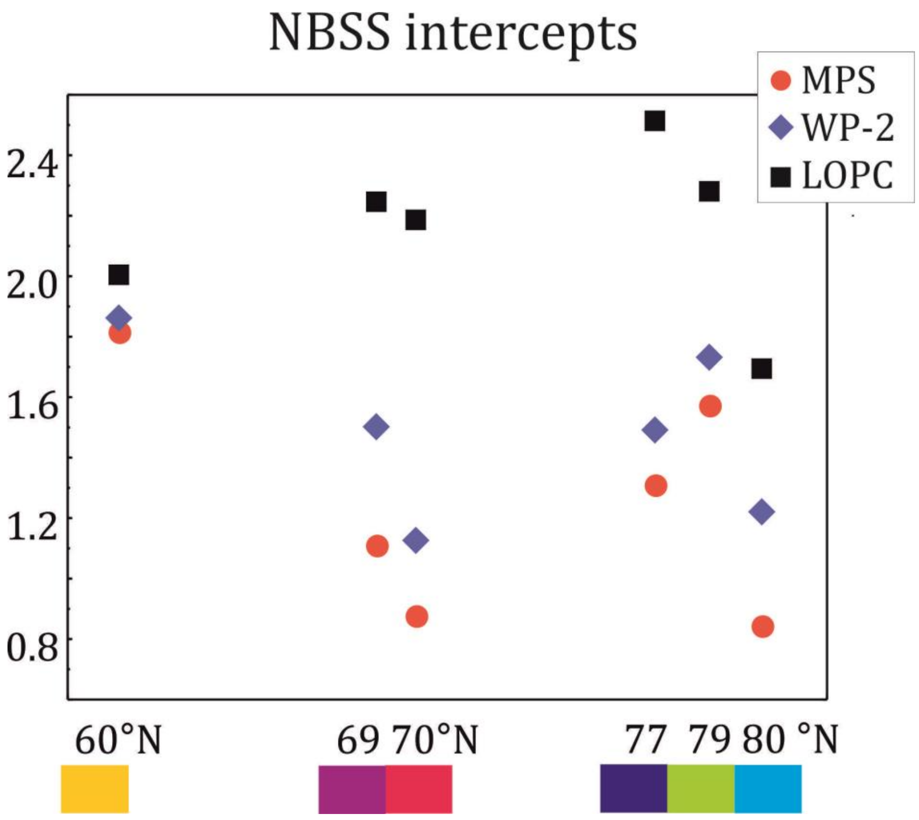


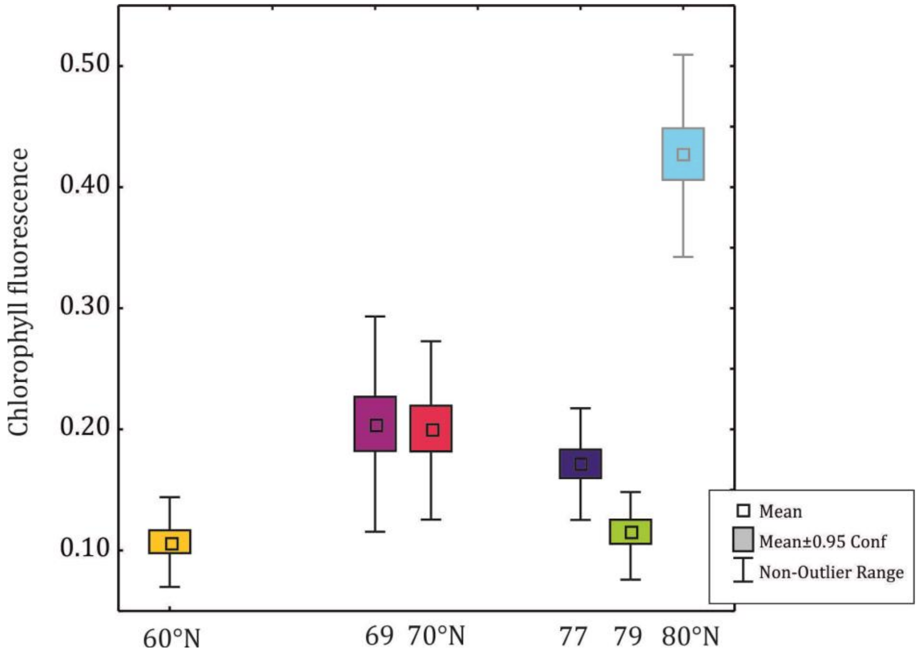
E. Trudnowska, IOPAN Poland

Normalized Biomass Size Spectra

