



DWARF - Declining size - a general response to climate warming in Arctic fauna? – A Polish – Norwegian Research Project

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SIZE MATTERS!!!

TUTORIAL REVIEW

www.rsc.org/csr | Chemical Society Reviews

Size matters: why nanomaterials are different

Emil Roduner*

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Transgenic Research 10: 83–103, 2001.
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Review

Size matters: use of YACs, BACs and PACs in transgenic animals

Patricia Giraldo & Lluís Montoliu*

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Received 15 August 2000; revised 20 October 2000; accepted 26 October 2000

SIZE MATTERS!!!

SCIENTIFIC
REPORTS



OPEN

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

Alf Norkko^{1,2}, Anna Villnäs¹, Joanna Norkko¹, Sebastian Valanko^{1,2} & Conrad Pilditch³

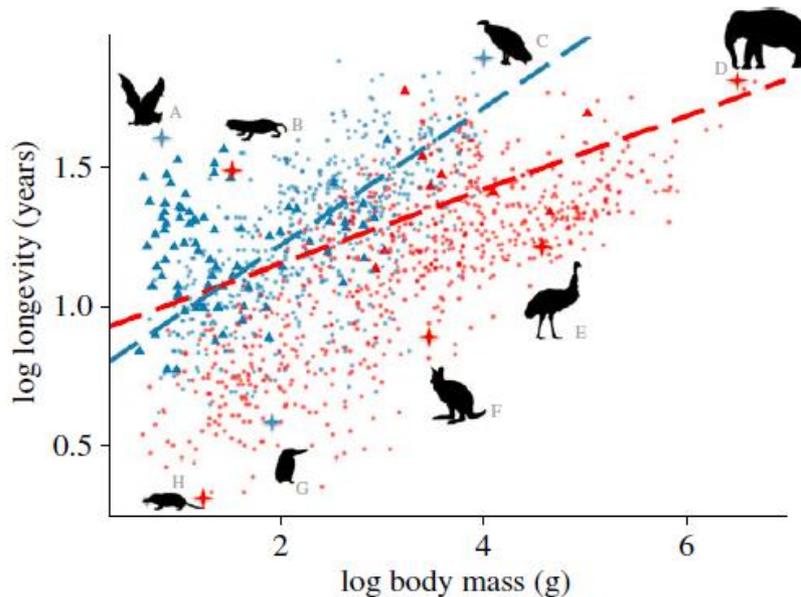
SUBJECT AREAS:
BIOGEOCHEMISTRY
COMMUNITY ECOLOGY
BIODIVERSITY
ECOSYSTEM ECOLOGY

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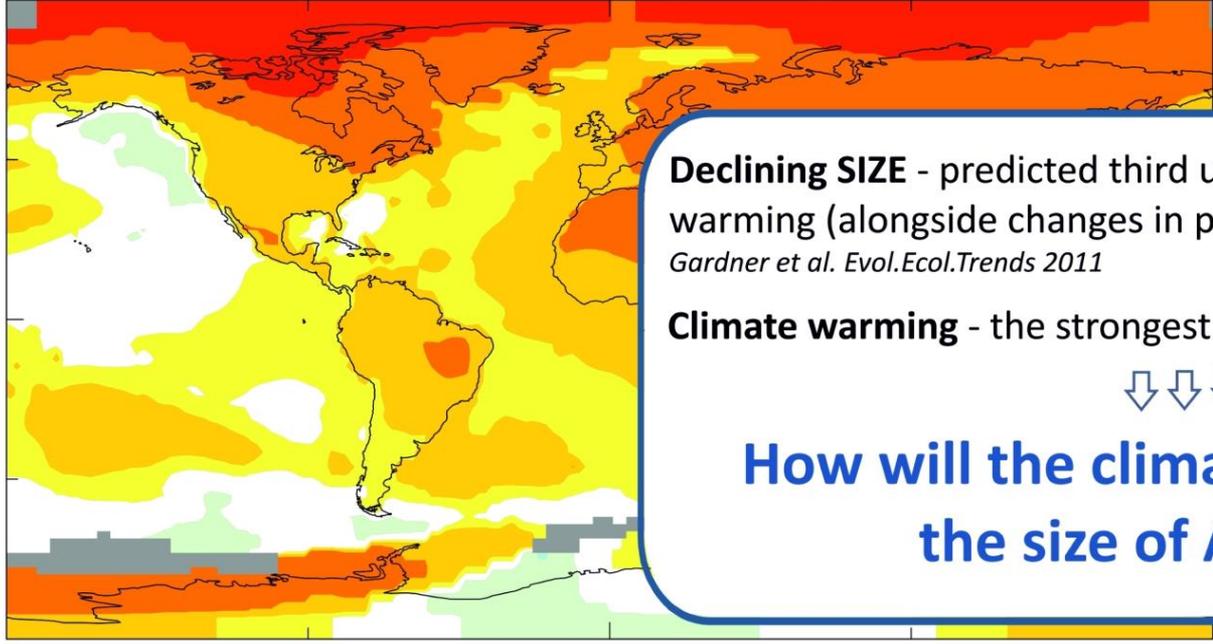
„**SIZE** is a supreme regulator of all biological matters” – Bonner, 2006 - determines the rates of basic processes (metabolism, generation time, longevity, locomotion speed, ...)

