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Lake ecosystem response to changes in climate and nutrient cycling during the Holocene at the subarctic treeline in northern Sweden

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A multi-proxy study was carried out on a sediment sequence from Lake Seukokjaure, northern Sweden, spanning the time period since deglaciation (approximately 9700 cal. years BP) to the present. Sedimentary pigments were used to reconstruct ecosystem changes as the pigments represent the phototrophic community that integrate responses of multiple regulation mechanisms of both direct and indirect climate change and nutrient cycling. Stable carbon- and nitrogen-isotope records obtained on bulk organic matter provided knowledge of carbon and nutrient cycling in the lake and valuable insights to the catchment development. These principal proxies were compared to loss-on-ignition, pollen, diatom, chironomid, and inferred lake water TOC using near infrared spectroscopy. The data suggest an evolution of Lake Seukokjaure from a productive lake just after the deglaciation, followed by a general but slight oligotrophication during the Holocene associated with distinct transitions in the phototrophic community. These changes were closely coupled to development of the catchment soil and vegetation, with rapid soil and forest establishment just after deglaciation and subsequent deterioration following the general decline in temperature during the Holocene. The local treeline retreat around 3300 cal. years BP was accompanied by a major shift in several of the investigated proxies, while another major transition around 1800 cal. years BP was likely coupled to altered internal lake structure and favorable conditions for an aquatic moss community. The multitude of data in this study enables identification of major responses and mechanisms controlling the development of subarctic lake ecosystems during the Holocene.