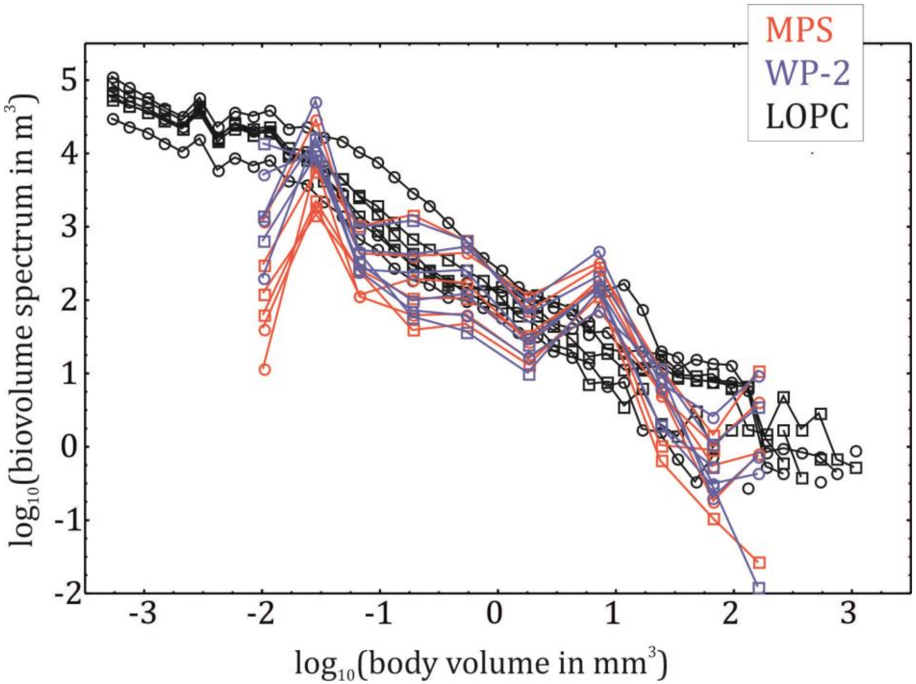


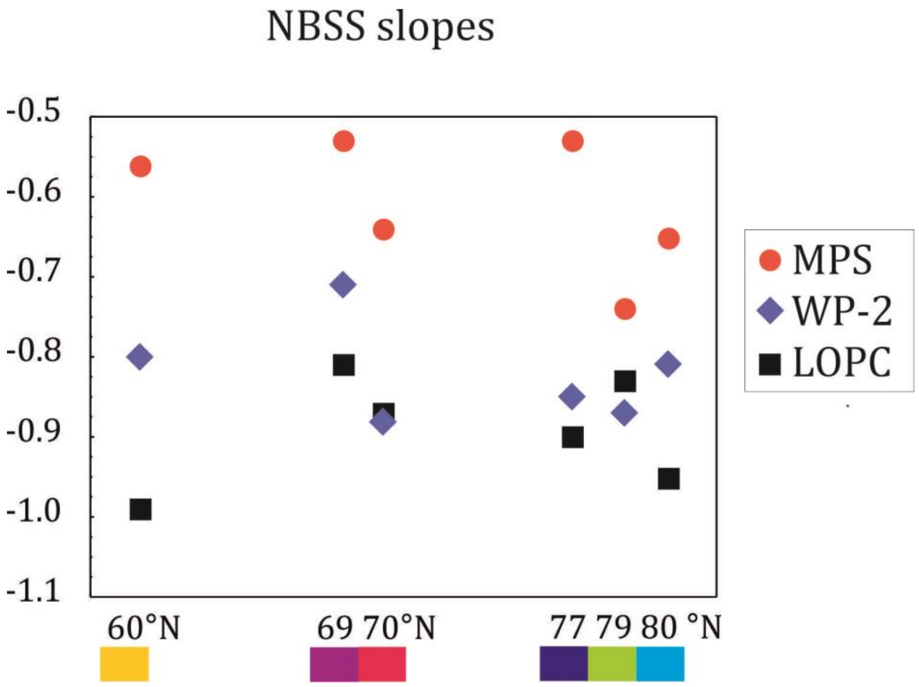
Primary production





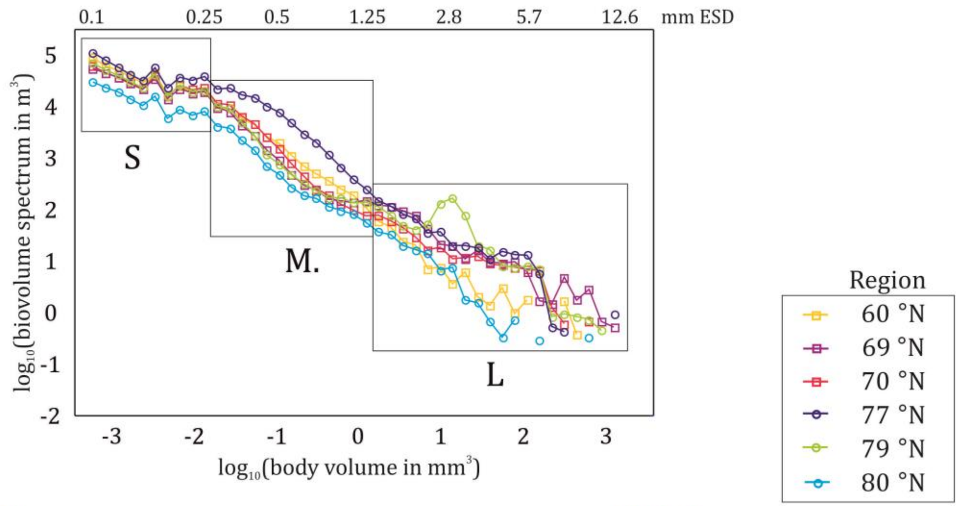
