

Long-term grassland management effects on soil Phosphorus status on rewetted Histosols

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Since the Neolithic Period, the cultivation of wetlands has played a significant role for the settlement of Humans northwest Germany. A continuing drainage of the wetlands over the centuries and an intensified soil cultivation during the last decades has caused irreversible peat degradation and led to fundamental changes in the landscape. Nowadays, almost 70 % of the 4345 km² peatland of Lower Saxony is altered by agriculture. For the revitalization of wetland ecosystems, permanent rewetting is an integral component to preserve the functions of organic soils and achieve resilient, speciesrich wetlands. However, permanent rewetting measures are not always feasible. In our study area at the Osterfeiner Moor, a fen located in the Dümmer lowlands near Osnabrück, intensive forage cropping areas were converted into extensive permanent grasslands accompanied by temporary rewetting during winter. This management practice combined with zero fertilization and a low mowing and grazing intensity aims at mitigating mineralisation of peat layers and creating a habitat for endangered meadow bird species.

In this semi-natural ecosystem soil phosphorus (P) dynamics play a crucial role. However, longterm research results on P availability of degraded and rewetted fens are still lacking. Thus, we investigated the interaction of different grassland uses and P dynamics in the soil. We described P depletion of the topsoil over a time scale of 17 years after the implementation of restoration measures. Our study site comprises of 180 ha protected grassland divided into 52 management plots. According to the management system, we divided the plots into meadows, pastures and combinations of cutting and grazing. The soils in our study area can be characterised as drained organic soils, WRB: Rheic Sapric Histosols (Drainic), with drastic degradation properties through moorsh forming processes. Plant-available P (double lactate extraction method: P_{DL}) was analysed from representative topsoil samples (0-10 cm) from all fields.

During the first four years of extensive grassland use, changes in P_{DL} were negligible. Values of P_{DL} reached an arithmetic mean of about 70 mg l⁻¹, while in the last 13 years, mean P_{DL} decreased to less than 44 mg l⁻¹. Changes in P_{DL} status in soil were significantly depending on time and type of grassland management. After 17 years we found highest P_{DL} concentrations in the soil in pastures (44 mg l⁻¹) while meadow grassland had a lower P_{DL} concentration of 23 mg l⁻¹. Fields with a combination of cutting and grazing had a P_{DL} concentration of 36 mg l⁻¹.

Generally, on grazed fields, the majority of nutrients returns to the soil through excrements. Therefore, on permanent pastures, even with no fertiliser applications or feeding supplements to the grazing livestock, concentrations of P_{DL} in the soil will only slowly decline. On the other hand, nutrient flux via biomass production on meadows cause stronger depletion of P_{DL} in the longterm. These results have consequences for nutrient management of extensive grassland on rewetted fens in practice and in turn has an effect on botanical composition, feed quality and on the abundance of soil fauna.