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



(Healy et al. 2014)

Annual J-D 2006-2012 L-OTI(°C) Anomaly vs 1951-1980 0.58



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?

-4.1 -4 -2 -1 -.5 -.2 .2 .5 1 2 4 4.1

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

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



Calanus hyperboreus



C. glacialis



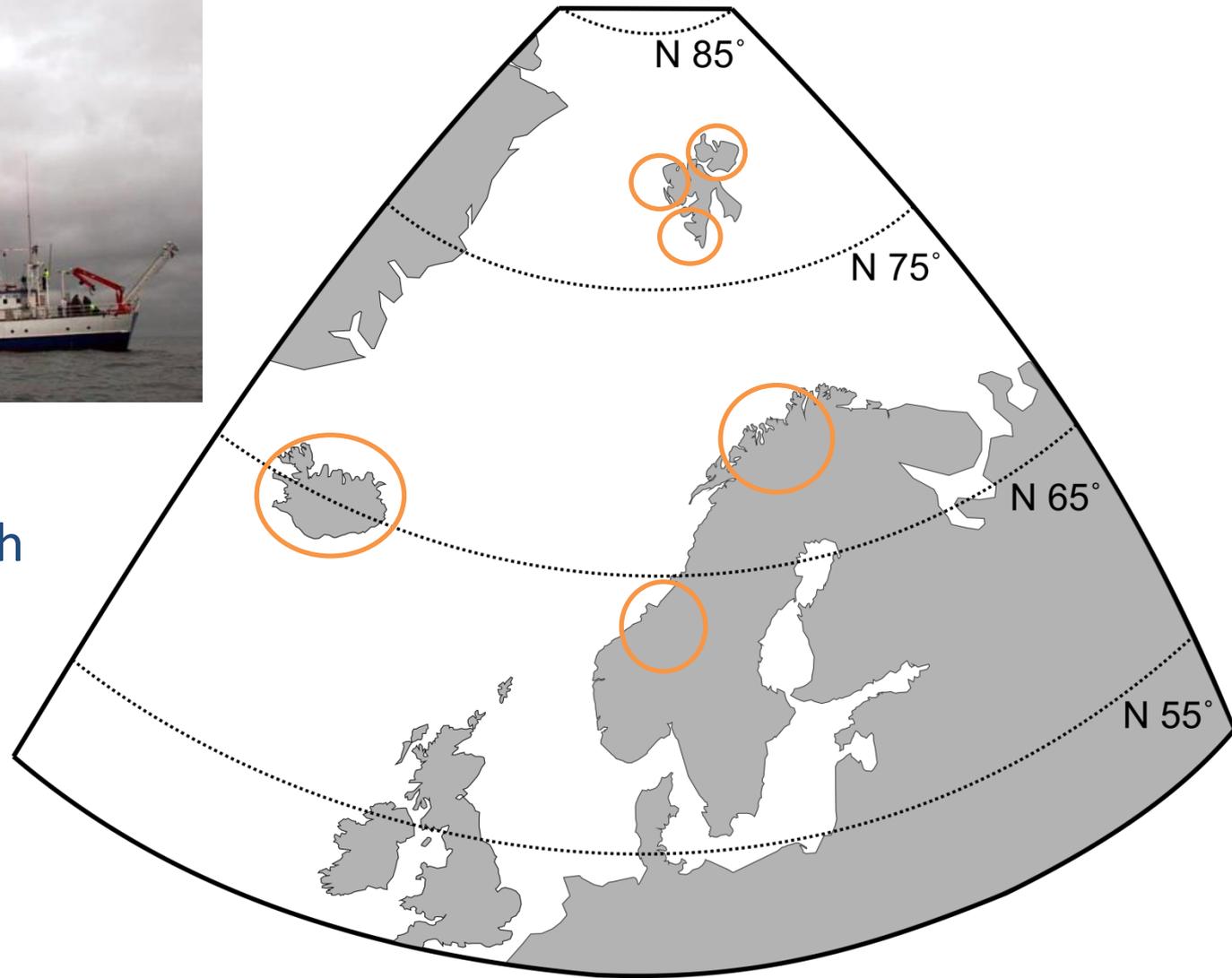
C. finmarchicus



R/V „Oceania”

Very wide research
polygon

From: 63°5'N
Up to: 80°N



WP 1 TERRESTRIAL FAUNA

- Springtails (Collembola) and true insects



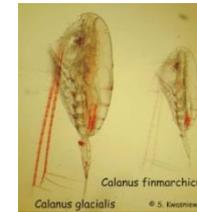
WP 2 LIMNETIC FAUNA

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



WP 3 MARINE PELAGIC FAUNA

- Mesozooplankton

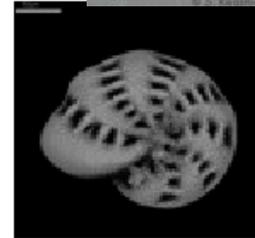


WP 4 MARINE BENTHIC FAUNA

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



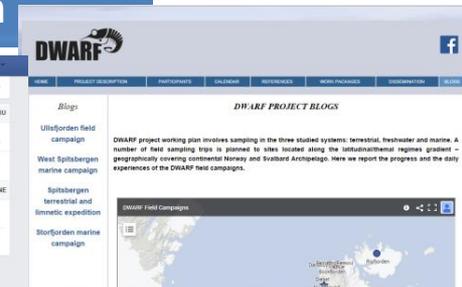
WP 5 Paleontological record of Size Distribution in Foraminifera