Normalized Biomass Size Spectra



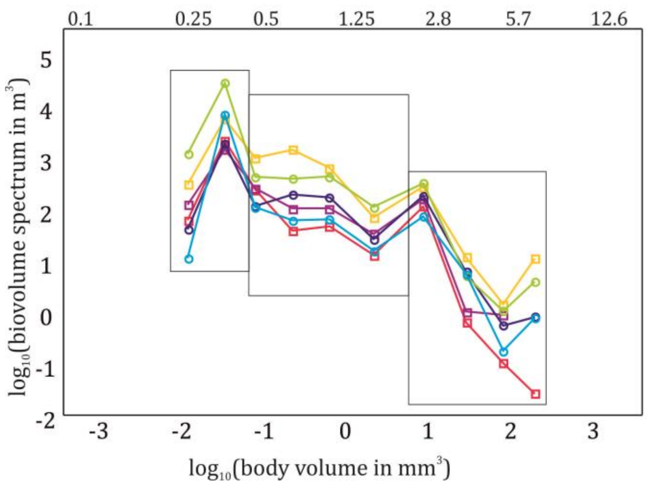


Size spectra

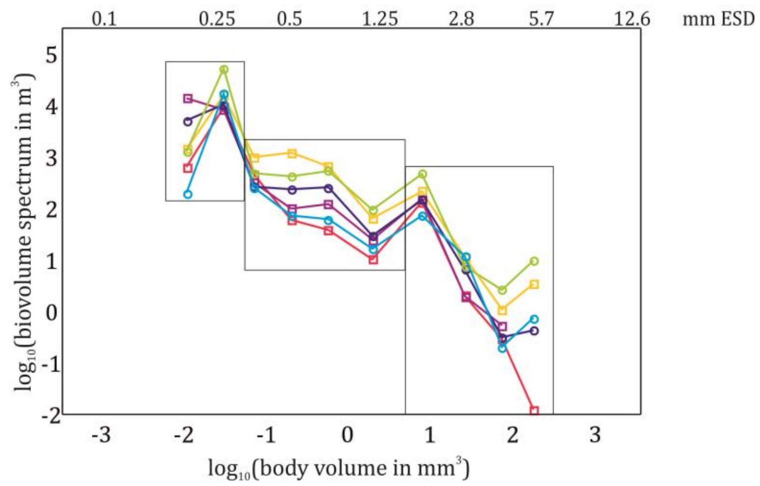
LOPC



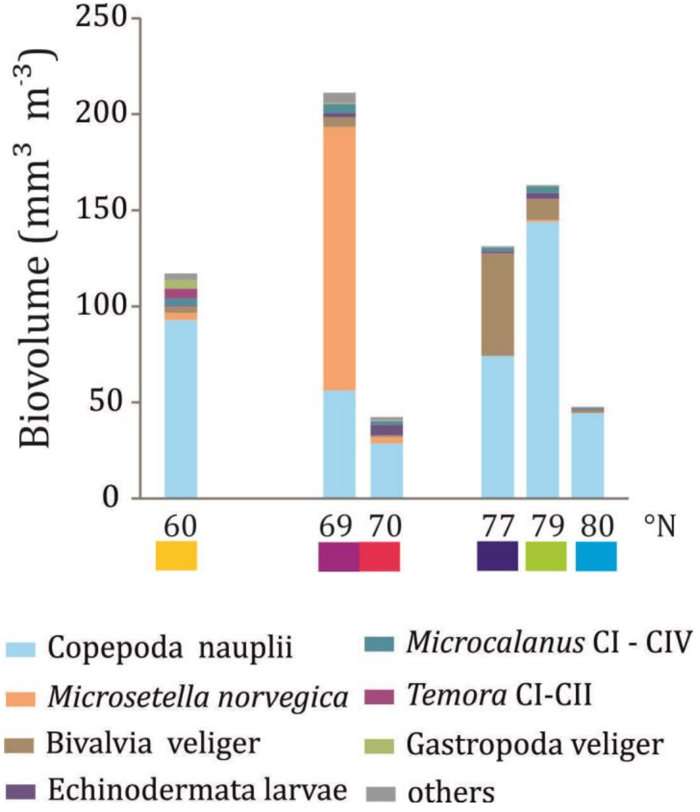
