DWARF
VP1 – Terrestrial fauna

Close collaboration with

WP 2 – Limnetic fauna and

WP 6 – Database and literature survey

How is the body size modified by temperature?
What are the underlying ***proximate*** mechanism/factors?

Is adult body size determined by cell size or cell numbers?
Relationships between body size, cell size and genome size.

Why does temperature affect body size?
Adaptive or non-adaptive changes?
What are the ultimate factors?

Effect of temperature on body size

1. How do animals vary in body size along climate gradients

Bergmann's rule = body size increase towards colder areas *(In ectotherms often called **Bergmann clines**)*

However, we also find the opposite pattern "***Converse Bergmann clines***" .

This is most common in terrestrial ectotherms

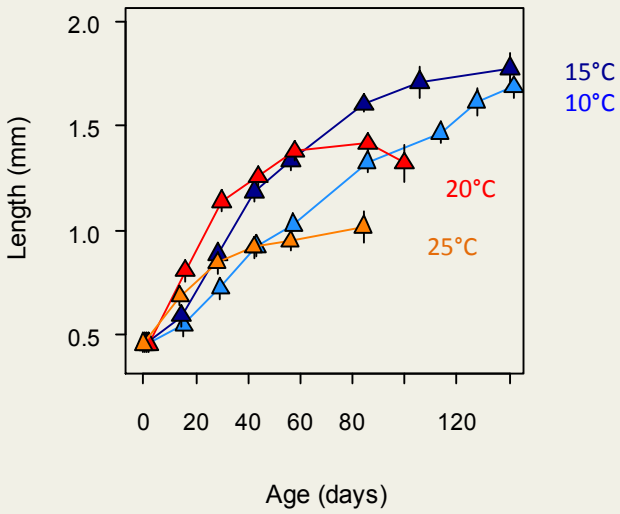
Effect of temperature on body size

2. How do animals respond on developmental temperature (Phenotypic plasticity)

Temperature-size rule (TSR)= ectotherms grow slower, but reach larger size if kept at lower temperatures;

Widespread across taxa,
but little understood:
adaptive or non-adaptive?

Folsomia quadrioculata;
growth curves at four temperatures



Temperature characteristics of temperate and arctic areas of terrestrial vs. marine systems

Why is converse Bergmann clines mostly observed in terrestrial ectotherms?

	Terrestrial	(micro climate)	Marine	(pelagic)
	Temperate	Arctic	Temperate	Arctic
Annual mean	mild	cold	mild	cold
Growth season	mild	variable	mild	cold
Growth season	long	short	long	long
Annual variation	moderate	strong/stochastic	low	low
Diurnal fluctuation	strong	strong	little	little

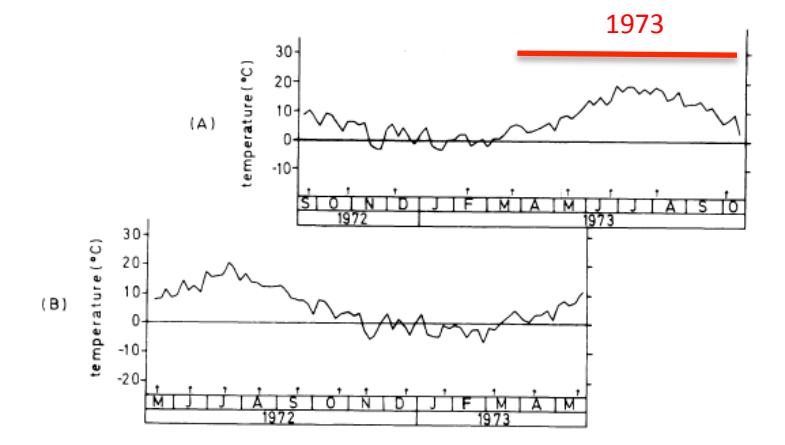
The arctic: unpredictable;
adapted to reduce risk of time limitation.

