Denitrification and Microbial Processes in Dredge Material Created Wetlands

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Louisiana's coastal wetlands are rapidly disappearing due to a combination of subsidence, sea level rise, and lack of sediment input. These marshes provide many valuable ecosystem services, including improvement of water quality via nitrate removal, where soil microbes convert bioavailable NO3 to gaseous forms under anaerobic conditions. Artificial marsh creation is one restoration strategy being used to combat these losses. As a relatively new strategy, little is known about the long-term success of created marshes in terms of the trajectory of ecosystem services. This study investigated the impacts of marsh creation on biogeochemical cycling in a brackish marsh on the north shore of the Lake Pontchartrain estuary in Lacombe, Louisiana. Cores were collected from two types of created marsh: a confined marsh surrounded by containment dikes and an unconfined marsh where dredged sediment was allowed to flow freely. An adjacent natural marsh was used as a control. Samples were also analyzed for general soil characteristics, including bulk density, moisture content, organic matter, total N, total C, total P, inorganic P, and microbial biomass N. Intact 10 cm cores underwent a seven-day incubation after the water column was spiked to 2 mg L-1 N to measure the nitrate removal rate. The denitrification rate was not found to be significantly different between the confined marsh (43.7±15.2 mg N m-2 d-1), unconfined marsh (53.9±19 mg N m-2 d-1), and natural marsh (65.0±39.6 mg N m-2 d-1). Additionally, there was no significant difference found in important indicators of biogeochemical cycling, including organic matter, total carbon, and microbial biomass N, between the confined and natural marshes, although all were lower in the unconfined created marsh. These results indicate that the water quality function of newly created marshes is quick to develop, despite the longer timeframe necessary for the accumulation of organic carbon. Overall, dredge material created marshes appear to be as effective at nitrate removal as their natural counterparts, making this a viable restoration strategy for mitigating water quality concerns.