ABECO
ASSOCIAÇÃO BRASILEIRA DE CIÊNCIA ECOLÓGICA E CONSERVAÇÃO

Natureza & Conservação
Brazilian Journal of Nature Conservation
Supported by Boticário Group Foundation for Nature Protection
http://www.naturezaeconservacao.com.br

Correspondence

Conservation of mosaics calls for a perspective that considers all types of mosaic-patches. Reply to Luza et al.

Landscapes composed of different types of ecosystems can have especially high levels of biodiversity. Biodiversity conservation at the landscape level critically depends on maintenance of the biodiversity in the different types of habitat present, that is, on the conservation of habitat mosaics. We thank Luza et al. (2014) for having started a debate on this topic, specifically on the forest-grassland mosaics in southern Brazil. However, we feel that the perspective offered by Luza et al. – in spite of the title of their paper – needs to be developed further, as implementation of their recommendations brings the risk of biodiversity losses, particularly in protected areas. The challenge for conservation is to adequately consider the distinct ecological properties of the different habitat types of a forest-grassland mosaic in a management concept.

Like grasslands in many other tropical and subtropical regions in the world (Bond and Parr, 2010; Parr et al., 2014; Veldman et al., 2015), grasslands in southern Brazil have been neglected in conservation and are threatened by conversion to other land uses (Overbeck et al., 2007, 2015). Further, within Brazilian conservation units, grassland biodiversity is at risk due to the lack of proper management strategies (Pillar and Vélez-Martin, 2010). Forests in the region, in contrast, are much better protected, outside of and within conservation units, even though they may be subjected to disturbances, e.g. by cattle or illegal deforestation or extraction. Even though Brazil's main conservation law encompasses the protection of all kinds of native vegetation, it is still often misnamed as "Forest Code' (Brancalion et al., 2016) and a bias towards the protection of forest continues in its enforcement (Overbeck et al., 2015). Therefore, grasslands and their biodiversity at current are at much higher risk than forests. As stated by Luza et al., 'strategies reconciling the temporal and spatial maintenance of high biodiversity levels in forest-grassland mosaics of Campos Sulinos', and in our opinion specifically for the grassland parts, are indeed urgently needed. Here, we comment on specific points in their argumentation and suggest further steps regarding conservation strategies for forest-grassland-mosaics.

Luza et al. state that 'disturbance levels evenly distributed across the landscape are likely to decrease regional levels of diversity'. We do not agree with this argument for two reasons: (1) the argument on distribution of disturbances is no description of any real-world situation and (2) disturbances do not necessarily decrease diversity, especially on a regional level and across different types of ecosystems. The challenge is to include the role of disturbances into management activities and conservation strategies.

Disturbances are not evenly distributed across the landscape in the region used by Luza et al. as example; they likely were never evenly distributed and even more likely never will be. The disturbances they refer to, fire and grazing, occur primarily in grasslands, not in forests. Depending on grassland management practices, grazing animals may enter forests and then can indeed impede regeneration of forest species, and fire may, depending on specific weather conditions, enter a few metres into a forest. But there is no evidence that these disturbances cause replacement of forest by grassland vegetation in the region. They do, however, impede advancement of forests over grassland, which means that they are, indeed, the very reason for the occurrence of present forest-grassland mosaics. Current theory has it that in the absence of fire and grazing, woody species increase in cover in grassland and that forests species would colonize grassland areas. This has been shown for areas where disturbance has been excluded (Oliveira and Pillar, 2004) as well as predicted by vegetation modelling (Blanco et al., 2014), and corresponds to the phenomenon of shrub encroachment observed in grasslands around the world. When Luza et al. call for 'efficient fire control' in protected areas (we assume they mean areas without cattle grazing) they thus accept that grasslands will,

DOI of original article: http://dx.doi.org/10.1016/j.ncon.2014.09.005.

over the course of several decades, if not centuries, be substituted by forest vegetation. This means that forest-grassland mosaics will, on the long run, be replaced by forest landscapes in these protected areas. Clearly, this means loss of the grassland biodiversity and, with this, of regional biodiversity. As land conversion and degradation rates outside of protected areas in southern Brazil currently are high (e.g. Andrade et al., 2015), this could ultimately mean, in the lack of more efficient conservation mechanisms for grassland on a regional scale, an almost complete loss of grassland ecosystems and their species over large areas.