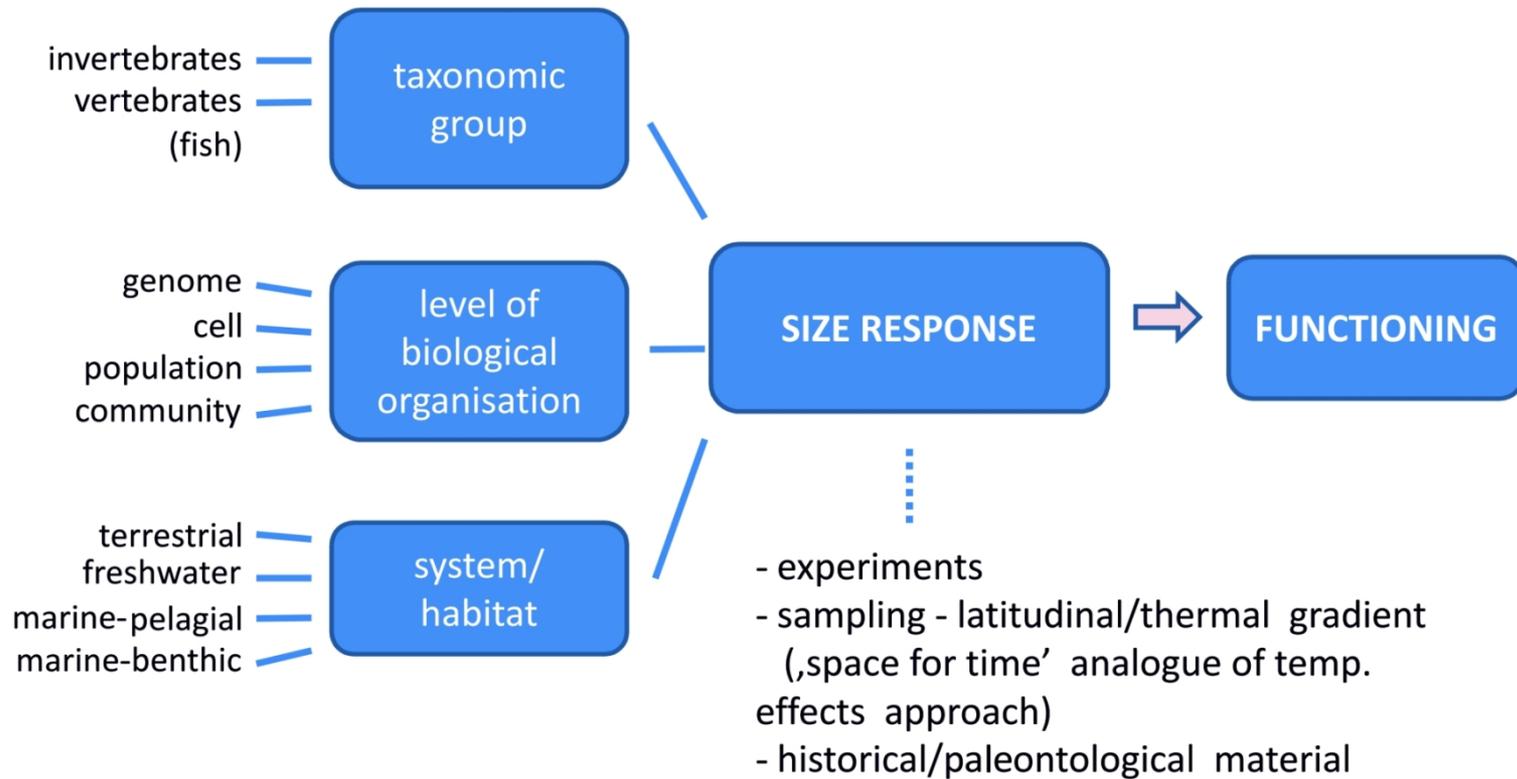
WP 6 DATA BASE & LITERATURE SURVEY

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

- Publications
- Conference presentations
- Social media: Facebook, Web page blog

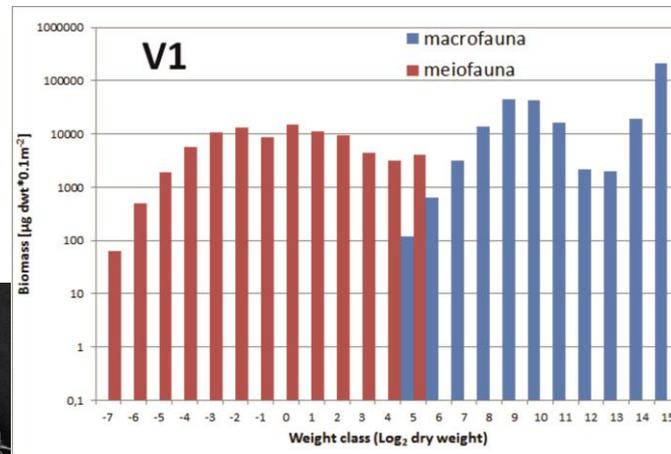


DWARF Hypothesis: Elevated temperatures will induce size reductions in a large range of high latitude ectotherms.

