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Symbiotic methane-oxidizing bacteria in peat moss: microbial diversity and environmental relevance

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Peat bogs cover only a small area of the Earth's surface, yet store up to 30% of the global terrestrial carbon and are responsible for 10% of the total methane flux to the atmosphere. Aerobic symbiotic methane oxidizing bacteria (methanotrophs) in peat moss (*Sphagnum*) play a vital role in the carbon cycle in peat bogs, reducing methane emissions and providing $CO_2$to *Sphagnum* under submerged conditions, leading to effective *in situ* carbon recycling.

To assess the methanotroph community, we used both genetic and molecular markers. A micro-array, based on the gene encoding the methane oxidizing enzyme, shows a surprisingly high biodiversity in the methanotroph community in *Sphagnum* mosses, including not only type II methanotrophs, which are generally considered to be dominant in peat bogs, but also type I methanotrophs. Furthermore, the methanotrophic community is remarkably similar in *Sphagnum* mosses from different parts of the world. We also used bacteriohopanepolyols (BHPs), bacterial biomarkers, to investigate the relative significance of the different types of methanotrophs. Aminobacteriohopanepentol is highly diagnostic, only being found in type I methanotrophs, while aminobacteriohopanetetrol is only a minor component in type I organisms but more abundant in type II species. We therefore propose that the observed similar abundances of aminotetrol and aminopentol confirm that the methanotrophic community in *Sphagnum* peat must indeed consist of a mixture of both type I and type II methanotrophs.

To determine the influence of environmental factors on the activity of these methanotrophs, potential methane oxidation rates were analyzed for *Sphagnum* from varying water levels. Our results show that these symbiotic methanotrophs are especially active at areas with high water levels. Under these circumstances, the *Sphagnum* layer, containing the symbiotic methanotrophs, prevents up to 90% of the methane emission. Our mesocosm studies indicate that the methanotrophic activity increases with increasing temperature. However, methane oxidation cannot keep up with the rise in methane production at temperatures above 15^{o}C, resulting in a net increase in methane emissions with increasing temperature. Hence, even though methanotrophs significantly reduce methane emissions, peat bogs will act as a positive feedback to global warming.