HIGH LATITUDE LACUSTRINE MICROBIAL BIODIVERSITY IN RESPONSE TO FUTURE CLIMATE CHANGE

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• Microorganisms do have a biogeography …. microbial endemism is real.

There is a long-standing belief that for microbial organisms 'everything is everywhere' but 'the environment selects' and that microbes show weak or absent latitudinal diversity gradients as a result of unlimited dispersal capabilities (the 'Ubiquity Hypothesis'). Using a global freshwater diatom dataset (Fig. 1), we showed that latitudinal gradients in local and regional diatom genus richness are present and highly asymmetric between both hemispheres (Fig. 2). Our results stress the importance of dispersal and migration in structuring diatom communities which is consistent with predictions from metacommunity concepts but refutes the 'Ubiquity Hypothesis'. The apparent endemism found in microbial communities is thus likely to be real, with obvious consequences for conservation under future climate change scenarios and the related migration of (exotic) species.

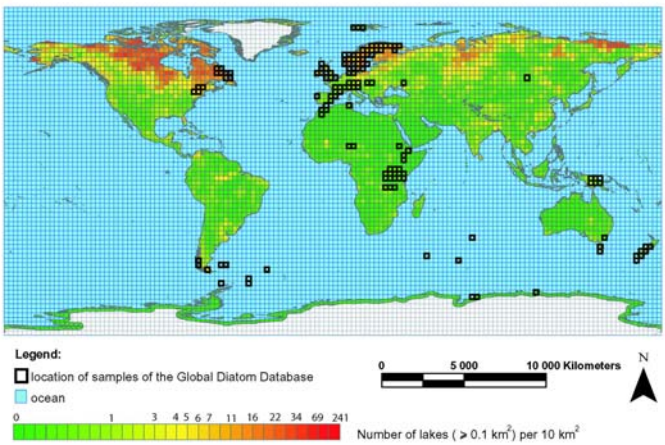

Fig.1: Study regions included in our global diatom database containing nearly 1850 lakes

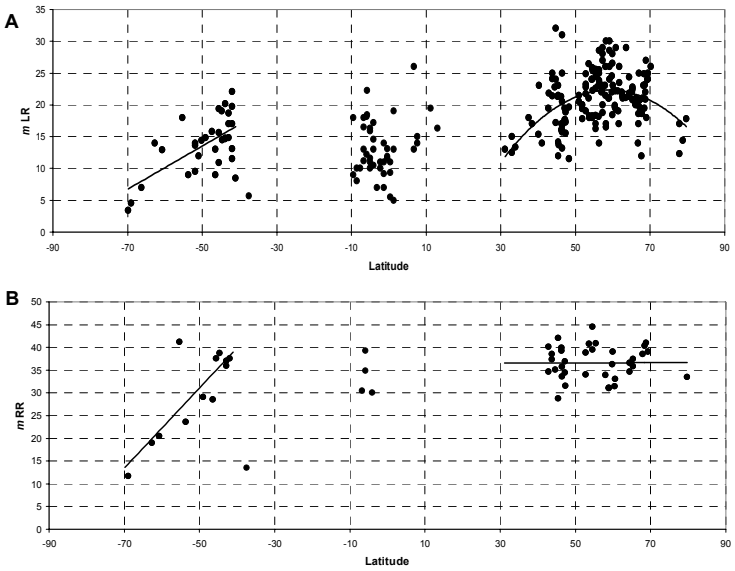

Fig. 2: The interhemispheric asymmetry in mean local (A) and mean regional (B) lacustrine diatom richness. Lakes were grouped into equal sized grids of 100 by 100 km. For regional richness data, only grids containing more than 10 samples were included. Mean local richness (mLR) between 70 and 40°S decreases linearly with latitude in the Southern Hemisphere while in the Northern Hemisphere it shows a hump-shaped relationship with latitude and peaks between 55 and 70°N. Mean Regional richness (mRR) strongly declines with latitude in the Southern Hemisphere, whereas it is virtually flat in the Northern Hemisphere.

