



Forests, shrublands and grasslands in southern Brazil are neglected and have specific needs for their conservation. Reply to Overbeck et al.

In their reply to our policy forum paper on the conservation of forest-grassland mosaics in southern Brazil (Luza et al., 2014), Overbeck et al. (2016) commented on several points in which they agree or disagree with our ideas. We thank them for moving this important discussion along. It is great to note that Overbeck et al. (2016) agree that different habitat types have specific needs for their spatial and temporal maintenance. The continuation of this discussion should enable us to improve the conservation of forests, shrublands and grasslands within mosaics. Here we bring some points not discussed yet, with special focus to forests and shrublands in southern Brazil. We present several observations done in forests-grassland mosaics in the past decade, which are either published or deserve attention in future studies.

Forests and grasslands differ in their needs for conservation (Luza et al., 2014; Overbeck et al., 2016). On one hand, grasslands depend on disturbances such as grazing and burning to persist in southern Brazil (Overbeck et al., 2016), a region under climate changes that increasingly favor forest expansion (Anadón et al., 2014). On the other hand, in southern Brazil, forests may persist in landscapes managed with fire and grazing, but the health of these forests in terms of conservation value has not been evaluated yet. Overbeck et al. (2016) well pointed that it is important to identify conservation targets considering the differences between the conservation of wilderness areas and areas under different management regimes. The former permits the conservation of animal and plants sensitive to human activities, e.g. those depending on shrublands that develop in southern Brazil when burning is not frequent, while the latter enables to conserve open ecosystems by maintaining anthropogenic disturbances. We consider that both targets are important and can be implemented under different circumstances in southern Brazil. Naturally, to conserve forests, shrublands, and grasslands in mosaics with different land uses, we have first to identify the specific conservation needs of these habitat types.

Indeed, the conservation of non-forest ecosystems like grasslands and savannas is neglected (Overbeck et al., 2007, 2015), and we applaud those who have brought attention to how important is conserving open ecosystems. However, we emphasize that forest conservation is neglected as well. While grasslands and savannas currently face rapid conversion of large areas for agriculture (Overbeck et al., 2015), forests have already lost most of their original area in southern and south-eastern Brazil (for timber production, croplands and ranching) many decades ago (Koch and Corrêa, 2002; Victor et al., 2005; Ribeiro et al., 2009). For instance, more forests were lost than

grasslands in Rio Grande do Sul state (RS). Using data from Cordeiro and Hasenack (2009), we observe that 83% of the original area of forests and 51% of the original area of grasslands were lost in the state until 2002. Of course, we hope grasslands do not reach the forest losses.

Forests are not necessarily well conserved in southern Brazil. Overbeck et al. (2016) argued that “forests in the region (...) are much better protected, outside of and within conservation units”. Forests have not only lost most of its original area, but are also poorly conserved in most places. As mentioned by Overbeck et al. (2016), forests may be subject to disturbances by cattle, deforestation, and selective logging. Moreover, forests face the consequences of fragmentation, defaunation, and impacts by invasive species such as the wild boar (*Sus scrofa*; Pedrosa et al., 2015). The impact made by domestic cattle in forests date back to the arrival of Europeans ca. 300 years ago (Behling et al., 2009) and still persists in most of the forests neighboring grasslands, both outside and within protected areas. A minor proportion of grasslands are in protected areas (Overbeck et al., 2007). The protected areas for sustainable use permit traditional management with cattle ranching, and most strictly protected areas have former landowners still using lands within the protected area as farms. Therefore, cattle have free access to most of the forest interiors in mosaics in southern Brazil. When looked from outside, these forests may give the false impression that they are healthy. It is common to see an apparent closed forest from the outside that actually is a forest lacking a rich and complex juvenile plant community when one enters it (Fig. 1).

The cattle use the forest and obviously benefit from it by drinking water, taking shelter from storms, and foraging. In the winter, when most of the native grassland foliage is dry, the cattle feed on large amounts of tree juveniles in the forest. Considering that the cattle avoid unpalatable, toxic and thorny plants, these are the very plants that remain after the winter. In the Pampas, most forest understories are dominated by the toxic shrub *Daphnopsis racemosa* and thorny species such as those of the genus *Xylosma* spp. (unpubl. data). Furthermore, in *Araucaria* mixed forests, domestic cattle and pigs eat (and predate) large amounts of *Araucaria angustifolia* seeds, possibly affecting the dynamics of *Araucaria* populations and the native fauna that depends on this unique food resource during the winter (Shepherd and Ditgen, 2005; Iob, 2007).

