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Important polar ecosystem could be altered by climate change

Climate change could alter the species diversity of an important type of polar bacterial community, according to laboratory tests. At temperatures similar to those forecasted using current climate warming rates, researchers observed an increase in toxin-producing bacteria that could alter freshwater polar ecosystems.

The Arctic and maritime Antarctic is reported to be experiencing one of the fastest rates of recent climate warming. During the past 50 years, the Antarctic Peninsula has experienced an estimated rise of 0.5ºC per decade. Such increases in temperature are likely to affect polar freshwater ecosystems.

One of the most likely ecosystems to be affected are cyanobacterial mats. Cyanobacteria - also known as blue-green bacteria - obtain their energy from sunlight and primarily occur in mats that grow on the surface or at the bottom of ponds, lakes, streams and ice-melt-water ponds. The mats are important primary producers of feedstock for organisms living on the sea floor and also provide protective cover for large ice-free zones during the polar summer. Cyanobacteria have been reported to produce toxins harmful to plants and animals and it is thought that the production of these toxins is greater at higher temperatures. Changes in climate could therefore influence the species composition of the immediate mat community, as well as polar freshwater ecosystems in general.

The study collected cyanobacterial mat samples from five locations in the Arctic and the Antarctic. The mats were exposed to different temperatures (4ºC, 8ºC 16ºC, 23ºC) over six months and the temperatures were kept constant with as little variation as possible.

The mats exposed to a constant temperature of 8ºC or 16ºC showed high cyanobacterial diversity, and higher concentrations of toxins produced by cyanobacteria. In contrast, mats held at 4ºC and 23ºC seemed low in diversity. This indicates that a moderate shift in temperature from 8 to 16ºC, which could potentially be reached during summer months in polar regions at the present warming rate, could favour toxin-producing cyanobacteria or elevate the levels of toxin produced by pre-existing cyanobacteria. Both of these could profoundly alter freshwater polar ecosystems, perhaps by establishing more competitive species that can withstand the toxins.

Further analysis indicated that some cyanobacterial species dominated at certain temperatures. For example *Phormidium autumnale, Nostocales* and *Leptolyngbya sp.* were almost exclusively found in mats cultured at 8ºC. It should be noted the mat cultures contain several organisms and, as such, other factors may have been influenced by the temperature, for example viral activity, which may have affected the growth of individual cyanobacteria.

Exposing cyanobacterial mats to constant temperatures in the laboratory cannot be directly compared to the warming situation in the Antarctic and Arctic, especially as it is unlikely that temperature will stay constant throughout. However, it does allow an initial assessment of the possible impact of rises in temperature due to climate change. However, the study does not consider the scale and or significance that changes in cynanobacterial mats would have on ecosystems.