AMMONIA OXIDIZING ARCHAEA AND BACTERIA RESPOND DYNAMICALLY TO DROUGHT IN REWETTED FEN PEATLANDS

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The impact of drought on ammonia oxidizing microbes in peatlands remains unclear, despite their role as a rate-limiting step in nitrification and the increasing prevalence of drought in the future. This study aims to identify trends in archaeal and bacterial ammonia oxidizer abundances and their feedbacks to drought in two rewetted fens in northeastern Germany, namely a percolation fen (PW) and a coastal fen (CW). We used an unsupervised k-means clustering algorithm to define drought conditions based on water table depth. Ammonia oxidizing archaea (AOA) and bacteria (AOB) abundances are quantified via *amoA* gene copies with (RT-) qPCR from the peat soil at time points throughout the drought cycle. These results are supported by metatranscriptome analysis and phylogenetic-based clade assignment of AOA amplicon sequences. Shifts in nitrifying communities were found to correlate with overall site hydrological stability, with AOB outnumbering AOA at both sites. At drought onset, there was a decrease in nitrogen fixation genes in the PW metatranscriptome. Simultaneously, there was an increase in quantified and SSU RNA of AOA and AOB. Towards the end of the drought cycle in October, there was an increase in the SSU RNA copies of assimilatory nitrate reduction to ammonium (ANRA) associated genes and a decrease in AOA and AOB. In contrast, CW AOA and AOB did not respond dynamically to drought; neither did nitrogen-cycling SSU RNA genes in this site. There was also a higher AOA clade diversity in PW (4 clades across 3 species) compared to CW (exclusively *Ca. Nitrosotaleales* clade Alpha). Our results suggest that ammonia oxidizers respond significantly to drought, corresponding to dynamic shifts in nitrogen cycling gene transcription following a decrease in nitrogen fixation. As such extreme weather events occur more frequently, they will likely play pivotal roles in rewetted fens’ ecosystem functioning in a changing climate.

**Keywords:** Rewetted fens; ammonia oxidizing archaea; ammonia oxidizing bacteria; RNA; summer drought; nitrogen cycling