Rewetting and Drainage of Nutrient-Poor Peatlands Indicated by Specific Bacterial Membrane Fatty Acids and a Repeated Sampling of Stable Isotopes (δ15N, δ13C)

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Peatland degradation impairs soil functions such as carbon storage and the existence of biodiversity hotspots. Therefore, and in view of the ongoing climate change, an efficient method of evaluating peatland hydrology and the success of restoration efforts is needed. To understand the role of microbial groups in biogeochemical cycling, gaseous loss and isotopic fractionation that lead to specific isotopic depth patterns (δ 13 C, δ 15 N), we integrated previously published stable isotope data with a membrane fatty acid (mFA) analysis related to various microbial groups that are known to be common in peatlands. We performed two sampling campaigns to verify the observed stable isotope depth trends in nutrient-poor peatlands in Northern Europe. Cores were taken from adjacent drained (or rewetted) and undrained sites. Fungal-derived mFA abundance was highest in the uppermost part of the drained layer. We found increasing bacterial-derived mFA concentrations with depth peaking in the middle of the drained layers, which correlates with a δ 15 N peak of bulk material. The results support our hypothesis that changing peatland hydrology induce a shift in microbial community and metabolism processes and is therefore also imprinted in stable isotope values. Under waterlogged conditions overall levels of microbial-derived mFAs were generally low. Drained layers showed simultaneous changes in microbial abundance and composition and depth trends in stable isotope bulk values. Bacteria, particularly acidobacteria, can be expected to dominate increased denitrification with low oxygen saturation accompanied by increased δ 15 N bulk values in the remaining substrate. Interestingly, cores from recent rewetted peatlands show no depth trend of δ 15 N in the layers grown under rewetting conditions; this is congruent with relatively low concentrations of microbial-derived mFAs. Hence, we conclude that stable isotopes, especially δ 15 N values, reflect changing microbial metabolic processes, which differ between drained and undrained - and especially also for recent rewetted-peatlands. As today stable isotope measurements are routine measurements, these findings enable us to get cost- and time efficient reliable information of drainage and restoration success.

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