The arctioc: predictable;
adapted to efficiently utilize prevailing temperatures during growth season

Soil temperature (2mm below surface) during growth season two successive years in a spruce forest near Oslo (1972-1973), and at Svalbard (Ny Ålesund 1993-1994)

Forest floor (Oslo):

Growth season about 7 months both years
(May – October)



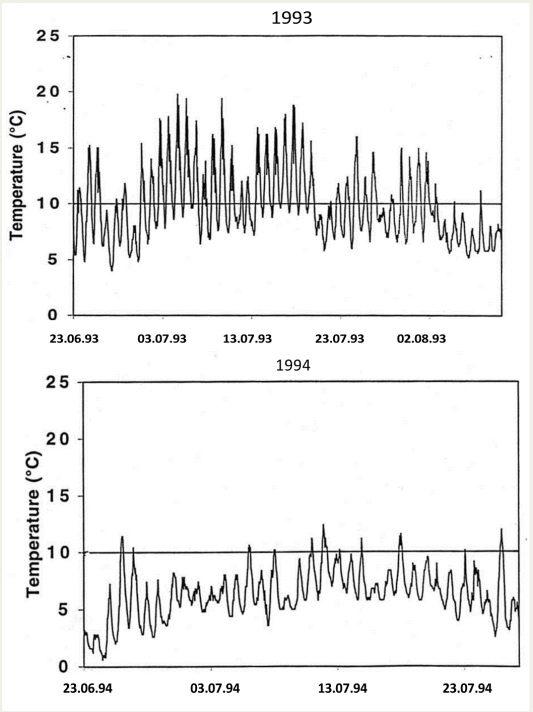
1972

Kings Bay:

