# Reconstruction of Palaeoecological and Palaeoclimatic Conditions of the Holocene in the South of the Taimyr according to an Analysis of Lake Sediments

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**Abstract**—A sediment core from Khatanga-12 Lake (Taimyr Peninsula, Krasnoyarsk krai) has been studied. The 131.5-cm-long core covers ca. 7100 years of sedimentation. Chironomid analysis, a qualitative reconstruction of the paleoenvironment in the region, and a quantitative reconstruction of variations of the mean July air temperature and in the water depth of the lake have been performed using Northern Russia chironomid-inferred mean July temperature models (Nazarova et al., 2008, 2011, 2015). Khatanga-12 Lake was formed during the Middle Holocene warming as a result of thermokarst processes. The development of the lake ecosystem at different stages of its development was influenced by climatic and cryolithogenic factors. The Middle Holocene warming, which occurred around 7100−6250 cal. years BP, activated thermokarst processes and resulted in the formation of the lake basin. Later, between 6250 and 4500 cal. years BP, a period of cooling took place, as is proved by chironomid analysis. The bottom sediments of the lake during this period were formed by erosion processes on the lake shores. The reconstructed conditions were close to the modern after 2500 cal. years BP.

*Keywords:* Chironomidae, paleolimnology, Holocene, climate reconstructions, Russian Arctic region, Khatanga

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## INTRODUCTION

The development of polar ecosystems under the continuously changing climate conditions is an important problem of paleoclimatic and paleoecological investigations (Hoff et al., 2015; Fritz et al., 2016). Despite the environmental development that has been reconstructed in almost the entire northern hemisphere (Mayewski et al., 2004; Schirrmeister et al., 2011; Meyer et al., 2015; Rudaya et al., 2016), paleoecological and paleoclimatic data on the Siberian sector of the Arctic region are still insufficient (Nazarova, 2012; Palagushkina et al., 2012; Nazarova et al., 2013a, b; Frolova et al., 2013, 2014; Solovieva et al., 2005, 2008).

Aquatic organisms, including *Chironomidae* (Insecta: Diptera) (Solovieva et al., 2005; Nazarova et al., 2015), are the best biological indicators for the quantitative reconstructions of changes in the air temperature, because their distribution and development are significantly dependent on temperature (Nazarova et al., 2008; Self et al., 2011). The chi-

tinized structures of chironomids are well-preserved in lake sediments (Nazarova et al., 2008) and easily identified (*Biologicheskie indikatory v paleobiologicheskikh issledovaniyakh...*, 2013). The methods of qualitative and quantitative reconstructions have been elaborated in detail (Brooks, 2006; Nazarova et al., 2015) and used worldwide in paleoclimatic and paleoecological studies (Larocque et al., 2001; Smol et al., 2005; Barley et al., 2006).

In 2011−2013, within the framework of Russian−German cooperation, several expeditions were organized to the region of the Khatanga River (southeast of the Taimyr Peninsula), during which surface and core samples of lake sediments were taken, on which lithostratigraphic, granulometric, and spore palynilogical analyses, and radiocarbon dating were performed (Klemm et al., 2015). The aim of the present study is to reconstruct the environmental conditions of the Holocene in the southeastern part of the Taimyr Peninsula based on the micropaleontological analysis of lake sediments using the statistical chironomid models