… There has been a discernible impact of regional climate change, particularly increases in temperature, on biological systems in the 20th century … (IPCC 'Biodiversity and Climate Change' report, 2002).

• Antarctic (often endemic) microorganisms respond remarkably quickly to climate and concomitant environmental changes

State-of-the-art global circulation models predict that temperature rise will be highest at high latitudes, where ecosystems are particularly sensitive to climate change and direct human activity (pollution, physical damage, introduction of alien species). Monitoring and paleolimnological studies in different parts of the Antarctic revealed that lake water depth, salinity, and nutrient levels already changed drastically during the past decades in response to recent temperature anomalies. Microbial communities, both at the species (Fig.3) and the community level (Fig.4), respond in a remarkably sensitive manner to these environmental changes as assessed using multi-method taxonomic inventories. These communities can be thus used as 'canaries in the coalmine' in the monitoring of changes occurring at high latitudes. From a conservation perspective, further efforts should be devoted to the protection of these often endemic organisms (Fig.5) and their habitats, and to better asses their current biodiversity patterns.

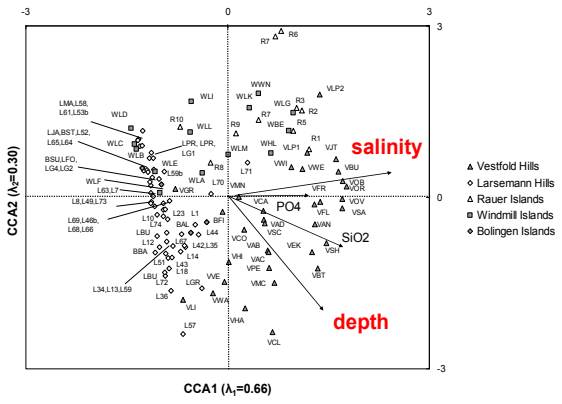

Fig.3: Ordination diagram showing the importance of lake-depth and salinity in constraining lake-diatom communities in five east-Antarctic ice-free regions as assessed using microscopy-based taxonomic inventories.

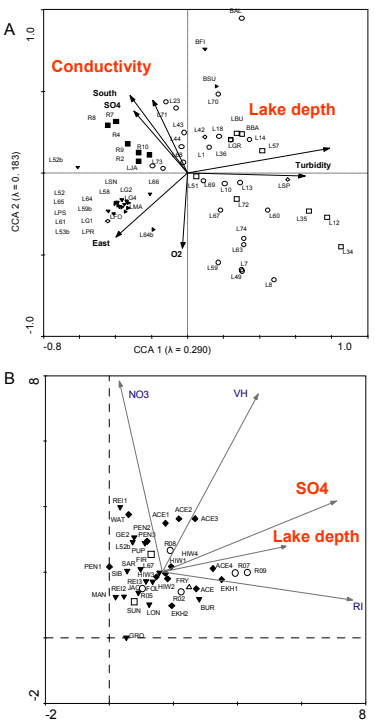

Fig. 4 (left): Ordination diagram showing the importance of (A) lake-depth and conductivity (positively correlated with salinity) in constraining the autotrophic community structure in Antarctic lake as assessed using high performance liquid chromatography of photosynthetic pigments and (B) Sulphate (positively correlated with salinity) and lake depth in constraining the eukaryotic microbial communities as assessed using denaturant gel electrophoresis with universal eukaryotic primers.

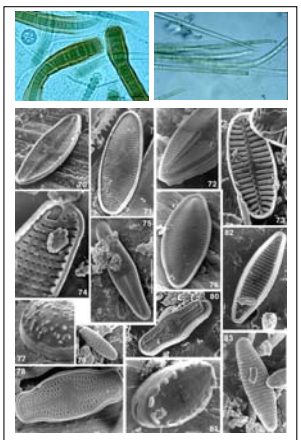

Fig. 5: Pictures of selected (often endemic) microorganisms (cyanobacteria and diatoms) inhabiting east-Antarctic lakes.

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