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commentary

Ecotones – where biomes meet

The classification of biomes (or vegetation types) represents one of the most basic summaries of ecological units and provides part of the basis of biogeography. The first systematic continental biome map was a map of Africa produced by Schantz in 1923 (Küchler 1960). Since then, biome mapping has continually developed to inform biodiversity sciences. Initially such developments were mainly in the form of expert mapping, where vegetation scientists with good knowledge of the area being mapped, and often drawing on actual plant community data, drew the boundaries of biomes (Kent 2012). More recently, ever more reliance has been put on remote-sensing data, where algorithms are used to interpret satellite imagery to classify biome distributions (and other land use types; Xie et al. 2008).

With the concomitant development of other large-scale spatial datasets, such as of climate and soil, there has been an increased interest in the drivers of biome distribution, or elements of vegetation such as woody cover, at macroecological scales (e.g., Stephenson 1990, Greve et al. 2011, Campo-Bescós et al. 2013). Understanding what drives biome distribution is especially important in the face of global change, in response to which the distribution of biomes may be expected to shift. It has been suggested that if such shifts are to take place, the transition zones between vegetation types, i.e. the ecotones, would be most suitable for monitoring such changes (e.g., Berner et al. 2013; though see Kupfer and Cairns 1996). Ecotones are often also areas of high richness as they may harbour species from different biomes (e.g., van Rensburg et al. 2009), and may be important areas of gene flow and hybridization (Kark and van Rensburg 2006).

Against this background of the importance of ecotones, and a lack of attention historically afforded them (Kark and van Rensburg 2006), it is exciting that the South African Journal of Botany will shortly be releasing a special issue dealing with "biome boundaries" in the South African context (Potts et al. 2015a). South Africa harbours a particularly high diversity of biomes (Mucina and Rutherford 2006), with some regions of high biome turnover across relatively small geographic distances (Fig. 1). This, together with the rich history for biome research in the country (Potts et al. 2015a), makes the region a natural laboratory to understand ecotones and their drivers.

The special issue presents work conducted at a range of spatial scales (Potts et al. 2015a), ranging from transplant experiments across biome boundaries (Esler et al. 2015) to works conducted across all biomes in the country. One of the country-scale studies examines the use and limitations of dynamic vegetation models in understanding the shifts of biome boundaries in response to climate change (Moncrieff et al. 2015), while another examines the extent to which ecotones can be also used to differentiate between alien plant composition (Rouget et al. 2015).

Other studies look at the role of soils in determining biome distribution (reviewed in Potts et al. 2015a). One of these used soil carbon isotope analyses to ask whether soil type might drive biome boundaries in a grassland-forest mosaic (Gray and Bond 2015). By examining the depth profile of carbon isotopes they concluded the opposite: that biome affects soil carbon. In the fire-prone grasslands, fires deplete nutrients, while nutrient build-up happens in forests, which are protected from fires. In this system, disturbances, rather than the abiotic environment, drive the position of ecotones.

A number of papers in the special issue look at changes in vegetation structure and boundaries through time using repeat aerial and ground-based photography (reviewed in Potts et al. 2015a). These studies, which could illustrate how shifts in biome boundaries occur (e.g., Masubelele et al. 2015), illustrate the importance of long-term monitoring on ecotone environments for recognizing the effects of global change on biome distribution.

Of particular interest to the field of ecotone research will be a paper by Potts et al. (2015b), which reviews different manners in which ecotones are defined. Their review divides these into five different categories: field observations, including expert observations and more anecdotal accounts; modelling of correlations between environmental factors and biome characteristics; experimental approaches such as transplant experiments and controlled laboratory experiments where one or two factors can be systematically manipulated to determine their effect on plant growth; mechanistic modelling, which relies on simulations of biomes based on a process-based understanding of its components; and finally, phylogenetic approaches, which seem to not be used to delineate biome boundaries as much as they utilize information about biome shifts within clades or diversification rates to understand the origin of biomes.

While this special issue particularly focuses on ecotone research within the South African context, it highlights a number of advances in the field, and illustrates a number of different approaches that can be utilized in the field of ecotone research, many of which will be of interest to biogeographers. Biogeographers already have a great interest in the drivers of biodiversity change across gradients, which is apparent from the many studies dealing with

Figure 1. Photo showing three biomes within a very short distance from one another at the Kranskop in KwaZulu-Natal, South Africa. The slopes on the right of the photo face north-west, exposing them to warm conditions resulting in the occurrence of drier savannas. The grasslands on the top of the ridge are burnt regularly and could be prone to frosts. The forest on the south-eastern slopes are exposed to fewer hours of sun exposure, and are fed by moist air rolling in from the Indian Ocean, allowing the growth of the lush forests.

different measures of beta diversity (Koleff et al. 2003). By studying the processes and diversity patterns at ecotones we can additionally further our understanding of patterns and drivers of such changes.

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