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Freshwater resources are unevenly distributed and remain scarce, comprising < 1% of the Earth's surface. Therefore, fresh waters are among the most vulnerable habitats worldwide. Freshwater biomes are of outstanding global importance to element cycling, productivity, and other ecosystem services, e.g. aesthetic value, recreation, fishing and drinking water supply. Currently, the major threats to global aquatic biodiversity can include both increasing freshwater scarcity due to climate change, and increased anthropogenic pressure (e.g. global population growth, irrigation). In the future, the significance of inland waters and freshwater biodiversity will steadily increase.

Lakes are one of the largest freshwater ecosystems. A total of 304 million lakes occur globally, with the majority of them (ca. 90%) typically being small and shallow. Lakes represent ideal natural laboratories for testing ecological theory concepts (e.g. dispersal, community dynamics, regional productivity, biogeography) by having well-defined borders and containing clearly distinct biota.

The boreal biome contains one of the largest terrestrial carbon pools, and boreal lakes are 'active pipes' for carbon transport, transformation and storage between terrestrial systems and atmosphere, and may act as sinks for organic matter between land and the sea. Why boreal lakes are so unique? They were glaciated for the past 15 000 years, and their relative young age and pristine nature provide 'a glimpse into the past'.

The main focus of my dissertation is the biodiversity, distribution, composition and abundance of pelagic bacteria, protists, aquatic fungi, zooplankton and fish in 75 unpolluted, relatively large lakes of southern Scandinavia. This study is the first to cover an extensive longitudinal gradient (750 km) on a set of boreal lakes carefully selected to be as similar as possible with respect to factors other than local productivity and spatial position. We applied both DNA-metabarcoding and non-molecular methods to explore community ecology and distribution patterns of biota across trophic levels, and related the data to the measured spatial factors and local environment.

Overall, the results revealed that the entire pelagic community structure is affected by both spatial and environmental factors. Our results support the hypothesis that biogeography of freshwater fish reflects historical dispersal limitation, with a pronounced richness-decay westwards, whereas distribution patterns of freshwater bacterioplankton, phytoplankton and zooplankton are less obvious and are not as strongly impacted by historical dispersal limitation as vertebrates.