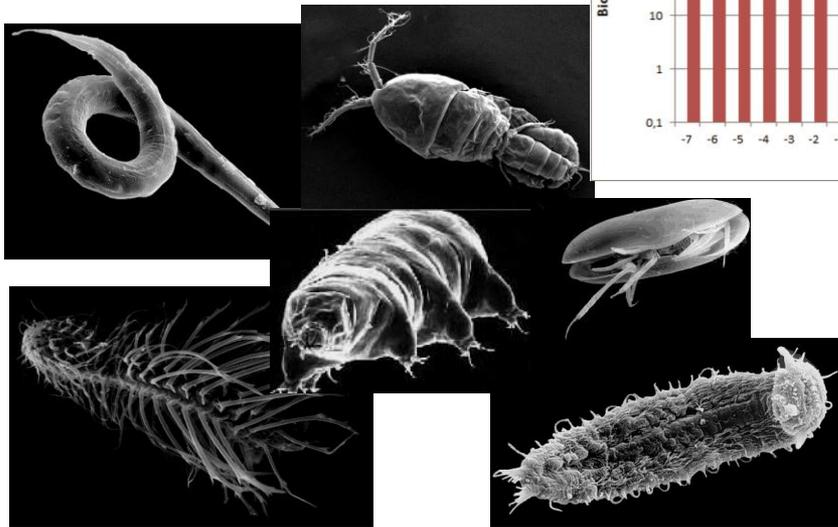


- Analyses of size structure of populations of selected macrofaunal species and of benthic communities across meio- and macrofauna
- What are implications of change in size structure on the functioning of the system (secondary production, respiration, bioturbation)

