

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

Principal Investigator: dr hab. Maria Włodarska-Kowalczuk



**Call:** Core 2012 Call of *the Polish-Norwegian Research Programme*  
implemented under the *Norwegian Financial Mechanism*

**Area:** Climate change including polar research

**Programme operator:** The National Center for Research and Development

**Duration:** 36 M (February 2014 – January 2017)

**Budget:** 3 956 989 PLN

**Project Promoter:** Institute of Oceanology PAN

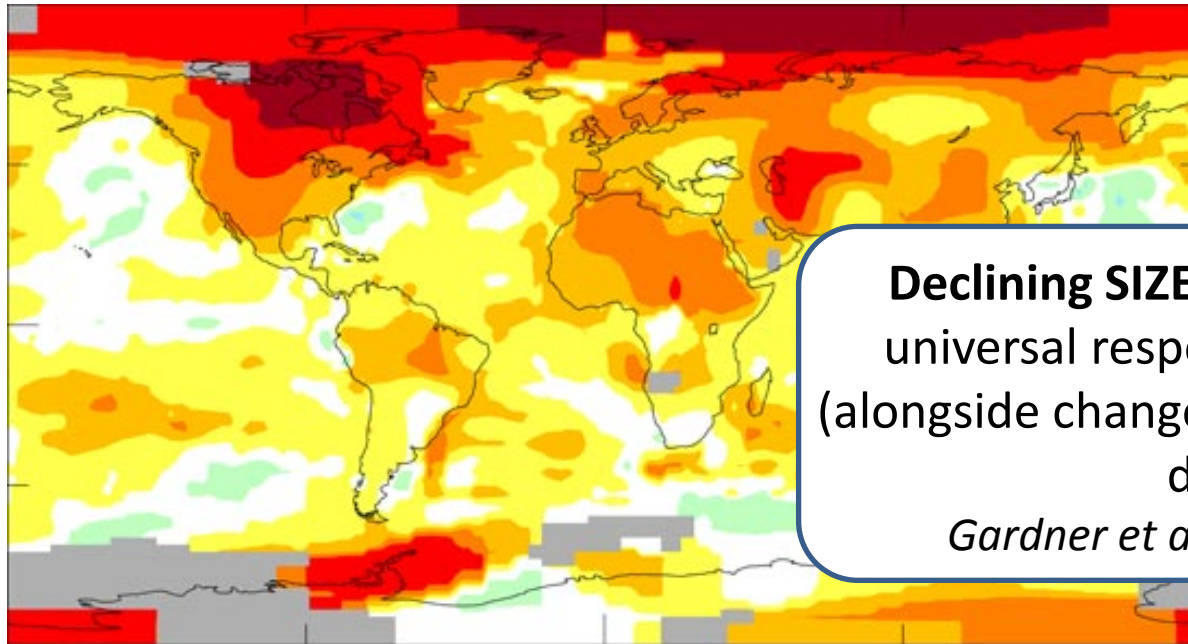
**Project Partners:** Norwegian Institute for Nature Research (NINA), Tromsø  
University of Oslo (UiO)  
Akvaplan-niva (APN), Tromsø

„**SIZE** is a supreme regulator of all matters biological” – Bonner, 2006  
determines the rates of basic processes (metabolism, generation time, longevity,  
locomotion speed, ...)