MPS



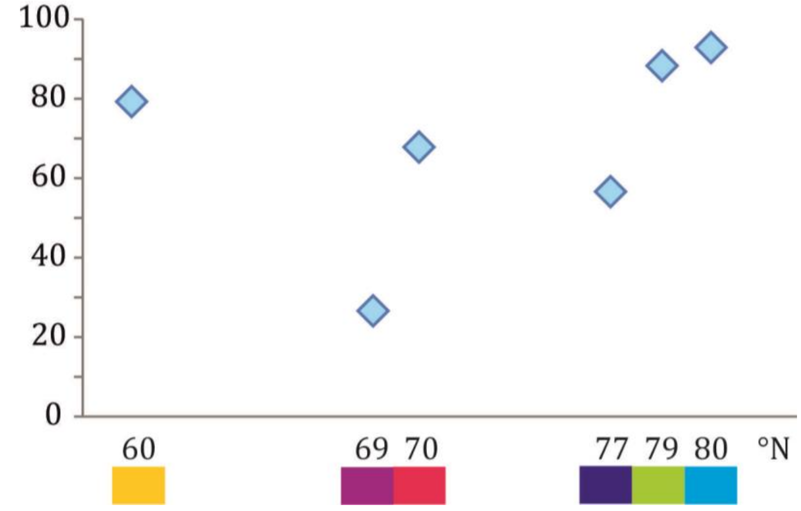
WP-2



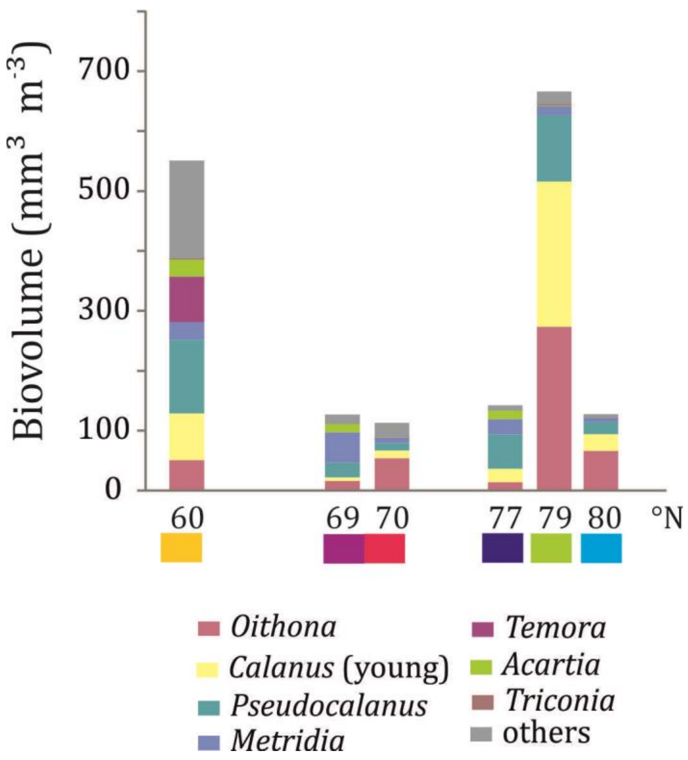
Community level : S size fraction (< 400 µm ESD)

