CHIRONOMID FAUNA OF CENTRAL YAKUTIAN LAKES (NORTHERN RUSSIA) IN PALAEOENVIRONMENTAL INVESTIGATION

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Palaeoenvironmental studies, using organisms as proxies for past climate change, can provide valuable insights on past climate variability, climate forcing mechanisms, and are an essential tool for predicting the possible course of future climate change (Alverson & Oldfield, 2000). Chironomid temperature inference models have been developed successfully in Western Europe and North America (Walker et al., 1997; Olander et al., 1999; Larocque et al., 2001; Brooks & Birks, 2001; unpubl.) and produce low error (0.7-1.1°C) temperature estimates (see review in Brooks, 2001, 2003). However, these models have limited application outside the regions in which they have been developed. Models developed in northwestern Europe do not cover a sufficiently long temperature gradient for use in Russia where the continental climate is more extreme and estimates for temperature optima and tolerances of cold and warm stenothermic taxa are not wide enough to reflect the true ecological range of these taxa.

There are very few examples of quantitative palaeoclimate studies in Siberia (e.g. Kumke et al., 2004). To date, quantitative reconstructions based on chironomid remains are made using a calibration data set developed for Sweden (e.g. Andreev et al., 2004, 2005). There is still a lack of calibration datasets for climatologically very sensitive areas such as arctic Russia.

The aim of our investigation is to study and to quantify the relationship between chironomid species assemblages and their environment in order to establish later on a calibration dataset for Northern Russia to provide the basis for quantitative paleoenvironmental reconstruction in this region.

The Republic of Yakutia is located in the north-eastern part of Russia (between appr. 57° and 75°N and between 110° and 160° E). There are ca. 700,000 lakes in Yakutia and 106,000 in the Central Yakutia. Most of the lakes have originated by thermokarst processes, are rather shallow (1-3 m) and characterised by specific thermal and chemical regimes (Ksenofontova et al., 2005). Climate is continental and dry with maximum temperatures in summer + 39 to 40° C and minimum temperatures down to -57° C in winter. The summer period is short, from the middle of June to the beginning of August. Annual precipitation is low at 250 to 300 mm per annum and smaller than the annual evaporation (350 to 400 mm).

At first instance 47 Central Yakutian lakes have been investigated, but only 40 are included in statisical analyses at the moment due to uncompleted chemical analyses for some of the lakes or a lack of chironomid capsules in the sediments. Chemical analyses included ca. 20 parameters and proved that the area of investigation was not affected by any sort of anthropogenic influence. All lakes are slightly alkaline, oxygen rich, have moderate transparency and some have high ionic concentration. As calculated, the lakes are situated within a temperature range of mean July temperature +16.52 to 18.12oC, of mean January To -37.88 to -43.46, and mean annual To -8.27 to -10.23oC. Selected mean temperature ranges, although rather narrow, reflect the real temperature variability in this region.

Chironomid sample preparation and slide mounting followed standard techniques described in Brooks and Birks (2000). Slides were mounted in Euparal. Between 47 and 292 head capsules were counted at 200–400·magnification from each lake. Chironomids were identified with reference to Wiederholm (1983), Oliver and Roussel (1983), Schmid (1993), Makarchenko and Makarchenko (1999), Rieradevall and Brooks (2001) and the national Chironomidae collection at The Natural History Museum, London, UK.

In total, 75 chironomid taxa were identified in the investigated lakes (Fig.1). Most abundant were Chironomus anthracinus-gr. (av.13.8%), Psectrocladius sordidellus (9.04%), Paratanytarsus penicillatus (7.25%), Cricotopus sp. E (6.61%), Dicrotendipes (6.16%), Tanytarsus lugens-gr. (5.46%).

Among the other taxa met in Central Yakutian lakes we would like to mention some, which have been found for the first time for Northern Russia or references for which in Northern Russia have not been found. Nanocladius B has a longer vmp than the taxa included in the Norwegian training set but looks the same as the one that has been previously found in Northern Ural region (Solovieva et al., 2005). Other rare taxa to be mentioned are Glyptotendipes severini, Pogonocladius, Propsilocerus, Psectrocladius barbimanus, Trissocladius. A complete list of Central Yakutian

chironomid taxa will be published soon on the Russian Chironomid homepage.

A comparison of the chironomid fauna identified from 40 Central Yakutian and 24 Northern Ural lakes (mean July ToC range 9.6 – 13.6oC (Nazarova, Brooks, unpubl.) has shown that both datasets have ca. 63 % of species similarity. Statistical tests using a passive canonical correspondence analysis with the Northern Ural lakes as passive samples and TJuly as the only constrained variable indicated that both datasets can be merged. The sample fit to the canonical axis of the Northern Ural lakes is significant and its median is only 5 % smaller than the sample fit of the Yakutian lakes. The squared residual distances of the Northern Ural lake samples are, with some exceptions, reasonably small. We can conclude that the chironomid fauna of the Northern Ural lakes fits well with the chironomid fauna of Yakutian lakes.

The diversity (N2 index) of Central Yakutian chironomid fauna slightly decreases with To rise and varies in different lakes from 8.1 to 20.46 averaging at 15.5.

Canonical correspondence analysis showed that the main environmental variables that drive the chironomid fauna are: water depth (9% explained variance), mean July air temperature (8% e.v.), water transparency (Secchi depth) (6% e.v.), water temperature (5% e.v.).

The investigation is progressing towards more northern and western territories of Yakutia including Verhojansk vicinity, Lena River Delta and some other distant parts of Siberia in order to extend the temperature gradient and by this to complete the chironomid inference temperature model for Northern Russia.

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