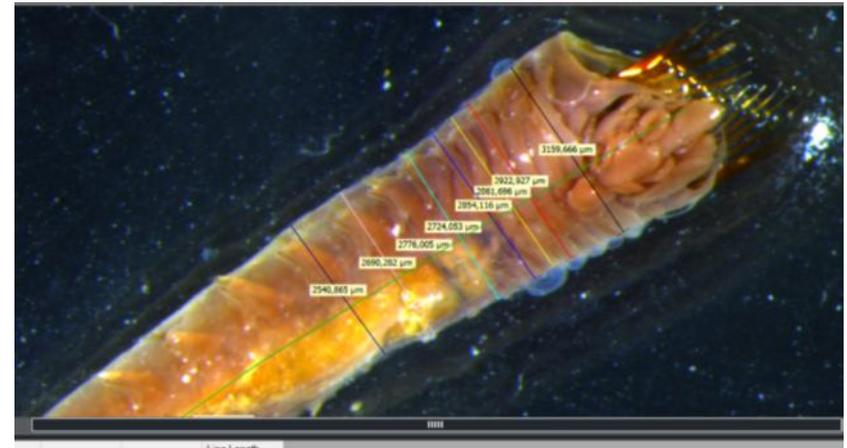
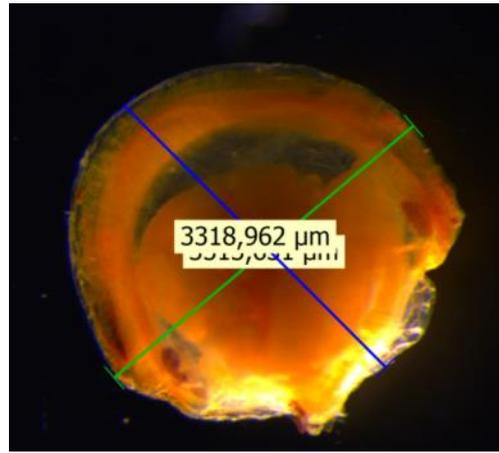
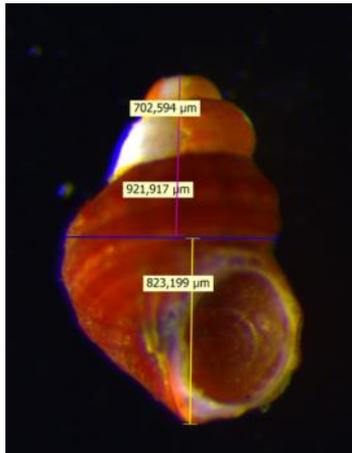
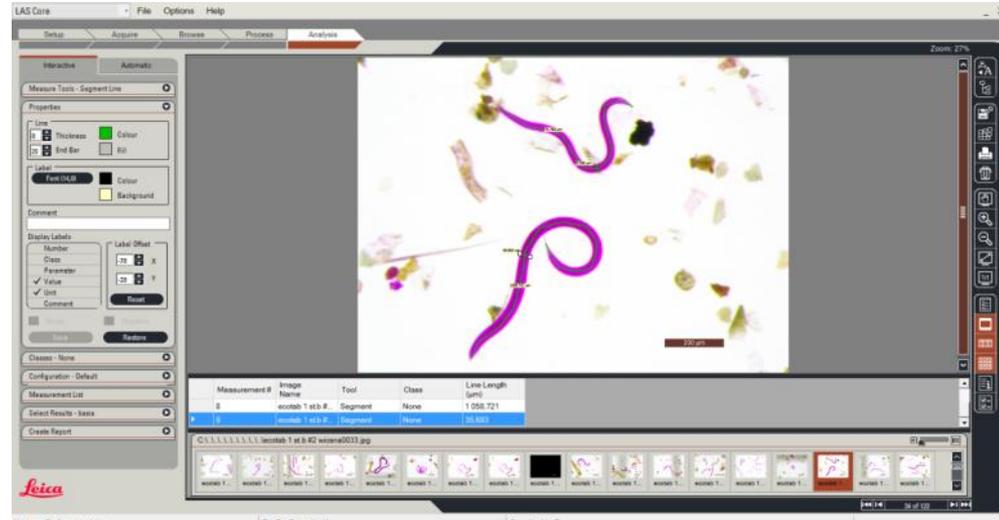
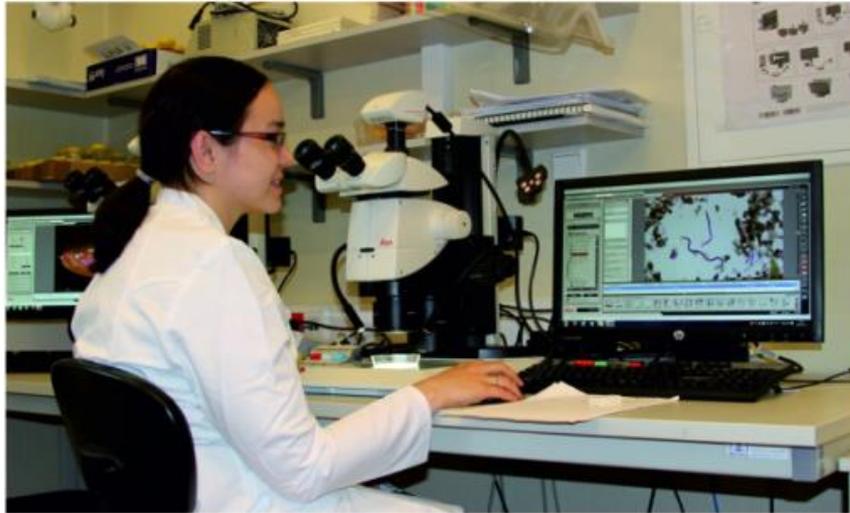
Meiofauna
32-500 μm