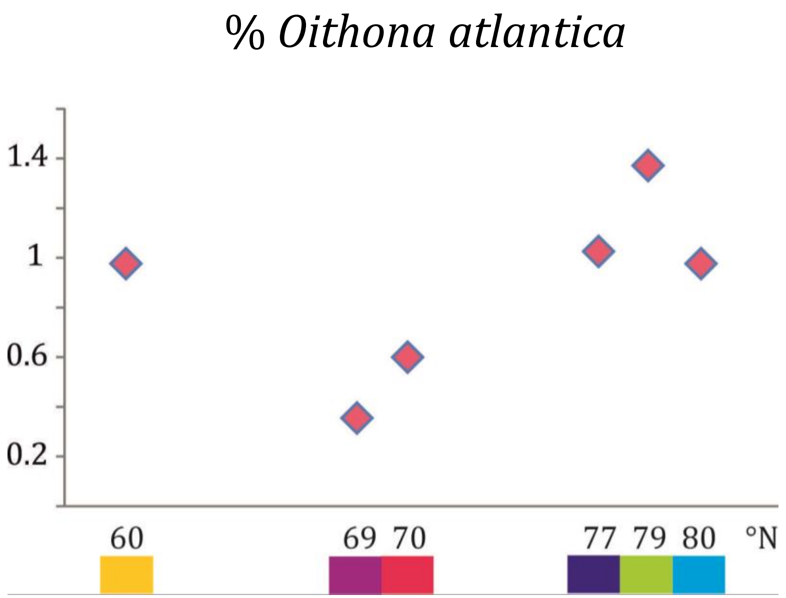


% Copepoda nauplii

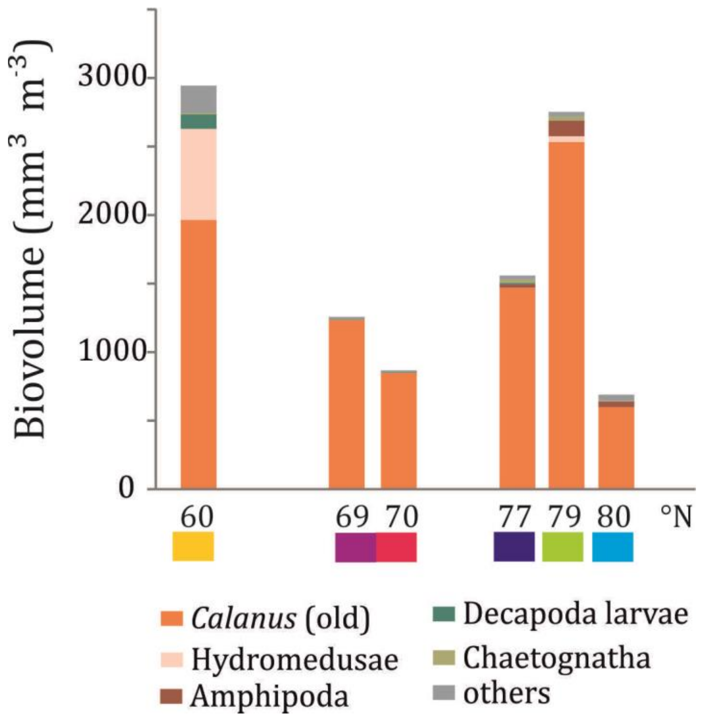


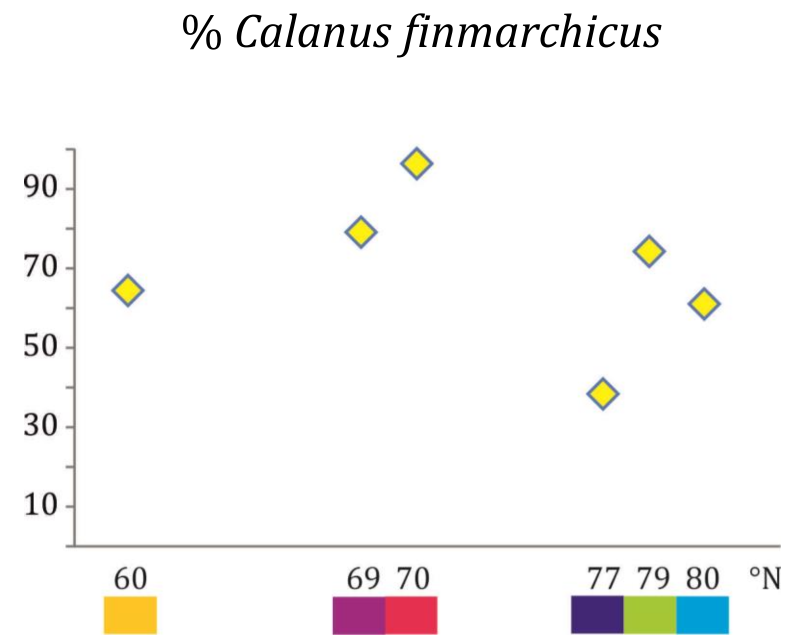
Community level : M size fraction (0.4 – 1.8 mm ESD)