Growth season about 1 month 1993
and 1.5 months in 1994

1993

June 23 Aug 13

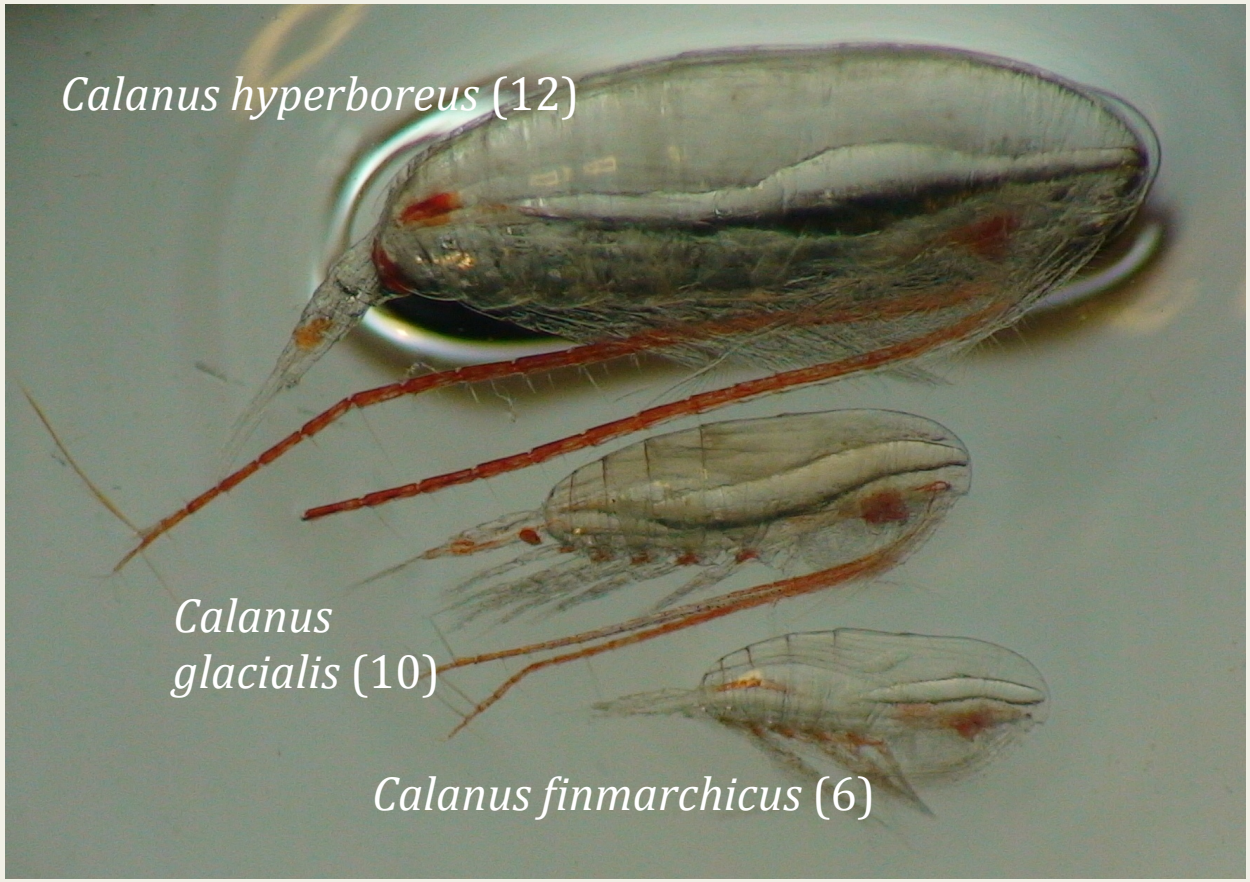


June 23 1994 July 23

Study organisms = marine plankton (calanoid copepods):

Four species that were found both at high latitude (Svalbard) and in temperate waters (fjords of southern Norway)

Calanus hyperboreus from Svalbard and the Oslofjord
Calanus glacialis from Svalbard and the Lurefjord just north of Bergen
Calanus finnmarchicus from Svalbard and the Oslofjord

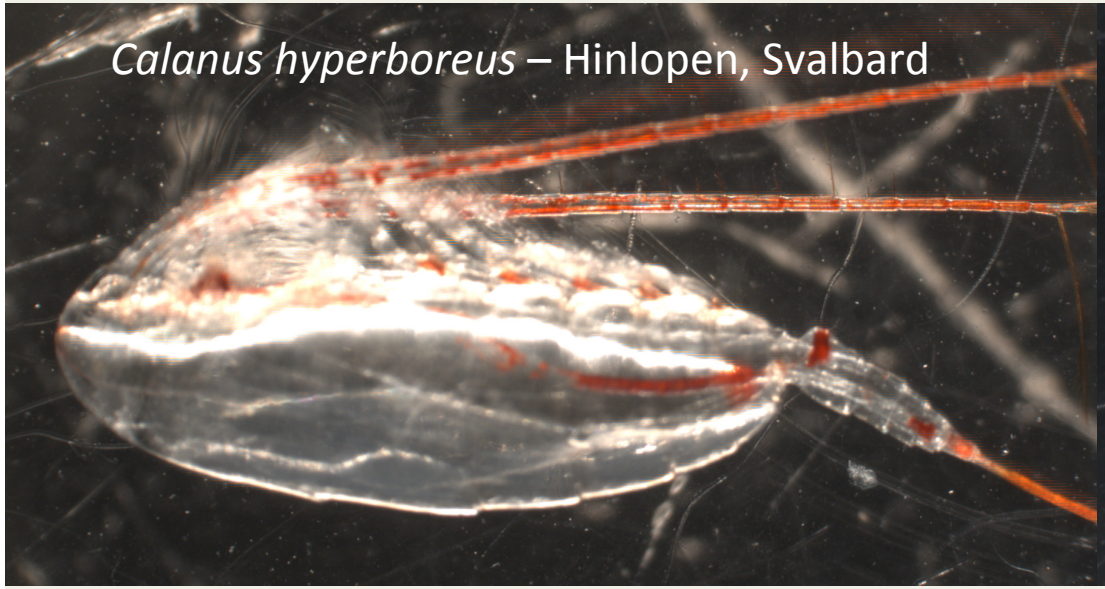


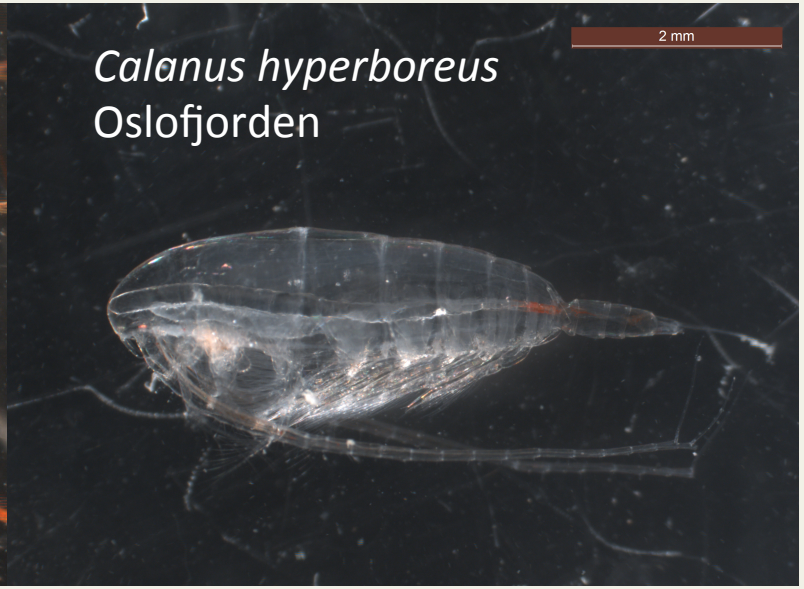
Paraeuchaeta norvegica **from Svalbard, the Oslofjord and the Lurefjord**

