



Litter Quality Drives Decomposition and Prokaryotic Communities in Estuarine Marsh Soils

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Climate change-induced sea-level rise and saltwater intrusion are expected to significantly influence carbon cycling in estuarine marshes by affecting microbial litter decomposition. However, the extent and mechanisms of these changes remain unclear. In this study, we investigated the impacts of litter quality and environmental conditions on litter decomposition and prokaryotic communities in an estuarine environment. We incubated both native and standardized litter (Tea Bag Index) in soils representative of various marsh types (freshwater, brackish, and salt) and different flooding frequencies (daily, monthly, and yearly) along the Elbe Estuary. The prokaryotic communities colonizing the litter and soil were characterized through 16S rRNA gene amplicon sequencing. Our findings indicate that litter quality plays a crucial role in litter decomposition along estuarine gradients. The decomposition of native litter increased with higher salinity and reduced flooding frequency, primarily influenced by the chemical properties of the litter, particularly lignin content and the lignin:N ratio. Conversely, the decomposition of tea litter decreased as salinity increased, suggesting that rising salinity creates unfavorable conditions for decomposition. The effects of flooding varied depending on litter quality: mass loss of recalcitrant litter (rooibos tea) diminished with more frequent flooding, while mass loss of labile litter (green tea) increased. Prokaryotic communities in both native and tea litter exhibited distinct assemblages and lower diversity compared to the local soil community, indicating selective colonization of the litter, which was especially evident for tea litter. Furthermore, tea mass loss was enhanced by a diverse soil prokaryotic community, whereas the decomposition of native litter seemed to be driven by an adapted soil prokaryotic community. Our results underscore the influence of biotic factors (litter quality and prokaryotic communities) and abiotic factors (salinity and flooding) on litter decomposition in estuarine ecosystems, suggesting that anticipated changes in salinity and hydrodynamics due to climate change could substantially alter decomposition dynamics in these environments.