Climate-driven shifts in permafrost melting and ecotoxicological consequences during the Holocene: chironomid-based reconstructions from periglacial environments in the Eastern Alps

The Austrian Science Fund (FWF) – Lise Meitner Program; project M1337; 2012–2014
Principal investigator: Boris P. Ilyashuk

Fig. 1. Panoramic view of the Ötztaler Alps, South Tyrol, Italy; Lake Rasass and the adjacent pond are shown on the right side.

ABSTRACT

Understanding how climate change influences mountain lakes both directly and indirectly by modifying catchment processes is central to ongoing and future research. Special emphasis is now placed on problems associated with the interactions between climate change, the melting mountain permafrost, enhanced pollutant release, and ecosystem health (Thies et al., 2007). The general objective of the project is to reconstruct the changes in the ecotoxicological state of a high-alpine lake ecosystem over the last ca. 10,000 years caused by warming-related increases in metal inputs from an active rock glacier. This goal will be achieved by means of chironomid analysis (Diptera: Chironomidae) of the Holocene sediment records from Lake Rasass with a rock glacier and a pond without a rock glacier in the catchment situated in a periglacial environment in the Ötztal Alps, South Tyrol, Italy (Fig. 1, 2). Analysis of changes in the chironomid assemblages and the incidence of chironomid mentum deformities (Fig. 3) from these records will be used to define and compare periods of unfavorable ecotoxicological situations in both water bodies during the Holocene. The general temperature trends and the major warming events responsible for the past elevated mountain permafrost discharges in the study area will be identified based on a compilation of different palaeoclimate archives available for the region. Special attention will be placed on studying the trace metal bioaccumulation in living chironomids and the metal biomagnification through the contemporary benthic food chain in the lake affected by recent metal fluxes from mountain permafrost.

Fig. 2. Chironomid *Pseudodiamesa nivosa*: (A) – imago, (B) – pupa, and (C) – larva.

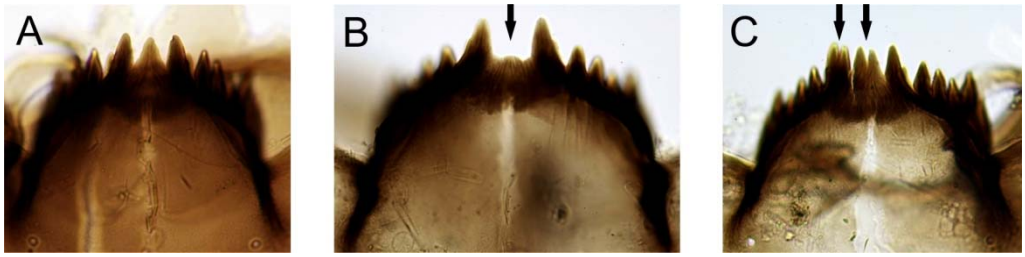

Fig. 3. Photographs of normal (A) and deformed (B, C) menta in the *Pseudodiamesa nivosa* head capsules from the Lake Rasass sediment; (B) – mentum gap; (C) – bifid 1st lateral and median teeth. Both types of mentum deformities were also observed in the head capsules of *Chironomus* sp., the dominant chironomid species in a Russian subarctic lake that received wastewaters from a copper-nickel smelter during six decades (Ilyashuk et al., 2003).

References

- Ilyashuk B., Ilyashuk E., Dauvalter V. 2003. Chironomid responses to long-term metal contamination: a paleolimnological study in two bays of Lake Imandra, Kola Peninsula, Northern Russia. *Journal of Paleolimnology* **30**: 217–230.
- Thies H., Nickus U., Mair V., Tessadri R., Tait D., Thaler B., Psenner R. 2007. Unexpected response of high alpine lake waters to climate warming. *Environmental Science & Technology* **41**: 7424–7429.