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The Holocene environmental history of the Verkhoyansk Mountains region (northeastern Siberia, Russia) reconstructed from high-resolution pollen data

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The study presented here is part of the IPY project 106 “Lake Records of late Quaternary Climate Variability in northeastern Siberia” and the German Research Foundation project RI 809/17-1,2 “Late Quaternary environmental history of interstadial and interglacial periods in the Arctic reconstructed from bioindicators in permafrost sequences in NE Siberia”. Both projects focus on generating high-resolution vegetation and climate proxy records mainly from lacustrine sediments along a north-south transect from Yakutia, Republic of Russia. This region is known for its climate extremes, with the Verkhoyansk Mountain Range being the coldest area in the Northern Hemisphere – “Pole of Cold”.

Radiocarbon-dated pollen records from Lake Billyakh (65°17’N, 126°47’E; 340 m a.s.l.) located in the central part of the Verkhoyansk Mountains were used to reconstruct vegetation and climate changes. The longest and oldest sediment core from the lake reaches back to >30 kyr BP, thus covering the last two Late Pleistocene Interstadials in Siberia. The pollen record and pollen-based biome reconstruction of the core PG 1756, which covers the last 15 kyr BP, suggest that open cool steppe and grass and sedge tundra communities with Poaceae, Cyperaceae, Artemisia, Chenopodiaceae, Caryophyllaceae and Selaginella rupestris dominated the area from 15 to 13.5 kyr BP. On the other hand, the constant presence of Larix pollen in quantities comparable to today’s values points to the constant presence of boreal deciduous conifer trees in the regional vegetation during the last glaciation. A major spread of shrub tundra communities, including birch (Betula sect. Nanae), alder (Duschekia fruticosa) and willow (Salix) species, is dated to 13.5-12.7 kyr BP, indicating a noticeable increase in precipitation toward the end of the last glaciation, particularly during the Allerød Interstadial. Between 12.7 and 11.4 kyr BP pollen percentages of herbaceous taxa rapidly increased, whereas shrub taxa percentages decreased, suggesting strengthening of the steppe communities associated with the cold and dry Younger Dryas Stadial. However, the pollen data in hand indicate that Younger Dryas climate was less severe than the climate during the earlier interval from 15 to 13.5 kyr BP. The onset of the Holocene is marked in the pollen record by the highest values of shrub and lowest values of herbaceous taxa, suggesting a return of warmer and wetter conditions after 11.4 kyr BP. Percentages of tree taxa increase gradually and reach maximum values after 7 kyr BP, reflecting the spread of boreal cold deciduous and taiga forests in the region. An interval between 7 and 2 kyr BP is noticeable for the highest percentages of Scots pine (Pinus subgen. Diploxylon), spruce (Picea) and fir (Abies) pollen, indicating mid-Holocene spread of boreal forest communities in response to climate amelioration and degradation of the permafrost layer.