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Habitat management affects soil chemistry and allochthonous organic inputs mediating microbial structure and exo-enzyme activity in Wadden Sea salt-marsh soils

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The Wadden Sea (WS) region is Europe's largest wetland and home to approximately 20% of its salt marsh area. Mainland salt marshes of the WS are anthropogenically influenced systems and have traditionally been used for livestock grazing in wide parts. After foundation of WS National Parks in the late 1980s and early 1990s, artificial drainage has been abandoned; however, livestock grazing is still common in many areas of the National Parks and is under ongoing discussion as a habitat-management practice. While studies so far focused on effects of livestock grazing on biodiversity, little is known about how biogeochemical processes, element cycling, and particularly carbon sequestration are affected. Here, we present data from a recent field study focusing on grazing effects on soil properties, microbial exo-enzyme activity, microbial abundance and structure. Exo-enzyme activity was studied conducting digestive enzyme assays for various enzymes involved in C- and N cycling. Microbial abundance and structure was assessed measuring specific gene abundance of fungi and bacteria using quantitative PCR. Soil compaction induced by grazing led to higher bulk density and decreases in soil redox (Δ >100 mV). Soil pH was significantly lower in grazed parts. Further, the proportion of allochthonous organic matter (marine input) was significantly smaller in grazed vs. ungrazed sites, likely caused by a higher sediment trapping capacity of the taller vegetation in the ungrazed sites. Grazing induced changes in bulk density, pH and redox resulted in reduced activity of enzymes involved in microbial C acquisition; however, there was no grazing effect on enzymes involved in N acquisition. While changes in pH, bulk density or redox did not affect microbial abundance and structure, the relative amount of marine organic matter significantly reduced the relative abundance of fungi (F:B ratio). We conclude that livestock grazing directly affects microbial exo-enzyme activity, thus slowing down C turnover, and indirectly changes microbial structure, namely relative fungal abundance, by reducing high-quality marine organic matter inputs.