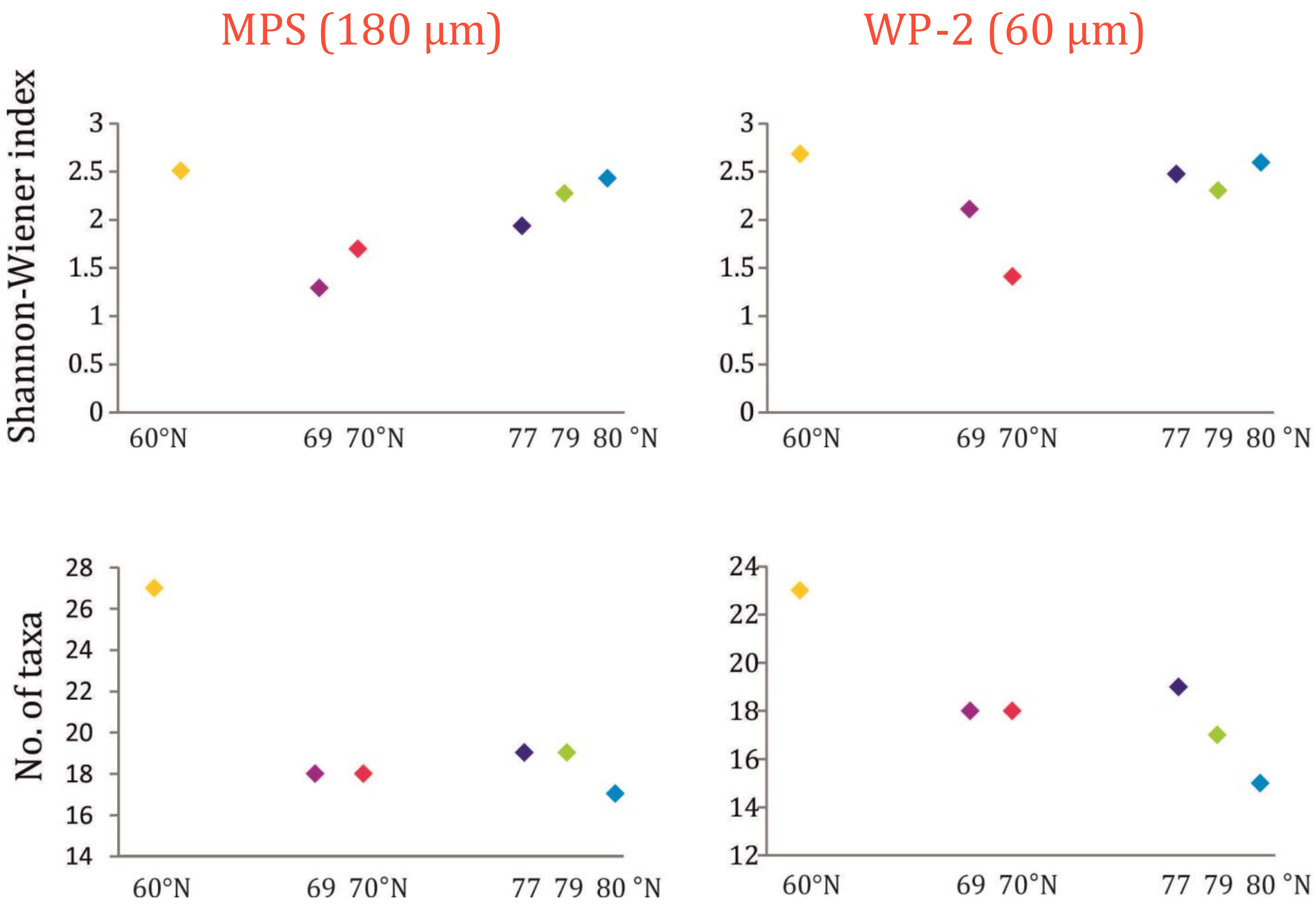


Community level : L size fraction (> 1.8 mm ESD)