Will we find Bergmann clines both within species and between related (congeners) with increasing latitude?

How is the relationship between body size and genome size within and between species in our focal species?

Body- and genome size of *calanoid copepods* species fron south Norwegian fjords and Svalbard (High Arctic)



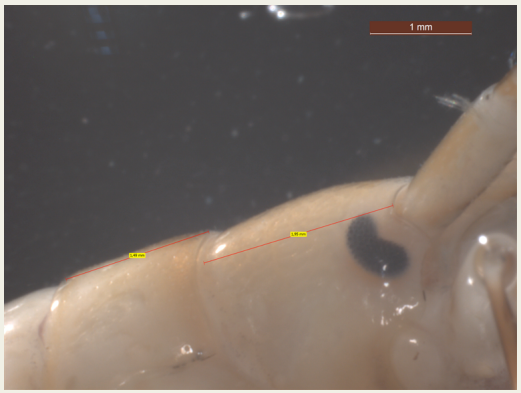


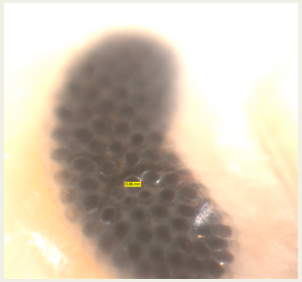
site	Species	C-value (pg DNA)		Body length (mm)	
Oslofjorden	*Calanus finmarchicus*			2,31	±0.07
Svalbard	*Calanus finmarchicus*	5,48	± 0.01	2,84	±0.10
Lurefjorden	*Calanus glacialis*	8,45	± 0.01	2,56	±0,10
Billefjorden	*Calanus glacialis*	11,08	± 0.36	3,4	±0.20
Rijpfjorden	*Calanus glacialis*	11,29	± 0.02	3,4	±0.16
Oslofjorden	*Calanus hyperboreus*	9,2	± 0.07	5,04	±0.60
Hinlopen East Svalbard	*Calanus hyperboreus*	10,55	± 0.13	6,85	±0.77
North Svalbard	*Calanus hyperboreus*	11,48	± 0.33	6,61	±0.19
Oslofjorden	*Pareucheta norvegica*	23,09	± 0.12	5,34	±0.20
Lurefjorden	*Pareucheta norvegica*	32,75	± 1.57	5,58	±0.24
Svalbard	*Pareucheta norvegica*	32,23	± 0.08	6,13	±0.57

Gammarus oceanicus

G. oceanicus from Danskeøya

Length of cephalon and
first pereon segment



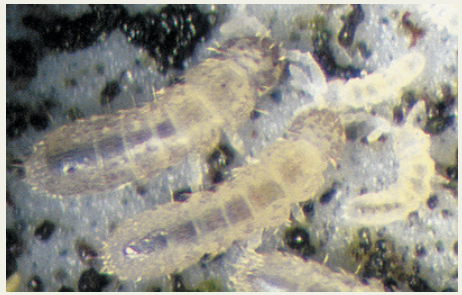


Eye with diam of one ocellus

Comparison of one high arctic and one temperate population of two collembolan species

