Abstract

Coastal zones play an important role in the exchange of carbon and nutrients between the land and the open ocean, and typically comprise a mosaic of benthic habitats harbouring diverse faunal and plant communities. Seagrasses are the only vascular plants adapted to live in fully marine environments, and their presence in coastal habitats is associated with key ecosystem services. Most notably, seagrasses establish productive meadows in oligotrophic environments, thereby providing habitats for metabolically active and diverse benthic communities. Remarkable aspects of seagrass ecosystems include their impressive organic carbon binding capacity (blue carbon) and nutrient recycling efficiency. However, a recent surge in seagrass research and advances in the conceptual knowledge of coastal biogeochemistry have revealed a greater complexity of seagrass ecosystems than previously thought. In particular, there is growing consensus for better exploring the effects of site- and species-specific characteristics on seagrass biogeochemistry, rather than making generalized claims regarding their potential role as a sink or source for carbon and nutrients.

The aim of this thesis is to fill some of the crucial knowledge gaps on carbon and nitrogen cycling in seagrass ecosystems. The first component of this research investigated the effects of wave-induced sediment resuspension on benthic metabolism and carbon turnover of a temperate seagrass meadow (Finland). Resuspension largely stimulated reoxidation processes thus directly (instantaneous), and indirectly (following days), influencing benthic metabolism. These findings highlight the importance of accounting for the natural occurrence of resuspension events when assessing the carbon turnover in seagrass ecosystems. The second study investigated the influence of potent greenhouse gas (CH_4 and N_2O) evasion on seagrass blue carbon potential. Evasion of CH_4 and N_2O substantially offset seagrass blue carbon potential at the subtropical study site (Wallis Lake, Australia), thereby highlighting the importance of accounting for CH_4 and N_2O cycling in future seagrass blue carbon assessments. The third study targeted site- and species-specific effects on benthic nitrification and denitrification in the seagrass rhizosphere. The results indicated that coupled nitrification-denitrification, a key process in the removal of fixed nitrogen from the oceans, can be largely stimulated by seagrass species with large biomass, provided nitrogen is not rapidly immobilized. This research prompts to assess local hydrodynamic and benthic community characteristics to critically resolve carbon and nutrient cycling in seagrass ecosystems.