

DEADHEADS AT HIGH ALTITUDE: SUMMARY FROM THE 10TH WORKSHOP ON SUBFOSSIL CHIRONOMIDAE, FINSE, NORWAY, 2011.

The 10th workshop on Subfossil Chironomidae was held at Bergen Museum/Finse Alpine Research Center, University of Bergen on June 30. – July 2. 2011, and organised by Dr. Gaute Velle. There were 23 palaeo-chironomid researchers present, representing 10 different nationalities (see group photo). The purpose with these workshops is to exchange ideas and to have critical and fruitful discussions about topics ranging from larval identification to ecological interpretation – whether people are working with subfossil or contemporary data. Problems and progresses in chironomid palaeoecology are discussed among people with their fingers deep in the mud, and the informal presentations give a fine overview of current state-of-the-art research and development.

After lunch, the workshop group went on the scenic Bergen-Oslo railway line to the field station at Finse (1222 m a.s.l.). A social ice-breaker hike to Hardangerjøkulen glacier was guided by Gaute Velle. The hike in the wet and midge rich snow melt-water landscape, together with discussions on the glacier advance and retreats, gave a fine inspiration to the following two days workshop.

The workshop was organised into four sessions with oral presentations; isotopes, transfer functions, climate, and environmental change. There were two practical sessions on taxonomy and statistics, and one session of general discussion.

A number of ongoing projects (4 presentations) involve stable isotope analyses of either subfossil



Participants at the workshop. Photo: Klaus P. Brodersen.

The pre-workshop day on June 30th in Bergen, was initiated with a welcome by Dr. Kari Hjelle, Head of Department at Bergen Museum. Dr. Richard Telford from the Department of Biology gave a presentation on “Numerical pitfalls in chironomid palaeoecology”. The talk was an introduction to the practical on statistics later on during the workshop (see below). A tour around the laboratory facilities with demonstration of the museum's new automated identification and enumeration equipment was led by Arild Breistøl and Gaute Velle.

headcapsules, modern headcapsules, living larvae or food items from different habitats. Many methods and ideas from macroinvertebrate stable isotope research over the last decades are now being evaluated and implemented on subfossil material. The ongoing work involves optimization of analytical procedures with very small sample size, pre-treatment procedures, signal similarities between headcapsules and larvae, influence of food sources, in-lake and among lake variability etc. Combining the ecological information from C-13,

N-15 and O-18 with the information from the long-term subfossil records may open new windows to interpretation of catchment-, lake- and ecosystem development.

The sessions on transfer functions and climate mainly contributed with both new and well known thoughts on the strengths and weaknesses of quantitative chironomid-based temperature models (e.g., previous workshops, Langdon et al. 2007, Brodersen et al. 2009, see also Velle et al. 2010). Interfering and confounding environmental variables both for the modern transfer functions assemblages and for the fossil assemblages still requires serious attention.

The presentations on (human) environmental change brings the interpretation beyond discussion of climate and temperature. An interesting attempt to combine the changes in the chironomid (temperature) record with numerous findings of pre-historic human occupation and changing environment in SW Swedish Lapland, underlines the challenges in the eventual interpretations. Likewise, a study of a sediment filled lake basin (a lake that is no longer there; Danube lowlands, Slovakia) also requires interpretational aspects that challenge the analytical skills out of the quantitative modelling. Modern DNA sequencing methods has also reached palaeoecology. These methods have recently been used to confirm taxonomic identifications, such as a likely placement of the fossil *Corynocera oliveri* type into the parthenogenetic *Tanytarsus heliomesonycitios* Langton (Stur and Ekrem 2011), parse out relationships between cryptic species, and harmonize taxonomic nomenclature. However, the application of DNA sequencing has more diverse utilities than taxonomic clarification. Eventually, the analyses will be able to reconstruct population differences and link divergence events with geographic locations and perhaps clear our understanding of ambiguous indicator species, such as *Corynocera ambigua*.

The discussions and challenges mentioned above perfectly set the scene for the practical session on statistics, tutored by Dr. Richard Telford. Using the statistical language R, Telford presented a method to test the statistical significance of a quantitative palaeo-environmental reconstruction inferred from biotic assemblages and transfer functions. A reconstruction is considered statistically significant if it explains more of the variance in the fossil data than most reconstructions derived from transfer functions trained on *random* environmental data (Telford & Birks, 2011). The workshop participants used the newly developed codes in R

(see Telford & Birks, 2011) and tested the significance of reconstructions resulting from data that was provided or from their own data (see workshop photo). Such significance testing fills a major gap in the range of numeric procedures available to palaeoecologists and it is recommended that these tests are used whenever a reconstruction is published.



Practical on statistics tutored by Richard Telford. Photo: Klaus P. Brodersen

Workshops are a fine stage for commencing on position papers. In the discussion session, some ideas for joint publications were presented and discussed. Many of us have data-sets that individually are small, but that together can constitute a wealth of information. Such data-sets include numerous data-points at a broad temporal and spatial resolution that can be used to test hypothesis on topics such as large-scale environmental influences, training set diversity, down-core diversity, reconstruction significance testing, or colonization. The repeated workshops on subfossil Chironomidae and the presence of identification guides, such as Brooks et al. 2007, help ensure that we have a common platform and that the taxonomy is comparable among data-sets. We anticipate this and future workshops will result in shared efforts and joint papers.

It was generally agreed that having the workshop

at field stations or similar type of residence halls were a great success, giving rise to a good social, informal, fruitful and efficient workshop. Then, there is nowhere to escape from the discussion! We thank all for active participating and constructive discussions. The next workshop on subfossil Chironomidae will be in spring or early summer, 2013, most likely in the UK.

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