Oslo Nordmarka

Liittle Slate Island, Savlbard



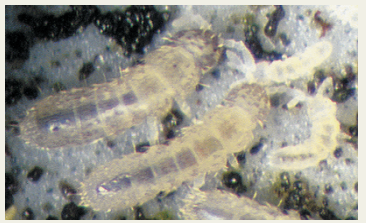
Folsomia quadrioculata

Hypogastrura viatica

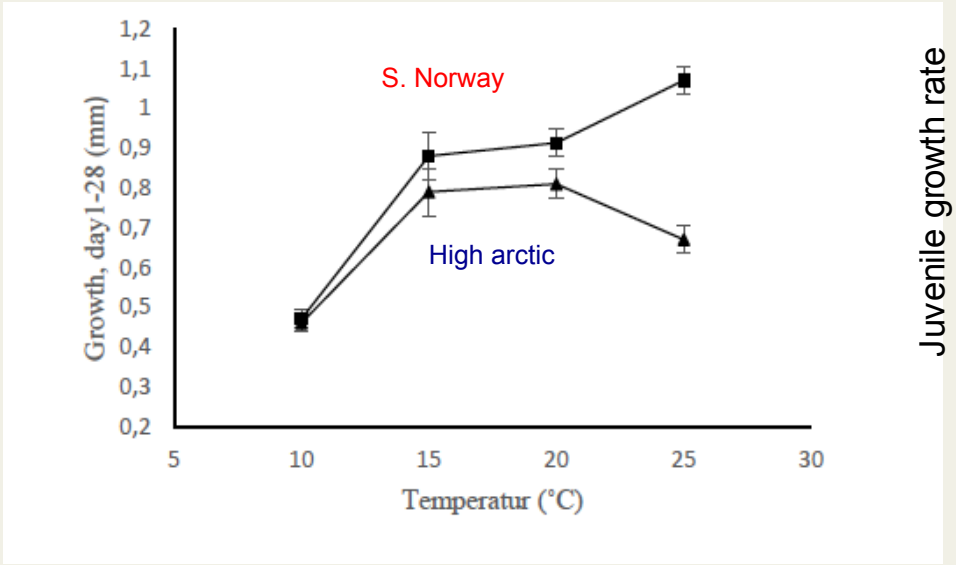
Portør, Southern coast of Norway

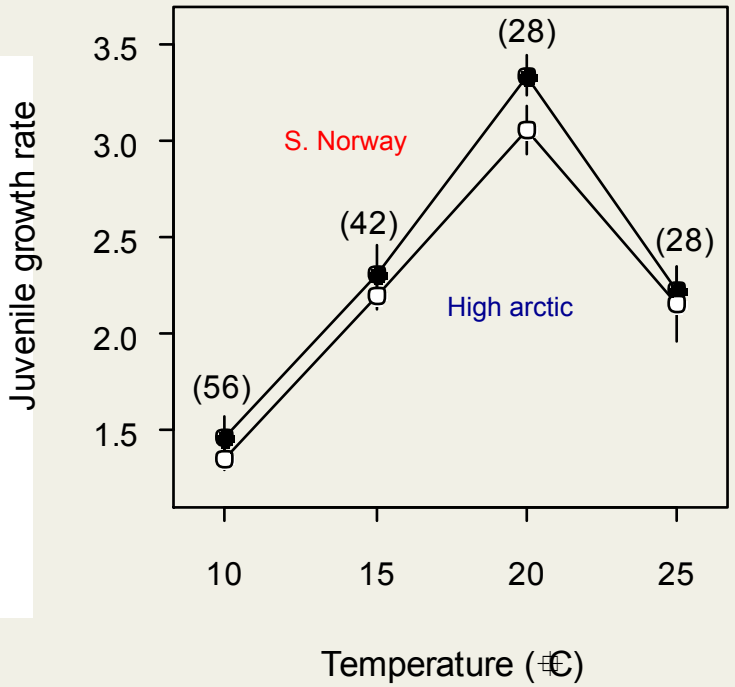
Effect of temperature on growth rate; micro-evolutionary differences in phenotypic plasticity