The protection of forest-grassland mosaics and their high biodiversity calls for an integrated view of conservation (Luza et al., 2014). In such a view, it is important to note that many plant and animal species rely on different habitat types, that



Fig. 1 – The cattle impact forests in southern Brazil by trampling and feeding on tree juveniles, especially in the cold months of the year, when the grassland is not so productive. (Left) A forest interior with free access of cattle in the Pampa (Encruzilhada do Sul, RS). (Right) A forest protected from the cattle for 20 years in the Southern Brazilian Plateau (CPCN Pró-Mata/PUCRS, RS), presenting a bunch of juveniles in several stages of tree recruitment toward the canopy.

is, they depend on the existence of a mosaic to maintain their populations. Some animals depend on the coexistence of forests and grasslands to forage and reproduce (Maragno et al., 2013). The populations of several tree species seem to be structured according to forest expansion over grassland. If this is true, then several species may depend on the areas of forest advancement to persist. Indeed, Hartz et al. (2012) found that, during the summer, several migratory bird species rely on fruits of pioneer tree species occurring in the mosaics of southern Brazil, potentially playing an important role in carrying seeds from the forest interiors to open sites. This finding indicated that the forest-grassland dynamics is also important to maintain ecosystem services in other regions of the country.

It is important to re-emphasize that we do not suggest exclusion of fire in grasslands. In southern Brazil, most grasslands are in private areas and, as pointed by Overbeck et al. (2016), there is legal regulation of fires both within and outside protected areas. However, an important point is missing in this discussion: native areas are reducing rapidly, and the impacts of disturbances will become increasingly strong relative to the total remaining area of natural mosaics. If less than 0.5% of the southern Brazilian grasslands are included in strictly protected areas (Overbeck et al., 2007), what is the reason to subject the landscape therein to a similar management that is already done in the rest of the grasslands? Of course, management to avoid strong fires is essential, so that the maintenance of major firebreaks or other mechanisms to avoid excessive biomass accumulation should be used to avoid uncontrollable fires. Nevertheless, we have to remember that strictly protected areas, e.g. national parks, constitute unique and small remnant areas where the natural process of forest expansion and shrub encroachment may still take place (Luza et al., 2014). These more wild mosaics provide habitats to animals typical of grasslands and shrublands whose populations have strongly declined or even gone regionally extinct in the course of the last centuries (e.g. black-maned wolves, deers, peccaries, tapirs, anteaters). We consider essential to have at

least some areas where climate changes influences over vegetation may take its natural course with the minimum possible direct human interference.

We agree with Overbeck et al. (2016) that it is challenging to include the role of disturbances into conservation strategies. For this, it is important to consider the requirements of different habitats in terms of management, and the goals of the land under management. Different categories of protected areas have different aims and specific management regulation for different habitat types. Management decisions are possibly the point that deserves more discussion among people with varying perspectives on the conservation of mosaics. What should we choose to conserve in a national park for example? This kind of question should be more widely and openly debated. Moreover, due to the high rates of land conversion and degradation of grasslands outside protected areas in S Brazil (Andrade et al., 2015), new protected areas urge to be created in non-forest ecosystems (Overbeck et al., 2015). We re-emphasize that these new areas should be created within the categories of sustainable use of the SNUC (Law 9985, July 18th 2000, Brazil – http://www.planalto.gov.br/ccivil_03/leis/L9985.htm), thereby maintaining traditional cattle ranching activities that enable the conservation of grasslands.

In this commentary, we emphasized that forests and shrublands must be protected from cattle and other disturbances. We have a lot to advance in the understanding of forest-grassland dynamics and the interdependency of different habitat types, but we do have urgency to identify and apply the specific needs of these habitats for their conservation and coexistence within mosaics. Therefore, we argue it is time to work together on a conservation agenda that includes these different needs of conservation. By doing so, we believe that in a near future we can influence why, where, when and how we will conserve forests, shrublands and grasslands within mosaics in southern Brazil.

Conflicts of interest

The authors declare no conflicts of interest.

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