**SIZE** structure shapes ecosystem functioning (e.g. energy flows in food-webs)



**Big Fish Eat Little Fish**, Peter  
Bruegel the Elder, 1557

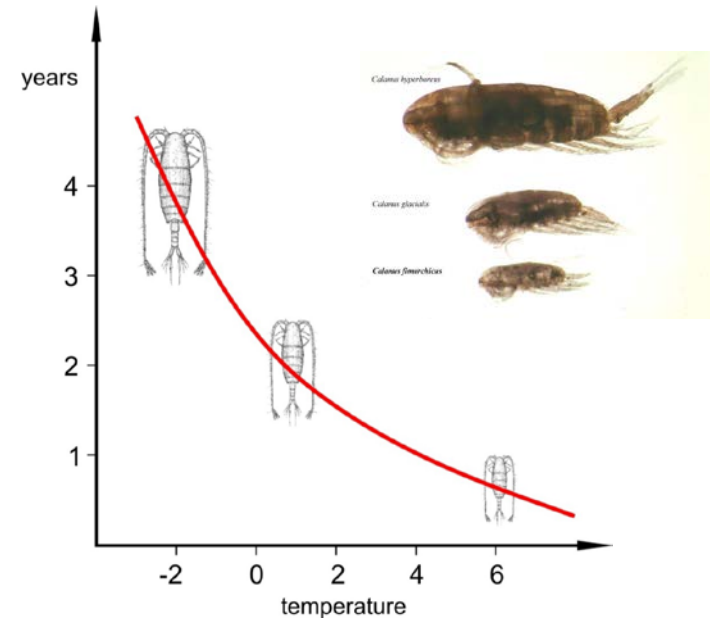


**Declining SIZE** – predicted as the third universal response to climate warming (alongside changes in phenology and species distribution)  
*Gardner et al. 2011, Trends Ecol Evol*



Difference between the average annual temperature in 2006 and 1951–80.