Hypogastrura viatica



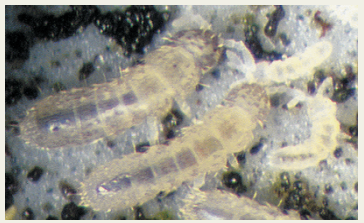
Folsomia quadrioculata



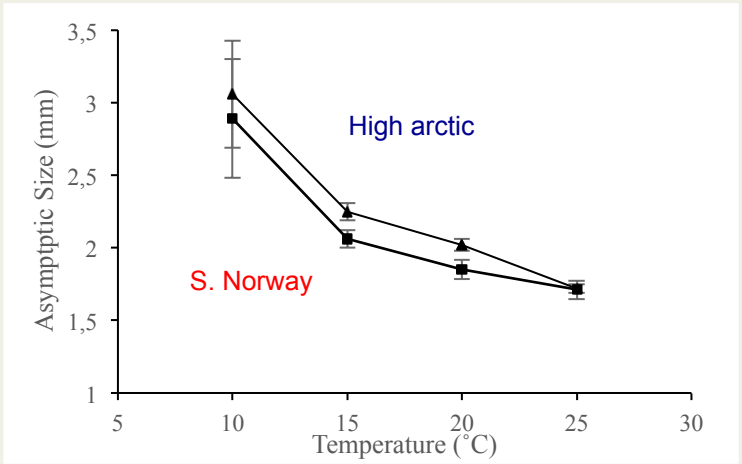


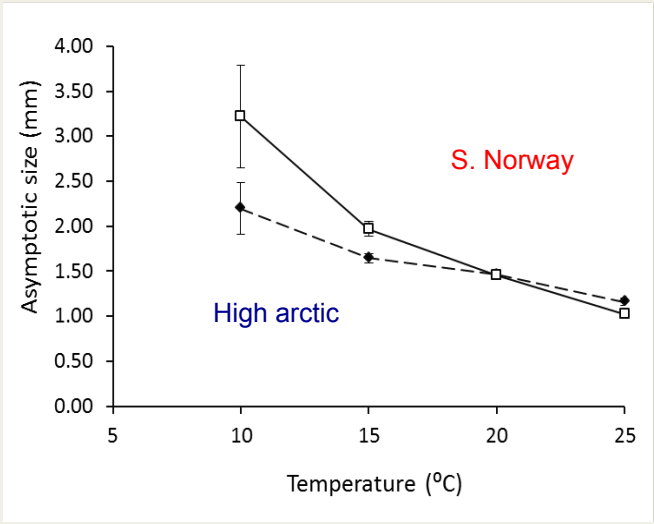
Effect of temperature on body size; micro-evolutionary differences in phenotypic plasticity