A wealth of literature is available that shows the importance of disturbances for creating habitat heterogeneity for different species groups in grassland systems (Harrison et al., 2003; Fuhlendorf et al., 2006), even though we do recognize that generalizations of the 'habitat heterogeneity hypothesis' must be made with due caution (Tews et al., 2004). A first step towards a comprehensive strategy for biodiversity conservation in forest-grassland-mosaics is the recognition that different types of ecosystems should have different conservation strategies, simply due to their distinct ecological properties (Veldman et al., 2015). In fact, the statement by Luza et al. that 'anthropogenic disturbance prevents the occurrence of tussock and shrub strata' is an oversimplification that is not true, in particular, for the highland grassland region of southern Brazil, which is their example region. Grasslands under intermediate levels of disturbances (by fire or grazing) are those that maintain the highest level of plant and structural diversity (Overbeck et al., 2005; Nabinger et al., 2009). The very fact that tussock grasses dominate grasslands in the region is the consequence of a history of burning, as tussock grasses (as opposed to prostate grasses with longer rhizomes or stolons) are adapted to this kind of disturbance. Likewise, the occurrence of shrubs, that indeed do form, together with tussock grasses, an important habitat for species from different groups, is related to disturbance cycles.

If we discuss conservation of mosaics of different types of ecosystems, we must think of conservation of the different patch types that form these mosaics. Luza et al., despite their title, suggest the opposite for protected areas such as National Parks: in their opinion, fire should be avoided/prevented as much as possible. This falls behind what legislation currently permits: In Article 38 of Law 12.651, use of fire in Conservation Units is explicitly allowed, as long as included in the management plan and if evolutionary characteristics of the natural vegetation in question are associated to the occurrence of fire. This is the case for grasslands in tropical and subtropical regions (Veldman et al., 2015). Further, fire and grazing suppression causes a build-up of flammable biomass, which eventually may burn, making fire control, when necessary, even more difficult and costly. In practice, the investment on fire and grazing suppression in grassland will eventually be paid by means of a big, uncontrollable fire. The problems associated with exclusion of fire in vegetation types where it is an important ecological process, has been recognized more than three decades ago on the northern hemisphere (the most emblematic case being the 1988 burn in Yellowstone National Park, see Franke, 2000) and, more recently, for the world's tropical grassy biomes in general (Parr et al., 2014) as well as in the Cerrado (ATBC, 2014). For the Campos Sulinos, we do not know, at present, what fire frequency would be the most adequate. We do know, as stated above, that biomass removal, be it by fire or grazing, is necessary for maintenance of vegetation diversity and structure, on different spatial scales.

We indeed need integrated perspectives that go beyond consideration of single ecosystem types or single species groups if we wish to conserve mosaic landscapes. In the case of forest-grassland mosaics, exclusion of disturbances, as suggested by Luza et al., will invariably lead to losses of biodiversity of grassland species. This concerns grassland plants, but also different groups of insects and birds of open habitats, just to state two examples. This kind of process has been shown elsewhere. Willis (2006), for example, evidenced losses and even local and regional extinction of bird species due to the replacement of open savannas by forests and woodlands in the Brazilian Cerrado. Shrub encroachment will be favourable for other species groups that are specific to this intermediate situation, albeit only for a certain period of time, as these states are unstable (Oliveira and Pillar, 2004), as also pointed out by Luza et al., and development of forest ultimately will be beneficial for forest species. It is not possible to 'maximize' species richness for all species groups at a given site (see e.g. Andersen et al., 2012 for distinct effects of fire on different species groups), and we should not use a single group of species to establish conservation objectives in large protected areas of (e.g. small mammals, as in Luza et al.). What maximizes biodiversity at the regional level is the presence of habitat mosaics with patches in different shapes and spatial configuration (e.g. Haddad, 2009). For a large protected area, such as a National Park, this means, necessarily, to develop a zoning plan that then allows specifying different types of management in different zones. This management needs to reflect ecological properties of the different types of habitat. Forests can be protected from disturbances, and grasslands can be managed with different disturbance intensities in different patches. Some patches could be held free from disturbances to allow natural succession, but we must recognize that the idea of undisturbed areas as 'source areas', as proposed by Luza et al., ultimately reflects a forest perspective: it considers colonization of forest species over grassland and thus development of forest as desirable. If this were applied, forests would expand over grasslands and grasslands ultimately would be lost.

From our following of the debate on acceptance or not of management as a tool for nature conservation in Brazil, we feel that the question of what exactly we wish to conserve often is not explicitly asked. Biodiversity conservation – which demands management if the objective is to maintain open ecosystems, such as grasslands, and the characteristic species of these systems – and wilderness preservation – which means exclusion of management – are very distinct objectives (Sarkar, 1999). Both have their justification, but we need to be aware of their distinct objectives and justifications whenever discussing or designing strategies for nature conservation.

Conflicts of interest

The authors declare no conflicts of interest.

Acknowledgements

Research leading to this comment was funded by CNPq (grant 563271/2010-8) and FAPERGS (grant 11/2185-0) to VP and by Fundação O Boticário (grant 0950_20122) to GO. VP and GO receive productivity grants from CNPq.