Credit: NASA Goddard Institute for Space Studies



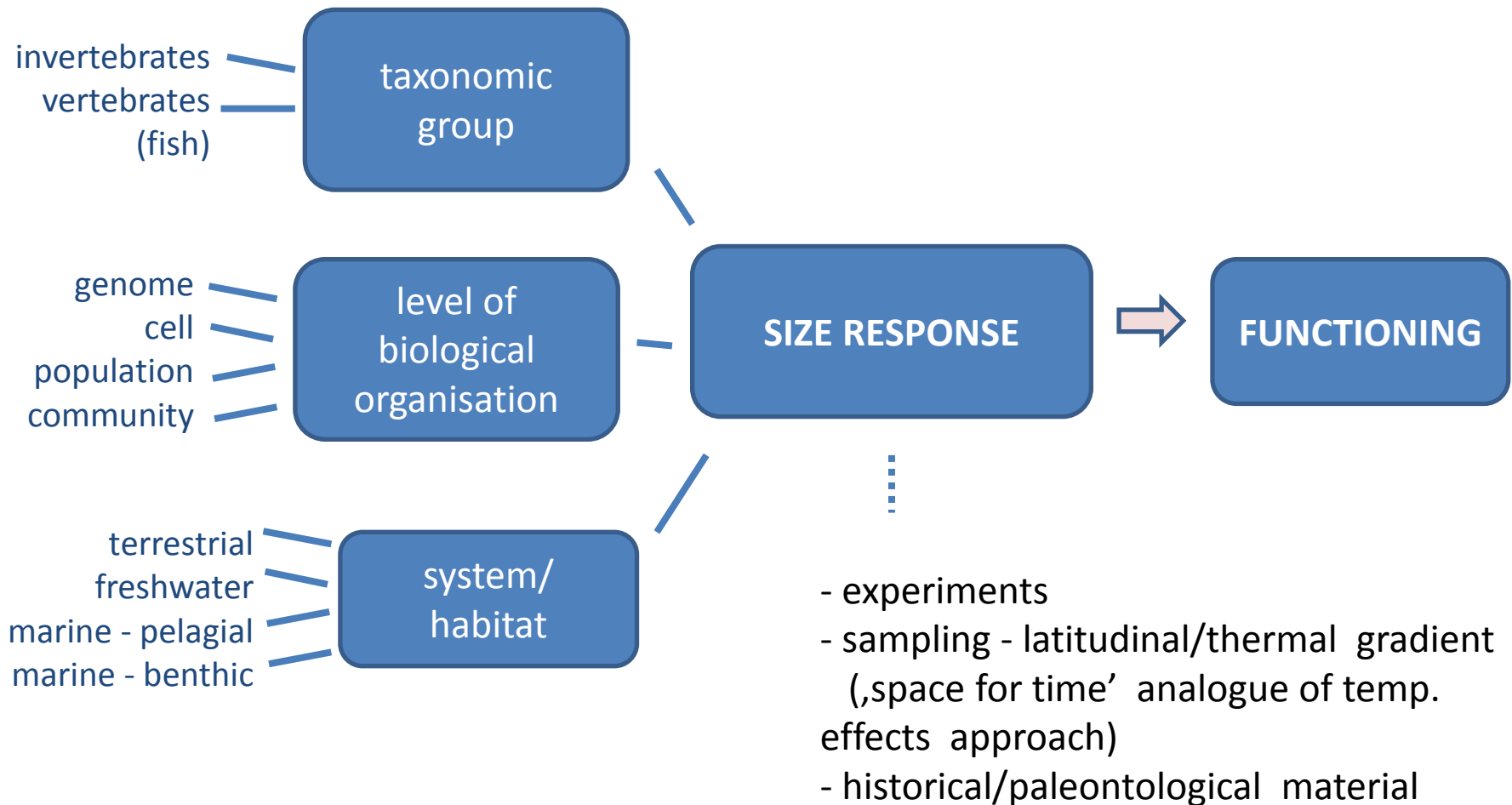
low temperature – long life, large size

**Bergmann's rule (1847)** – the higher latitude/the lower temperature- the larger size

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

**DWARF Hypothesis:** Elevated temperatures will induce size reductions in a large range of high latitude ectotherms.

## DWARF - Declining size - a general response to climate warming in Arctic fauna?





## WP1 TERRESTRIAL FAUNA

habitat: terrestrial  
faunal groups: springtails  
(Collembola); true insects  
b.o. level: body-, cell- and  
genome-  
approach: sampling and  
experiments



WP1 Leader:  
Prof. Hans P. Leinaas  
University of Oslo



*Hypogastrura viatica*



springtail



the dung fly  
*Scatophaga furcata*

## WP2 LIMNETIC FAUNA

habitat: freshwater

faunal groups: fish and crustaceans

b.o. level: body-, cell- and genome-

approach: sampling and experiments



WP2 Leader:  
Dr Martin A. Svenning  
NINA Tromsø



Arctic char



*Lepidurus arcticus*



*Mysis relicta*



*Gammaracanthus loricatus*



**WP3 MARINE PELAGIC  
FAUNA**

habitat: marine

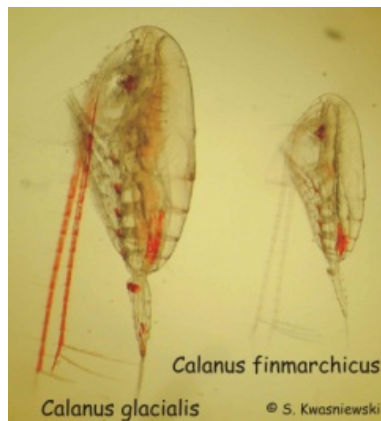
groups: mesozooplankton

b.o. level: community-, and  
body-

approach: sampling (direct  
measurements and optical  
methods)



WP3 Leader:  
Dr Sławek Kwaśniewski  
IOPAN, Sopot



## WP4 MARINE BENTHIC FAUNA

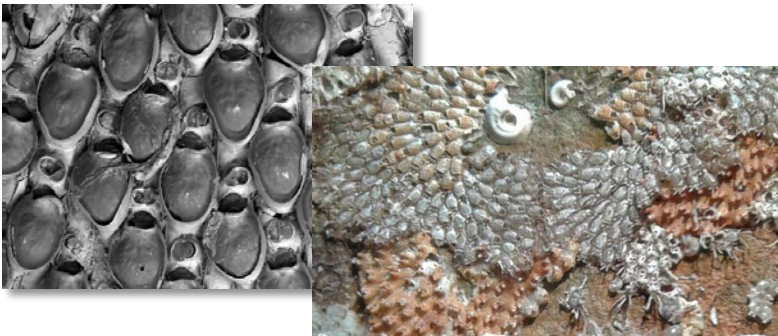
habitat: marine

groups: meio-macrofauna;  
Bryozoa

b.o. level: community-, and  
body-

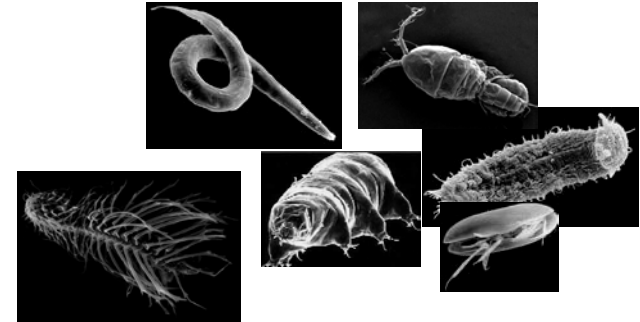
approach: sampling and  
historical materials

