

Environmental changes, forest history and human impact in the southern part of Valdai Hills (European Russia) during the last 7000 years

Elena Novenko (1), Andery Tsyganov (2), Natalia Pisarchuk (3), and Daniil Kozlov (1)

(1) Lomonosov Moscow State University, Faculty of geography, Department of Landscape Science, Moscow, Russian Federation (lenanov@mail.ru), (2) Penza State University, Department of Zoology and Ecology, (3) Belarusian State University, Faculty of Geography, Department of Physical Geography of the World and Educational Technologies

Understanding the long-term ecological dynamics of swampy boreal forest is essential for assessment of the possible responses and feedbacks of forest ecosystems to climate change and natural disturbance. The multi-proxy record from the Central Forest State Natural Biosphere Reserve (CFSNBR), located on the South of Valdai Hills, provides important new data on the forest history, human impact, paludification dynamics and environmental changes in the central part of the East European Plain during the Holocene. The results of peat humification, pollen, plant macrofossil, micro charcoal and testate amoeba analyses from forest peatland show that between 7000 and 4000 cal yr BP the southern part of Valdai Hills was occupied by broad-leaved forests. Spruce occurred in forest communities as small admixture and gradually increased its abundance. After 4000 cal yr BP spruce rapidly became the main forest forming species, however broad-leaved trees took place in plant cover. Despite significant climatic fluctuation, mixed broad-leaved-spruce forests persisted in vegetation until 900 cal yr BP and then were replaced by waterlogged herbal spruce forests. The extensive Sphagnum spruce forests are recent plant communities and were formed during the last 100 years that could be explained by changes in water balance of the territory due to both climate and anthropogenic factors.

According to reconstruction of Mid- and Late Holocene climate changes, warm and relatively dry period of the Holocene Thermal Maximum (7000-5500 cal yr BP) was followed by climate cooling that included several relatively cold phases at about 5000, 3500, 2000, 1200 cal yr BP and warm intervals at about 2600, 1500 and 900 cal yr BP. The distinct cooling was reconstructed between 800 and 400 cal yr BP, apparently, correlated with the Little Ice Age. Climate dynamics appeared as significant changes of environmental conditions at local ecosystem. Warming phases are indicated by high peat humification and organic matter content and relatively low peat accumulation rates. Peat deposits pose signs of several fire episodes. During cool and humid phases the rate of vertical and lateral peat growth increased, while degree of peat decomposition became lower. Dramatic changes in environmental conditions in the study area and changes in trends of ecosystem dynamics occurred during the last 400-350 years. The obtained results suggest evident climate warming, significant increase in surface wetness and increase fivefold of peat accumulation rates. During the last hundred years, the local wetness in the studied localities became considerably higher that promoted the growth of Sphagnum mosses and overall transformation of forest stands to Sphagnum spruce forests.

Evidences of significant human impact on the area about 300-250 cal yr BP were detected by indicator species in pollen analysis and reconstructions of woodland coverage by BMA approach. The modern vegetation of the Reserve may develop from a plant cover with mosaic pattern that included not only the mature spruce forests but also secondary birch woodlands, meadows and agricultural lands.

This study was supported by the Russian Science Foundation (Grant 16-17-10045).