REFERENCES

Andersen, A.N., et al., 2012. Savanna burning for biodiversity: fire management for faunal conservation in Australian tropical savannas. Aust. Ecol. 37, 658–667.

Andrade, B.O., et al., 2015. Grassland degradation and restoration: a conceptual framework of strages and thresholds illustrated by southern Brazilian grasslands. Nat. Conserv. 13, 95–104.

ATBC – Association of Tropical Biology, 2014. Resolution 19. Promoting Sustainable Fire Management in Cerrado, Available from: http://tropicalbiology.org/tropicalbiology/wp-content/uploads/2014/04/ATBC-resolution19-Cerrado-burning.pdf (access February 2015).

Blanco, C.C., et al., 2014. Feedbacks between vegetation and disturbance processes promote long-term persistence of forest-grassland mosaics in south Brazil. Ecol. Model. 291, 224–232.

Bond, W.J., Parr, C.L., 2010. Beyond the forest edge: ecology, diversity and conservation of the grassy biomes. Biol. Conserv. 143, 2395–2404.

Brancalion, P.H.S., et al., 2016. A critical analysis of the Native Vegetation Protection Law of Brazil (2012): updates and ongoing initiatives. Nat. Conserv., http://dx.doi.org/10.1016/j.ncon.2016.03.003.

Franke, M.A., 2000. The role of fire in yellowstone. In: Yellowstone in the afterglow. US National Park Service. Mammoth Hot Springs, Wyoming, https://www.nps.gov/yell/planyourvisit/upload/full-2.pdf (access February 2015).

Fuhlendorf, S.D., et al., 2006. Should heterogeneity be the basis for conservation? Grassland bird response to fire and grazing. Ecol. Appl. 16, 1706–1716.

Haddad, N., 2009. Principles of reserve design. In: Levin, S.A. (Ed.), The Princton Guide to Ecology. Princeton University Press, Princeton, pp. 529–537.

Harrison, S.B., et al., 2003. Ecological heterogeneity in the effects of grazing and fire on grassland diversity. Conserv. Biol. 17, 837–845.

Luza, A.L.S., et al., 2014. Moving from forest vs. grassland perspectives to an integrated view towards the conservation of forest-grassland mosaics. Nat. Conserv. 12, 166–169.

Nabinger, C., et al., 2009. Produção animal em campo nativo: aplicações de resultados de pesquisa. In: Pillar, V.D., et al. (Eds.), Campos Sulinos: Conservação e Uso Sustentável da Biodiversidade. Ministério do Meio Ambiente, Brasília, pp. 175–198.

Oliveira, J.M., Pillar, V.D., 2004. Vegetation dynamics on mosaics of Campos and Araucaria forest between 1974 and 1999 in Southern Brazil. Comm. Ecol. 5, 197–202.

Overbeck, G., et al., 2005. Fine-scale post-fire dynamics in South Brazilian subtropical grassland. J. Veg. Sci. 16, 655–664.

Overbeck, G.E., et al., 2015. Conservation in Brazil needs to include non-forest ecosystems. Divers. Distrib. 21, 1455–1460.

Overbeck, G.E., et al., 2007. Brazil's neglected biome: the south Brazilian campos. Perspect. Plant Ecol. Evol. Syst. 9, 101–116.

Parr, C.L., et al., 2014. Tropical grassy biomes: misunderstood, neglected, and under threat. Trends Ecol. Evol. 29, 205–213.

Pillar, V.P., Vélez-Martin, E., 2010. Extinção dos Campos Sulinos em unidades de conservação: um fenômeno natural ou um problema ético? Nat. Conserv. 8, 84–86.

Sarkar, S., 1999. Wilderness preservation and biodiversity conservation – keeping divergent goals apart. Bioscience 49, 405–412.

Tews, J., et al., 2004. Animal species diversity driven by habitat heterogeneity/diversity: the importance of keystone structures. J. Biogeogr. 31, 79–92.

Veldman, J.W., et al., 2015. Towards an old-growth concept for grasslands, savannas, and woodlands. Front. Ecol. Environ. 13, 154–162.

Willis, E.O., 2006. Protected Cerrado fragments grow up and lose even metapopulational birds in central Sao Paulo, Brazil. Braz. J. Biol. 66, 829–837.

Gerhard Ernst Overbeck*
Department of Botany, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil

Pedro Maria Abreu Ferreira
Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, RS, Brazil

Valério D. Pillar
Department of Ecology, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil

* *Corresponding author.*
E-mail addresses: gerhard.overbeck@ufrgs.br, gerhard_overbeck@yahoo.com (G.E. Overbeck).

18 March 2015
23 May 2016
1679-0073/

http://dx.doi.org/10.1016/j.ncon.2016.05.002