**Bryozoa – encrusting,  
colonial taxa**

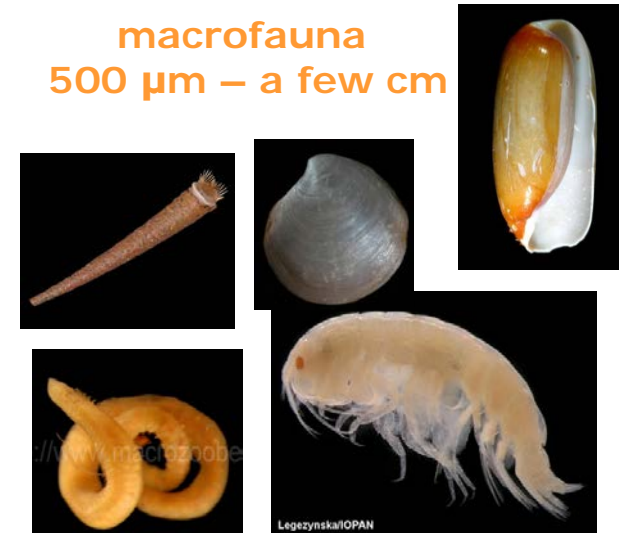


WP4 Leader:  
Dr M. Włodarska  
-Kowalczyk  
IOPAN, Sopot  
Akvaplan-niva, Tromsø

**meiofauna**  
32-500  $\mu\text{m}$



**macrofauna**  
500  $\mu\text{m}$  – a few cm



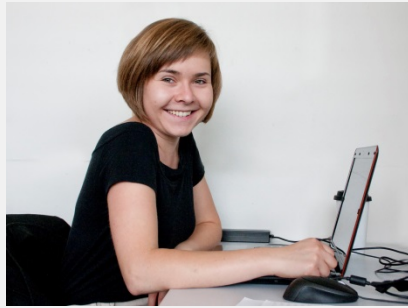
## WP5 Paleontological Record in Holocen

habitat: marine

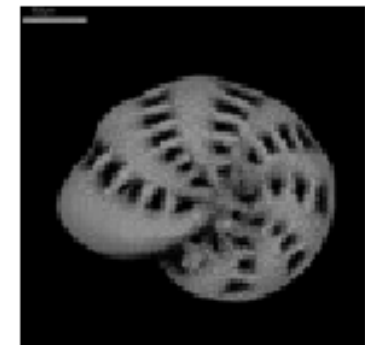
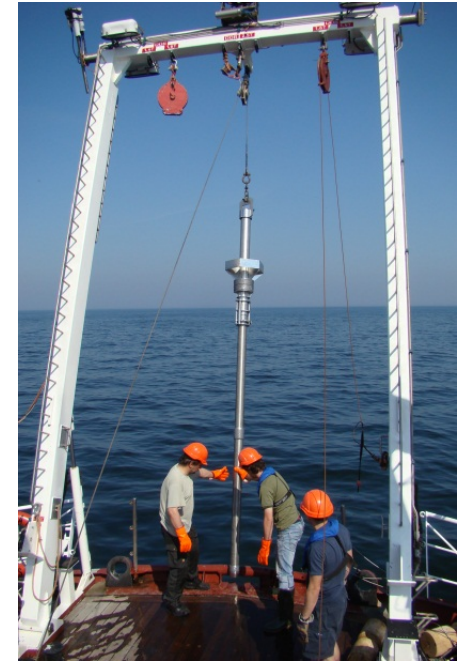
groups: Foraminifera

