

# The Patterns of Foraminiferal Test Size Change Along Thermal Gradients

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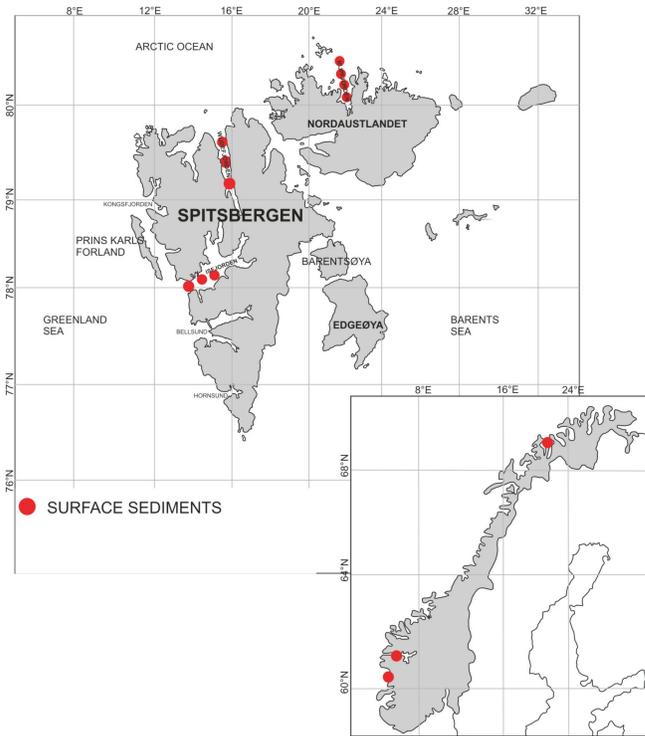
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## Introduction

The aim of the study was to determine how the size structure of benthic foraminifera community responded to changing thermal regimes. The temperature change is one recognized driver for size changes, and declining body size is proposed as common response to global warming. The main hypothesis was that temperature variations induced foraminifera size changes i.e., elevated temperatures caused size reductions in a range of foraminifera species.

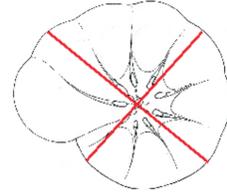
## Research area



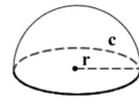
Samples were retrieved at sites located along the gradients of thermal regimes off Norwegian and Svalbard coasts (i.e., latitudinal gradient from 60°N to 80°N).

## Methods

Six species of calcareous foraminifera have been chosen for the study: *Cassidulina reniforme*, *Cibicides lobatulus*, *Elphidium clavatum*, *Islandiella norcrossi*, *Melonis barleeanum* and *Nonionellina labradorica*. Two dimensions: the longest and the shortest diameter were measured in 30 specimens of chosen species in each sample. The size of foraminifera was expressed as test volume approximated by formula based on 0.5 times the volume of a sphere ( $4/3\pi r^3$ ) or truncated cone  $[1/3\pi h(r_1^2 + r_1r_2 + r_2^2)]$ . To understand the linkage between the environmental gradients and size of the organisms, the data was supplemented with measurements of temperature and salinity.



$$\text{Volume} = 0,5(4/3\pi r^3)$$



$$\text{Volume} = [1/3\pi h(r_1^2 + r_1r_2 + r_2^2)]$$

$$r_1 = r$$

$$r_2 = 0,4r_1$$

*Elphidium clavatum*



*Melonis barleeanum*



*Cassidulina reniforme*



*Islandiella norcrossi*



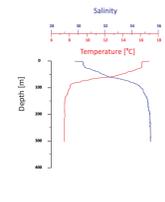
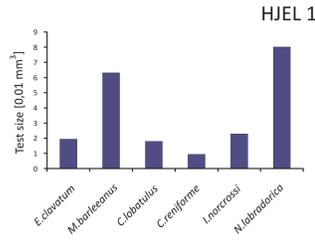
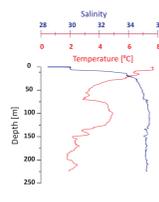
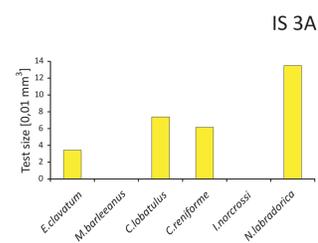
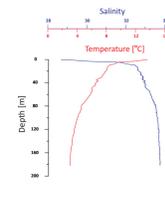
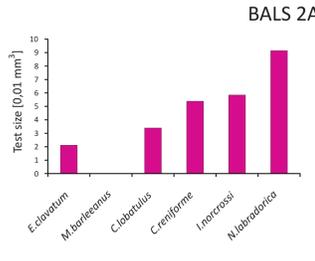
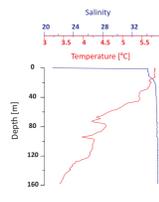
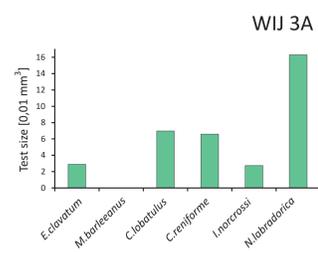
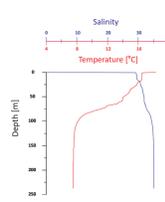
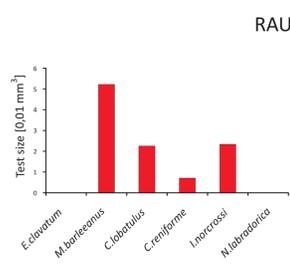
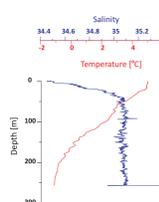
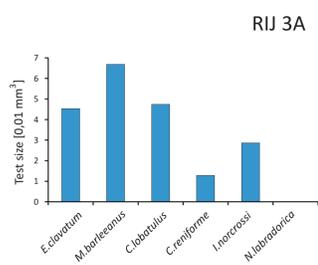
*Cibicides lobatulus*



*Nonionellina labradorica*



## Results and conclusions



The size of benthic foraminifera shells and temperature and salinity in the fjords of Svalbard: Rijpfjorden, Wijdefjorden and Isfjorden.

The size of benthic foraminifera shells and temperature and salinity in the fjords of Norwegian: Raunefjorden, Balsfjorden and Hjeltefjorden.

**Bergmann's rule (1847):**  
 The organism is larger, the colder the climate in which he lives.