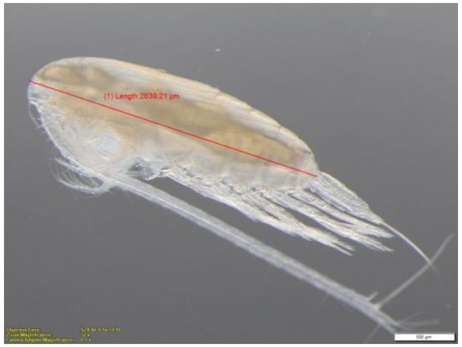


Community level: Biodiversity



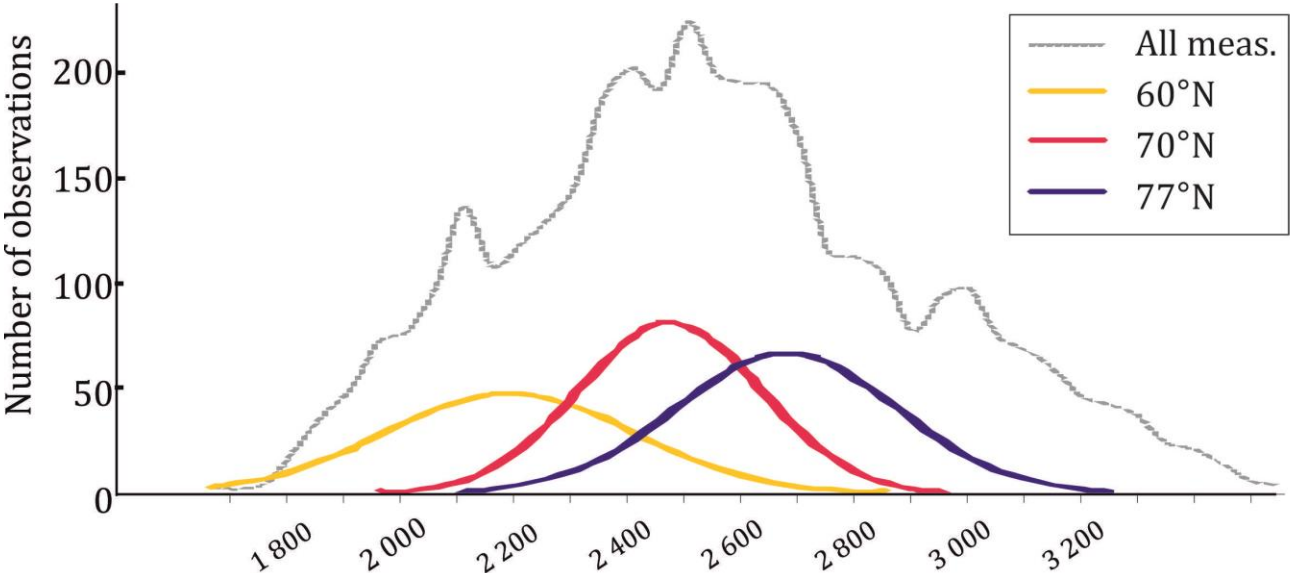
E. Trudnowska, IOPAN Poland

Individual level



Size measurements of preserved, photographed individuals (30 000) : prosome length, total length, width