b.o. level: community-, and  
body-

approach: paleontological  
sediment cores



WP5 Leader:  
Joanna Pawłowska  
IOPAN, Sopot



## WP1 TERRESTRIAL FAUNA

## WP2 LIMNETIC FAUNA

## WP3 MARINE PELAGIC FAUNA

## WP4 MARINE BENTHIC FAUNA

## WP5 Paleontological Record in Holocen

habitat: marine

groups: Foraminifera

b.o. level: community-, and  
body-

approach: paleontological  
sediment cores

## WP6 DATA BASE and LITERATURE SURVEY

Comparative analyses in genome size across different phyla/thermal regimes  
approach: Analyses of data in animal genome database (www.genome.com;



WP6 Leader:  
Prof. Dag Hessen  
University of Oslo



## WP1 TERRESTRIAL FAUNA

## WP2 LIMNETIC FAUNA

## WP3 MARINE PELAGIC FAUNA

## WP4 MARINE BENTHIC FAUNA

## WP5 Paleontological Record in Holocen

habitat: marine

groups: Foraminifera

b.o. level: community-, and  
body-

approach: paleontological  
sediment cores

## WP6 DATA BASE and LITERATURE SURVEY

Comparative analyses in genome size across different phyla/thermal regimes  
approach: Analyses of data in animal genome database (www.genome.com);

## WP7 SYNTHESIS and PUBLIC OUTREACH

INTEGRATION  
MANAGEMENT  
SYNTHESIS  
DISSEMINATION  
PUBLIC OUTREACH



WP7 Leader:  
Prof. J. M. Węśławski  
IOPAN, Sopot



**WP1 TERRESTRIAL FAUNA**



3 manuscripts submitted M32, M36

**WP2 LIMNETIC FAUNA**



2 manuscripts submitted M33, M36

**WP3 MARINE PELAGIC**



2 manuscripts submitted M34, M36

**WP4 MARINE BENTHIC**



3 manuscripts submitted M34, M36

**WP5 Paleontological Record**



manuscript submitted M36

**WP6 DATA BASE and LITERATURE SURVEY**



manuscript submitted M33

**WP7 SYNTHESIS and PUBLIC OUTREACH**



DWARF synthesis manuscript  
submitted M36



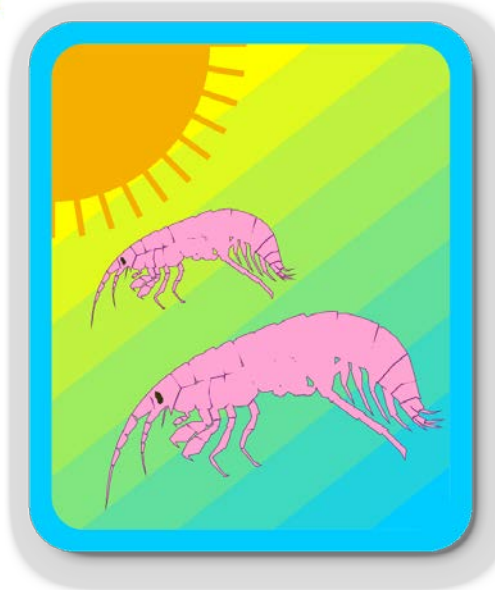
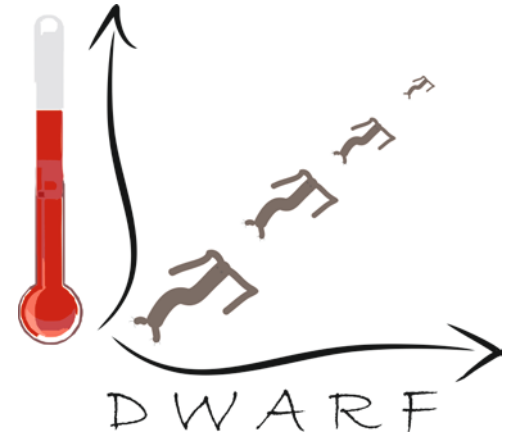
Website M3

Information and promotion plan M6

Progress report on dissemination M12, M24, M36

Popular science book M 30

Set of lessons scenarios downloadable from the project web-site M30





**DWARF**