Chironomid-inferred Holocene mean July air temperatures for the Lena River Delta area, East Siberia, and the Kola Peninsula, northwestern Russia

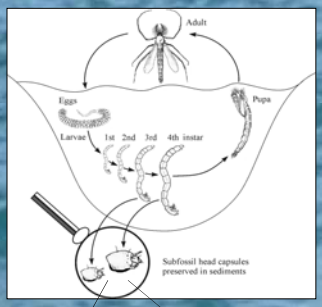
Ilyashuk, E.A.[a], Ilyashuk, B.P.[a], Andreev, A.A.[b], Bennett, K.D.[c], Hammarlund, D.[d], Hubberten, H.-W.[b]

[a] Institute of North Industrial Ecology Problems, Kola Science Center, Russian Academy of Sciences, Fersman St. 14, 184200 Apatity, Russia

[b] Alfred Wegener Institute for Polar and Marine Research, Telegrafenberg A43, 14473 Potsdam, Germany

[c] Department of Earth Sciences, Palaeobiology Program, Uppsala University, Villavägen 16, SE-752 36 Uppsala, Sweden

[d] GeoBiosphere Science Centre, Quaternary Sciences, Lund University, Sölvegatan 12, SE-223 62 Lund, Sweden



Quantitative palaeotemperature reconstructions in the Arctic and Subarctic regions are important for understanding of climatic dynamics, and can be used as means of extending our knowledge on long-term natural climate variability that allow current climate models to be tested and validated. Now the chironomid midges accepted as being one of the best biological palaeoclimate proxies are widely used in Quaternary studies, and chironomid analysis is recognized as the "most promising biological method for reconstructing past temperature".

Chironomids respond rapidly to environmental changes because of their short life cycles and the disperse abilities of the winged adults. Temperature has a profound influence on the physiology of chironomids and is usually the most important parameter explaining the geographic distribution and abundance of midges.

Radiocarbon-dated chironomid records from Lake Nikolay (73°20'N, 124°12'E) and Lake Berkut (66°21'N, 36°40'E) provided the detailed palaeotemperature reconstructions for the Holocene in the Lena River Delta area, East Siberia, and southern Kola Peninsula, northwestern Russia, respectively.

Mean July air temperature (T_{VII}) reconstruction was made using weighted averaging partial least squares model based on a chironomid calibration data set from northern Sweden (Larocque et al., 2001).

Lake Nikolay

Palaeotemperature reconstruction for Lake Nikolay suggests that during c. 10,300-9200 cal. yr BP T_{VII} were highest (9.9-11.6°C) and up to 2-3°C warmer than nowadays. Other quantitative Holocene climatic reconstructions from Arctic Russia indicate that the early Holocene was the warmest period in modern coastal and island areas.

T_{VII} decreased gradually to 8.2°C from c. 9000 to 6500 cal. yr BP. Such deterioration of local climate was probably connected with an extending rise of sea level in the Laptev Sea region, declining summer insolation, and onset of a colder, more maritime summer climate.
During c. 6500-3300 cal. yr BP climate became unstable, with two short warm oscillations (up to 8.9°C) at c. 5600 and 4500-4100 cal. yr BP, and one short cold oscillation (up to 8.2°C) at c. 5000 cal. yr BP, that correspond well with pollen-based climate reconstructions for the lake.

Thereafter, c. 3300-1400 cal. yr BP, T_{VII} were also relatively high (8.9-9.3°C). The reconstruction suggests that a cooling begun after ca 1400 cal. yr BP, when T_{VII} decreased to 8.5°C. The reconstructed T_{VII} is very close to the present value 8.7°C, derived from the modern climate database.

Lake Berkut

Palaeotemperature reconstruction for Lake Berkut suggests that at about 10,000 cal. yr BP T_{VII} increased from about 11.8°C to a maximum of about 13.2°C for a short period. Thereafter, at c. 9900–9500 cal. yr BP, there was a period of relatively high T_{VII} (12.1–12.6°C). The thermal maximum is broadly similar to present-day conditions and consistent with pollen data.

Later on, around 9500–5600 cal. yr BP T_{VII} decreased gradually to about 11.3–11.6°C, but there were short warm oscillations of varying intensity. Then, long-time period (c. 5600–4200 cal. yr BP) of relatively high T_{VII} (11.9–12.1°C) was marked.

Around 4000–3000 cal. yr BP T_{VII} decreased rapidly and between 3200 and 1600 cal. yr BP there was a climatic minimum period with T_{VII} about 11.2°C.

After c. 1600 cal. yr BP there is an overall upward trend, punctuated by strong cold oscillation of 10.2°C c. 1400 cal. yr BP. In the uppermost sample of the core, the chironomid-inferred T_{VII} is 12.5°C, consistent with meteorological data for the early 20th century from the nearby station at Kuzomen.