C. finmarchicus CV prosome length distribution (Bhattacharya method)

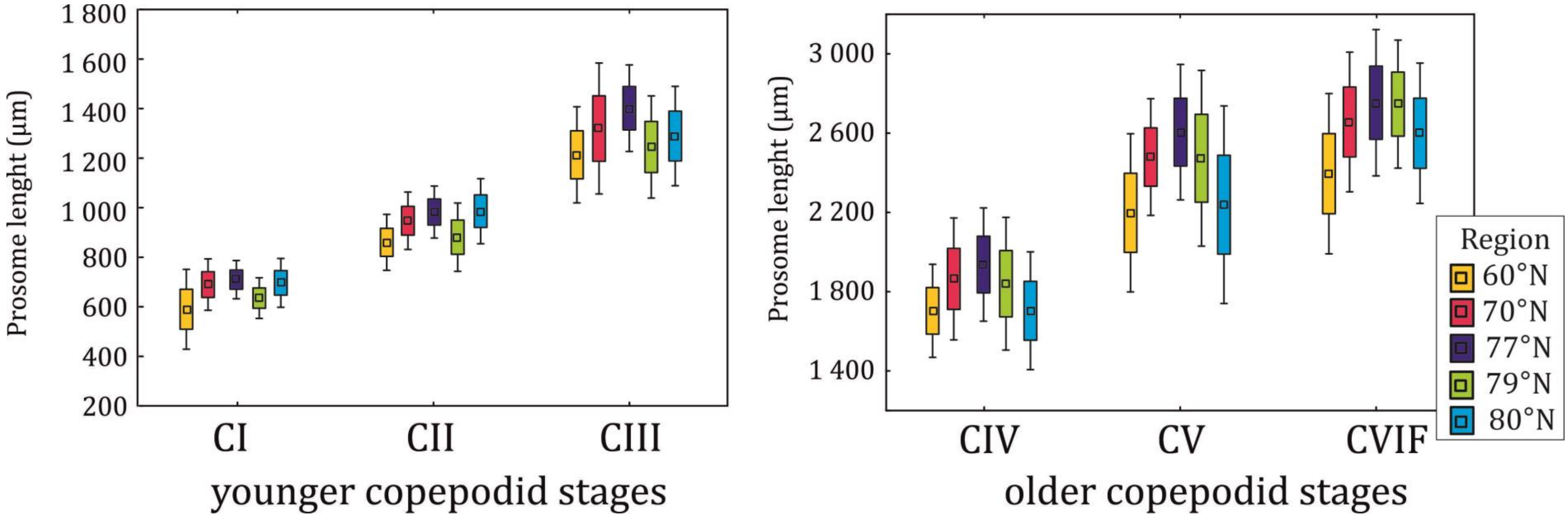


E. Trudnowska, IOPAN Poland

DWARF

Individual level - *Calanus*

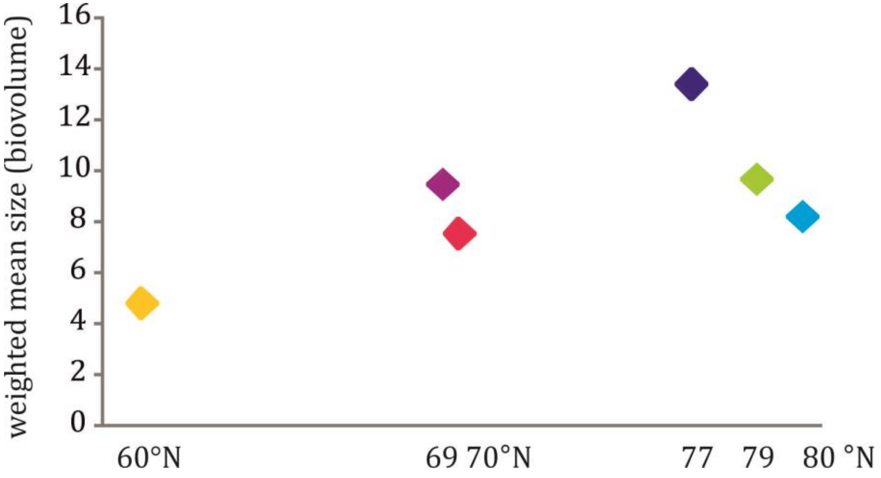
Prosome length (μm) of *C. finmarchicus* copepodid stages



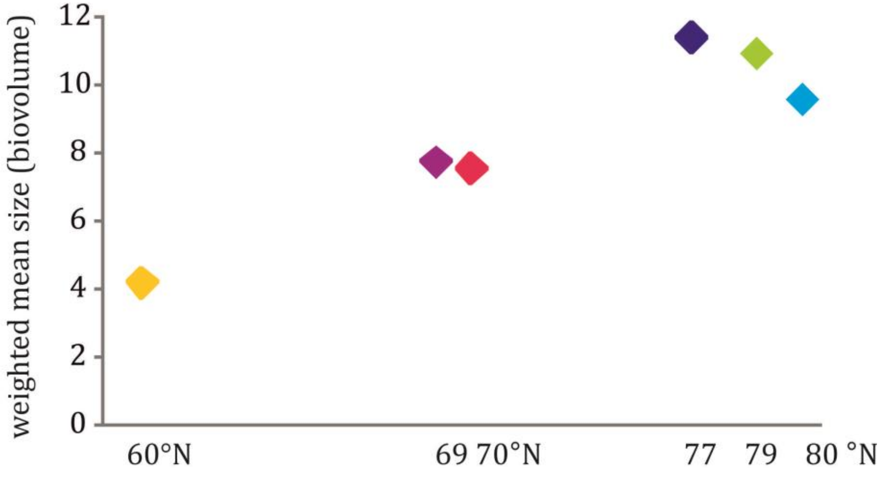
E. Trudnowska, IOPAN Poland

Size index of copepods

MPS (180 µm)



WP-2 (60 µm)



Take home message

each fjord is a different life history theater
- temperature has only a partial role to play