Hypogastrura viatica



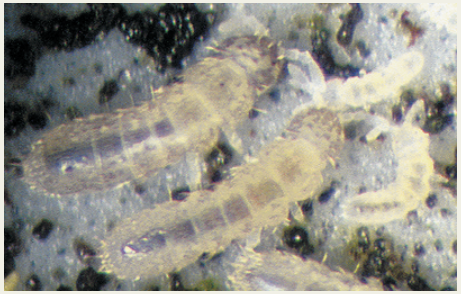
Folsomia quadrioculata



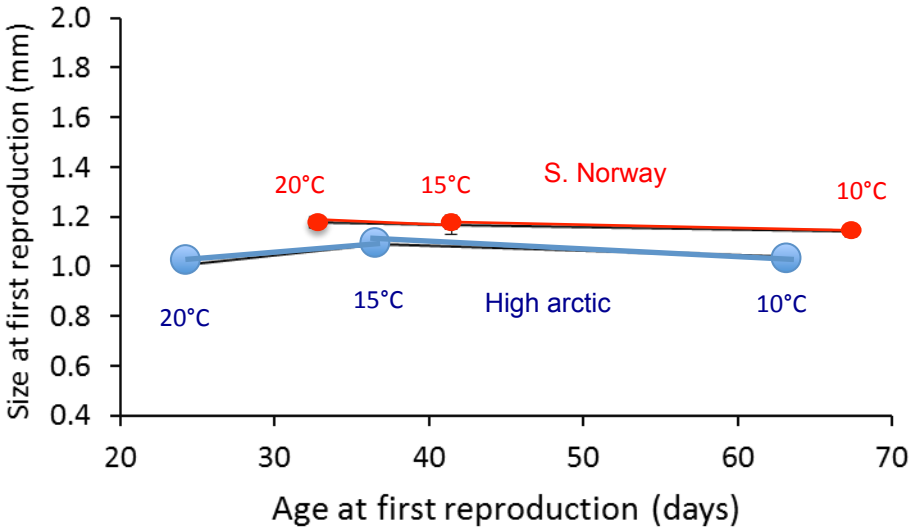


Reaction norms for asymptotic size

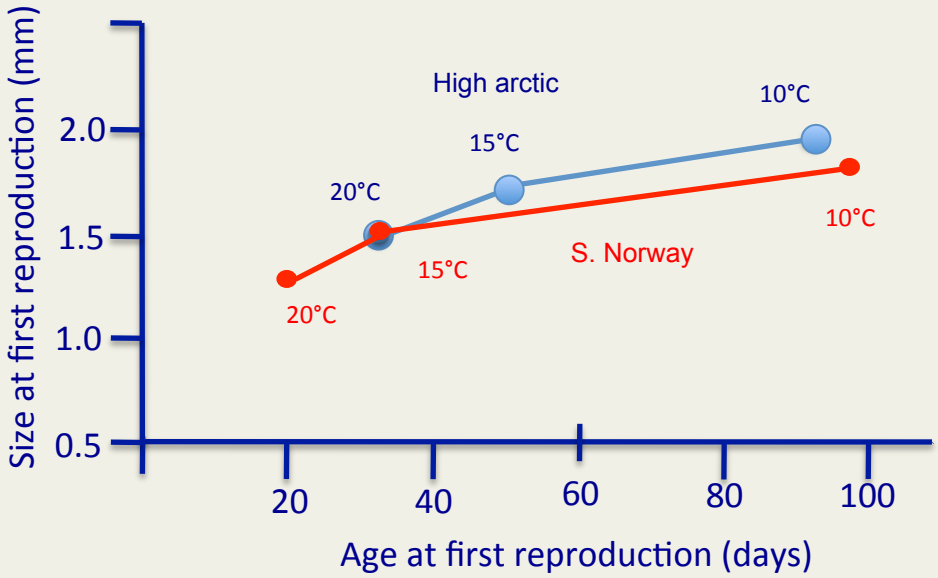
Age and size at maturity; comparison of one extreme high arctic and one mild temperate population of two collembolan species



Folsomia quadrioculata



Hypogastrura viatica



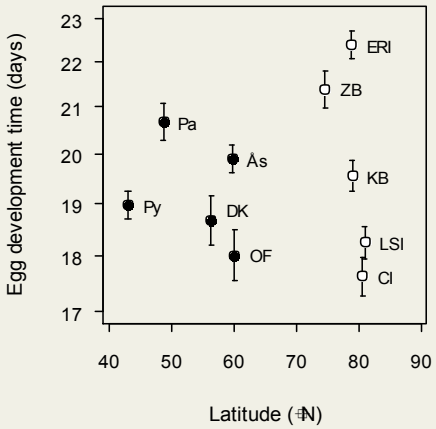
2015-16: more Collembola populations to be compared

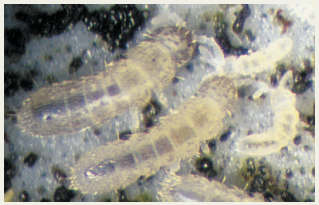
Field sampled populations to be measured.

Cultures from several Svalbard populations, incl. from hot spring area
have been kept for about one generation in the lab. Now ready for common garden experiments.

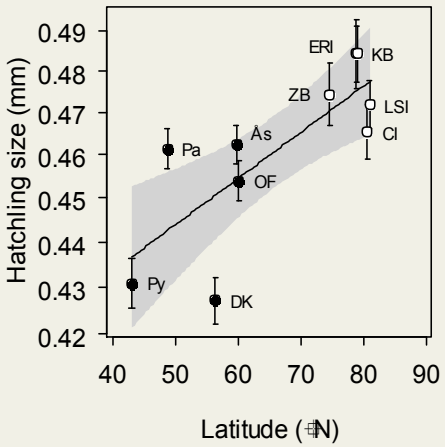
As shown for *Folsomia quadrioculata*, variation between populations may be great:

Egg development time





Offspring size



However, based on results so far we hypothesize that life history traits of *Hypogastrura viatica* we be more related to macro climate and less to local conditions, as seen in F. quadrioculata

DWARF
VP1 – Terrestrial fauna

Hans Petter Leinaas
Sagnik Sengupta PhD-student
Julie Johnsen M.Sc. (Jan 2015)

In collaboration with:
Dag Hessen
Martin Svenning
Kristian Alfsnes