

Resilience and degradation in a tropical wetland overgrazed by cattle

Sandra A Santos^A, Humberto L Perotto-Baldivieso^B and Dylan Young^B

^A Embrapa Pantanal, Corumbá, MS, Brazil

^B Department of Environmental Science and Technology, Cranfield University, Cranfield MK43 0AL, UK

Contact email: sandra.santos@embrapa.br

Keywords: Natural pastures, state-and-transition-model, thresholds, vegetation monitoring, indicators

Introduction

The Pantanal, one of the largest wetlands in the world, is highly valued for its diversity of flora and fauna, and the dynamic hydrological regime, combined with heterogeneous topography, has resulted in a mosaic of diverse habitats types in terms of species and physical structure. However, the Pantanal floodplains are also important for beef cattle production due to the abundance of forage resources. Cattle prefer grazing near water bodies because these areas have high quality forage as a result of flooding regimes (Santos *et al.* 2002). Many wetlands go through a wet/dry cycle that is essential to maintain their productivity and function. In drier years, wetland drawdown provides optimal conditions for a diverse range of forage species, and in these conditions cattle can graze continuously leading to pasture degradation. It is therefore essential to understand the spatial and temporal dynamics of forage production and consumption.

In this study we assessed and monitored vegetation, from long-term permanent plots located at the edge of one of the pond habitats intensively grazed by cattle, in order to evaluate degradation and quantify indicators of resilience (Briske *et al.* 2006).

Methods

To evaluate the effect of overgrazing during these periods, 25 plots of 0.25 m² were randomly selected at 10 m intervals along a permanent transect of 250 m situated on the edge of a wetland pond at a constant elevation. Measurements were taken at the end of the wet season (March) and dry season (September) in each plot during three hydrological years (2007-2010). Variables measured within each plot were: number of plant species (richness); visual estimate of percent live plant species cover; visual estimate of percent soil cover with plants, litter and gravel; mean plant height (cm) and total dry matter yield (DM). We also developed a state and transition model using plant functional groups (Fig. 1). Plant cover was classified as: C3 and C4 grasses (%), invasive forbs plant (%), macrophytes-forbs (%), exotic forages (%) and shrub cover (%). To determine the loss of grassland resilience we estimated a threshold between forage cover (functional indicator) and invasive forbs cover (degradation and structural indicator) (López *et al.* (2011) using piecewise regression (Muggeo 2008). Temporary exclosure cages (1m²) were allocated along a transect in order to examine recovery of forage cover for at least one complete cycle of growth.

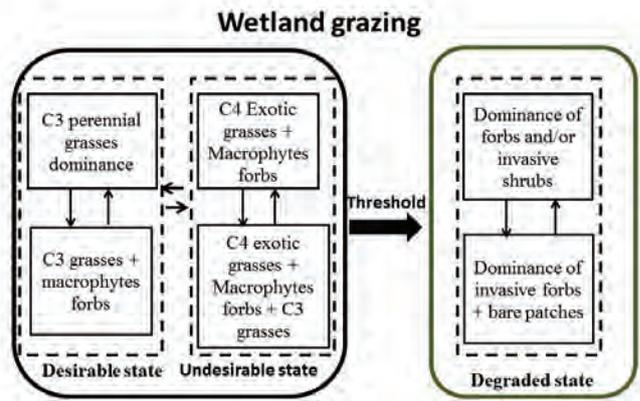


Figure 1 - State and transition model for wetland grazing areas using plant functional groups

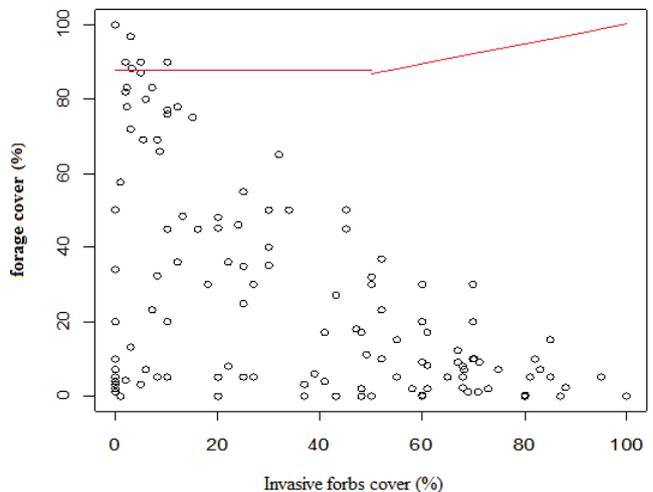


Figure 2 - Relationship between forage cover (%) and invasive forbs cover (%) in a wetland grassland showing the position of the functional threshold identified by piecewise regression.

Results

During the study period we identified and monitored 40 plant species that decreased whilst invasive forbs increased. Piecewise regression of forage cover and invasive forbs cover identified a breakpoint at ~50% invasive forbs cover indicating a loss of function in relation to forage production (Fig. 2).

This loss of resilience for forage production can be observed in one of the exclosure cages set up in sites with

invasive forbs cover over 70% and around 10% forage cover. The values for forage cover after six months, one year and two years of rest were 5%, 3% and 2%, respectively.

Conclusion

As a result of overgrazing during drier years, perennial grasses were replaced by invasive forbs. Therefore, the main challenge in relation to sustainable management of these wetland areas is to identify grazing thresholds to avoid severe disturbances and subsequent loss of resilience. As such, invasive forbs cover can be used an early warning indicator of habitat degradation.

References

- Briske DD, Fuhlendorf SD, Smeins FE (2006) A unified framework for assessment and application of ecological thresholds. *Rangeland Ecology and Management* **59**, 225-236.
- Muggeo VMR (2008) Segmented: and R package to fit regression models with broken-line relationships. pp. 20-25 (R News).
- Santos SA, Costa C, Souza GS, Moraes, AS, Arrigoni, MB (2002) Qualidade da dieta selecionada por bovinos no Pantanal da sub-região da Nhecolândia. *Revista Brasileira de Zootecnia* **31**, 1663-1673.
- López DR, Cavallero L, Brizuela MA, Aguiar MR (2011) Ecosystemic structural approach of the state and transition model. *Applied Vegetation Science*. **14**, 6-16.