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ESF ThermAdapt – Short Visit : Report

"Thermal adaptation and genetic diversity of *Daphnia* related to volcanic warming in Iceland"

Background

Temperature is an important abiotic factor influencing the fitness of organisms and is a major selective force in aquatic ecosystems. Iceland is a perfect study area to investigate thermal adaptation in aquatic organisms as this country contains several aquatic habitats of which temperature is locally increased by volcanic activity. The fate of organisms confronted with higher temperatures depends critically on their ability to adapt to these thermal selection pressures.

Report

During this short visit we sampled the following ponds:

Ponds sampled in geothermically heated areas (SW of Iceland)

- recent earth quakes (May 2008) in the SW of Iceland around Selfoss produced several hot springs
- Landmannalaugar thermal ponds and streams: average of 26°C

- Laugarvatn: lake with temperature gradient caused by two hot springs entering the lake (29.5°C at the shore and 15.1°C at 50 m). This thermal gradient was intensively sampled
- Opnur (Ölfusforir area): warm water pond (25.5°C)

Ponds sampled in cool areas (SW, South and SE of Iceland)

- ca. 30 kettle hole ponds of different age at the end of glaciers in the Skaftafell area (Skaftafellsjökull): average temperature ranged between 13.8°C and 18°C
- ca. 10 ponds along the N1 road to the SE of Iceland
- Tjörnin: Reykjavik city pond (16.8°C) and several ponds around Reykjavik (SW of Iceland)

When possible, we took living animals with us to Belgium for further analyses and we also collected and stored animals on ethanol (100%) for population genetic analyses and comparison between warm and cold populations. We measured abiotic factors of most of the ponds: temperature, pH, conductivity and oxygen, in addition to size, vegetation cover and depth.

The presence of non-heated and heated habitats by volcanic warming in Iceland provides us with a unique opportunity to study genetic adaptation to temperature in keystone Cladocera species along a thermal gradient under natural conditions. Only few *Daphnia* species were found in several low temperature ponds (Tjörnin and kettle hole ponds). In the warm water pond of Opnur, we isolated an abundant number of clones of *Simocephalus*. We intensively sampled the thermal gradient in Laugarvatn and collected abundant numbers of the cladoceran *Camptocercus* from different temperature areas. Given this is a semi-bentic species, it is very interesting to use this species for testing local genetic thermal adaptation as it has a very low migration rate and thus needs to adapt to its microhabitat conditions.

During the next months, we will culture the animals and try to experimentally assess local genetic adaptation through direct competition experiments between clones isolated from different habitats at different temperatures under standardized laboratory conditions. In a second step, we will investigate and compare the population genetic structure of the selected populations by means of microsatellite DNA markers. Finally, we will try to obtain insight into one of the possible physiological mechanisms underlying the adaptation to higher temperature by quantifying heat shock proteins.

We expect at least one paper to result from this project focusing on local thermal adaptation of Cladocera species in Iceland. Depending on the results of the competition trials and the microsatellite analyses, it may be that the data may be dealt with in two publications.

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