Plant communities on fertile soils of drained thermokarst lakes in Western Siberia

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Climate warming and increased precipitation and permafrost thaw in the Arctic are accompanied by an increase in the frequency of a full or partial drainage of thermokarst (thaw) lakes. After lake drainage, abundant plant communities on nutrient-rich sediments may develop, but the specific features of this process remain extremely poorly known across the Arctic. Here, we examine case studies of lake basins located in the continuous permafrost zone of the largest peatland in the world, the Western Siberia Lowland (WSL). We characterize the vegetation and biological productivity of the drained thermokarst lake basins (khasyreys) located in the southern tundra of the WSL. The biological productivity of the khasyreys vegetation is a factor of two to nine higher than that in the surrounding tundra and the khasyreys may provide substantial contribution to observed greening of the northern part of the WSL (65 to 70°N). In the early successional stage, during the first years after the drainage, the seasonally thawed layer has maximal thickness. These wet mesotrophic ecotopes are rich in nutrients. The plant communities are represented by a dense herb layer of a hydrophilic species of sedges, grasses, and cotton grasses, covering 60–70% of the area, whereas mosses cover < 1%. In the mid successional stage, from 50 years after drainage, as plant litter is accumulated, and the nutrients are leached from the soil, the abundance of herbs decreases to 25–40%, the abundance of mosses increases to 40–60%, and the overall productivity of the plant communities decreases. The late stage of the succession khasyreys lasts several hundred years. The ecotopes are characterized by an accumulation of peat, which reaches a thickness of up to 40 cm on the soil surface. Among the vascular plants, which cover between 10% and 60% of the area, the abundance of herbaceous species is minimal, and dwarf shrubs prevail. The moss and lichen have continuous coverage. At this stage, the plant communities consist of mesotrophs and mesoooligotrophs of a very low productivity, and the phytocoenoses are similar to the surrounding polygonal bogs. Overall, the main driving factor of the vegetation succession in the khasyreys is the accumulation of peat on the soil surface and microtopography of the lake bottom. The soil nutrient depletion occurs simultaneously with a decrease in the thickness of the active layer and an increase in the thickness of peat. The succession rate in different parts of the lake bottom varies, depending on the nutrient reserves in the initial sediment, the microlandscape, permafrost aggradation, and the content of redeposited peat.

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