Macrofauna
500 μm – a few cm



Manual measurements of organisms using Leica software



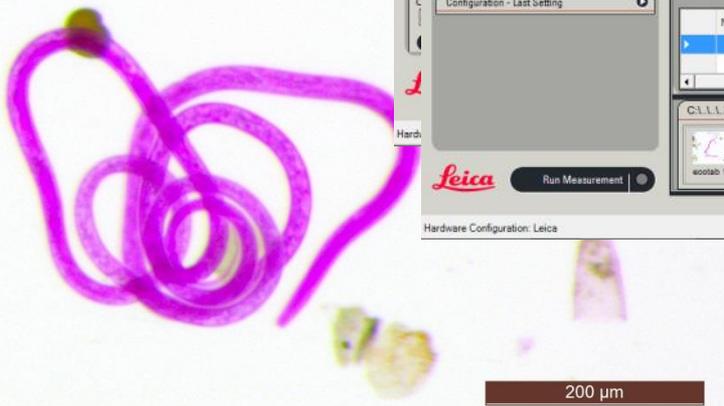
Semi-automated measurements of nematodes using Leica LAS software with Image Analysis module



Semi-automated measurements of nematodes using Leica LAS software with Image Analysis module

Feature Statistics

Number	Images	Accepted	Area(µm²)	X FCP	Y FCP	Feret 0(µm)	Feret 90(µm)	V Projection(µm)	H Projection(µm)	Length(µm)	Breadth(µm)
2	ecotab 1 at b #2	1	36548.654	669.000	1823.000	459.708	438.881	622.161	759.843	625.041	239.071
1	ecotab 1 at b #2	1	21707.774	1397.000	698.000	462.588	266.147	522.500	498.305	462.588	261.538



Semi-automated measurements of nematodes using Leica LAS software with Image Analysis module

Faster
More objective

Feature Details (2/0)		Feature Statistics									
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1	ecotab 1 st b #2 ...	1	21707.774	1397.000	698.000	462.588	266.147	522.500	498.305	462.588	261.538



200 µm



DWARF

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<http://www.iopan.gda.pl/projects/Dwarf/index.html>

<https://www.facebook.com/PROJECT.DWARF>

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