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Tidal Suppression Negatively Affects Soil Properties and Productivity of *Spartina densiflora* Salt Marsh ☆

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ABSTRACT

In order to intensify cattle utilization, embankments were constructed to avoid tidal ingressions in Samborombon Bay, Argentina, The objective of this study was to evaluate the effect of tidal suppression and cutting frequency of a salt marsh dominated by *Spartina densiflora Brongn*. Two paddocks of a commercial cow-calf operation farm, one prevented from tidal flooding and another exposed to overflow from natural tidal pattern (control), were the main plots of the nested design. The experiments were carried out during a dry (2008- 2009) and a wet growing season (2012-2013). Two defoliation frequencies, simulating light and moderate grazing pressure, were performed in the subplots nested within each main plot. Soil organic matter and N content were lower and soil structural instability index was much higher in the embankment than in the control treatment. Soil salinity during the dry growing season was higher in the embankment than in the control treatment. Bare soil was higher under embankment treatment and high defoliation frequency exacerbated this response. Relative contribution of *Spartina densiflora* was lower under embankment than control treatment and the changes of floristic composition depended on the growing season. Aboveground net primary production (ANPP) in the wet growing season was almost 70% higher than in the dry growing season. Embankment reduced ANPP and high defoliation increased ANPP with respect to low defoliation frequency in the control paddock, to a much higher extent in the wet season. Dry matter digestibility of *S. densiflora* was not affected by treatments. Crude protein was higher in control paddocks under high frequency. Our results showed that tidal suppression by embankment was not effective to increase productivity and forage value of *S. densiflora* saltmarsh but caused soil and structural changes that may negatively alter ecosystem processes of this vulnerable grassland of high importance for biodiversity conservation.

Introduction

Salt marshes are intertidal grasslands characterized by low species diversity but high primary and secondary production, which provide a high number of valuable benefits to humans, such as the provision of raw materials and food, coastal protection, erosion control, water purification, and carbon sequestration (Barbier et al., 2011). Both the structure and function of salt marsh plant communities are shaped by physical factors such as elevation, salinity, flooding, and nutrient availability (Mitsch and Gosselink, 2008), as well as by biotic processes, such as competition and facilitation among plants (Bertness, 1991; Hacker and Bertness, 1995) and trophic cascades driven by invertebrate grazers (Bortolus and Iribarne, 1999; Silliman and Bortolus, 2003; Silliman et al., 2005).

Salt marshes of the Northern Hemisphere have a long history of grazing by domestic animals and other management techniques (Doody, 2008). Among these techniques, the erection of embankments that completely exclude tidal flooding has been widely applied since the sixteenth century in order to extend the period of grazing all year round or for agricultural use (Dent et al., 1976; Bakker et al., 2002; Doody, 2008). It is broadly demonstrated that cattle and sheep grazing changes species composition, decreases the contribution of dominant species, and may increase bare soil at higher stocking rates (Bakker et al., 1985; Andresen et al., 1990; Bouchard et al., 2003; Kleyer et al., 2003). On the contrary, in South American salt marshes, grazing by domestic herbivores is quite recent and, consequently, the study of grazing effects is scarce and focused on native small herbivores (Jackson and Giulietti, 1988; Bortolus and Iribarne, 1999; Cardoni et al., 2007; Vila et al., 2008). Recent information about cattle grazing on *Spartina densiflora* salt marshes of Argentina

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