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Moving beyond biotic homogenization: searching for new insights into vegetation dynamics

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Abstract

Biotic homogenization has been predicted to occur in cities across the world. However, the empirical evidence has been less than convincing. Lososová and colleagues explore the middle ground between these two points of view in this issue of *Journal of Vegetation Science*. They take a more sophisticated approach linking homogenization to bigger questions of vegetation assembly in urban environments.

Biotic homogenization is the term that has been used to describe the perceived increasing similarity in the plants and animals observed in cities around the world. The concept emerged from the idea that humans are deliberately and accidentally contributing to much higher rates of biotic exchange due to their rapid and extensive mobility. In addition, homogenization could also be driven by the harsh environmental conditions of cities, which would be expected to limit the potential species pool. However, recent global studies have found limited evidence in support of homogenization (Aronson et al. 2014). Yet, we know that there are now very many cosmopolitan species found in cities around the world (Pyšek 1998), and many native species are being lost from cities (Hahs et al. 2009). So how can we reconcile the loss of native biodiversity, and gain of cosmopolitan plants, with the lack of observable homogenization?

Lososová and colleagues (2016) explore this issue by looking at differences in species richness and turnover in archaeophytes, neophytes and native plants between 32 cities in Europe. While the categorization of neophytes, archaeophytes and native plants is well recognized in Europe, its applicability to other continents is less clear.

Europe has a long history of human movements and anthropogenic exchange of plant materials between different continents. To account for the different lengths of residence time for introduced (alien) species, distinctions are made between "Old World" alien plants (archaeophytes) and modern alien plants (neophytes), with a cutoff year of 1492AD used to distinguish the two groups of aliens in Europe (Preston et al. 2004). This year was selected, as it is the year in which Christopher Columbus first set off to sail to the "New World". Archaeophytes have therefore been present in the local plant communities for long enough that they can be considered "almost native". Yet in other ways, they also retain characteristics of alien species, as these traits potentially explain how they were able to arrive and colonize new areas prior to the surge in human mobility. Therefore, they represent an interesting group of organisms in the context of European and other "Old World" cities. However, what this mean for our understanding of vegetation dynamics for cities outside of Europe is less clear.

To explore how the concept of archaeophyte and neophytes may apply in different contexts, it is useful to consider our understanding of the invasion process. Invasion is generally explained as a seed or propagule arriving at a safe site, where it is able to germinate, establish and grow.

Based on how well the species performs in the landscape, it is subsequently able to establish a source population from which seeds and propagules can disperse and the species begins to spread. Over time, the dispersal effectiveness of a population increases as the invasion process proceeds (Fig. 1; b), until it reaches some species-specific optimum, similar to that observed within native species (Fig.1; a). Based on performance, the rate of increase may be relatively rapid (Fig. 1; c), or if the environment remains stable the species may remain in relatively discrete locations in the landscape for a long period of time (Fig. 1; d). As archaeophytes have been in the system for at least 400 years, most of them have already passed through the dispersal phase (Fig. 1; b), and they are now distributed fairly widely across central Europe. This is essentially the pattern reported by Lososová and colleagues, who found there is relatively low turnover, and relatively consistent species richness of archaeophytes between their 32 cities. However, for neophytes, the invasion process has begun relatively recently, and species may not yet have reached their maximum dispersal across a landscape (Fig. 1; c, d). Therefore, they will be observed in more discrete locations, and their presence may more strongly reflect stochastic dispersal and population dynamics rather than niche availability. The high rates of turnover between cities for neophytes observed by Lososová and colleagues also support this pattern of more random distributions of species.

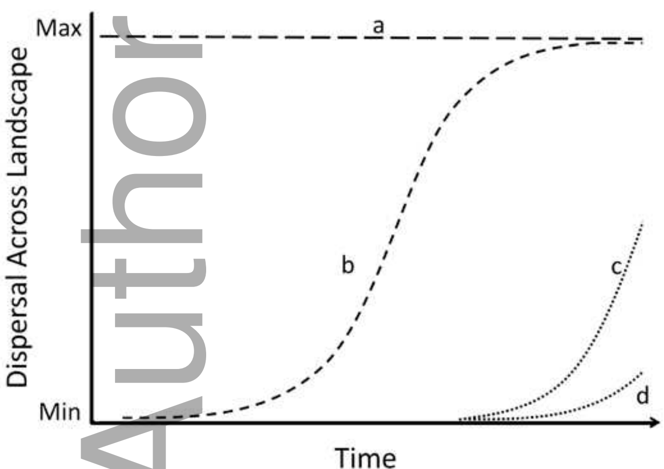

Fig. 1 Conceptual drawing illustrating how dispersal across a landscape may change over time as a species remains in the system. Curves represent a) natives, b) archaeophytes, c) neophytes with rapid establishment and spread, d) neophytes with slower establishment and spread.

Here we present some fundamental questions that arise from the research presented by Lososová and colleagues, all of which have implications for understanding the dynamics of vegetation assembly in cities: 1) What is the nature of disturbance regimes in cities and how does this translate into the availability of safe sites for organisms? 2) What is the pool of available propagules? Are there some neophytes in the seed bank, and what might break their dormancy? 3) What are the competitive interactions between species, particularly different combinations of natives, archaeophytes and neophytes? 4) Are there particular plant traits that influence arrival and performance under historical conditions (e.g., archaeophytes; Pyšek et al. 2009) or existing conditions (e.g., neophytes)? 5) Are there particular plant traits that influence species performance under predicted future conditions and altered disturbance regimes; or which might confer an ability to outcompete and dominate plant assemblages in urban environments? 6) How do these new dynamics affect the extinction debt of native plants in urban environments? 7) How can we use this fuller understanding of plant community assembly processes to feed back into our broader understanding of vegetation dynamics? These questions are all critical for informing our understanding of how to maintain resilient vegetation in cities, which is predicted to change rapidly with urban development and global climate change. Lososová and colleagues present an interesting assessment. It is now up to the broader research community to see where this path takes us.

Acknowledgements

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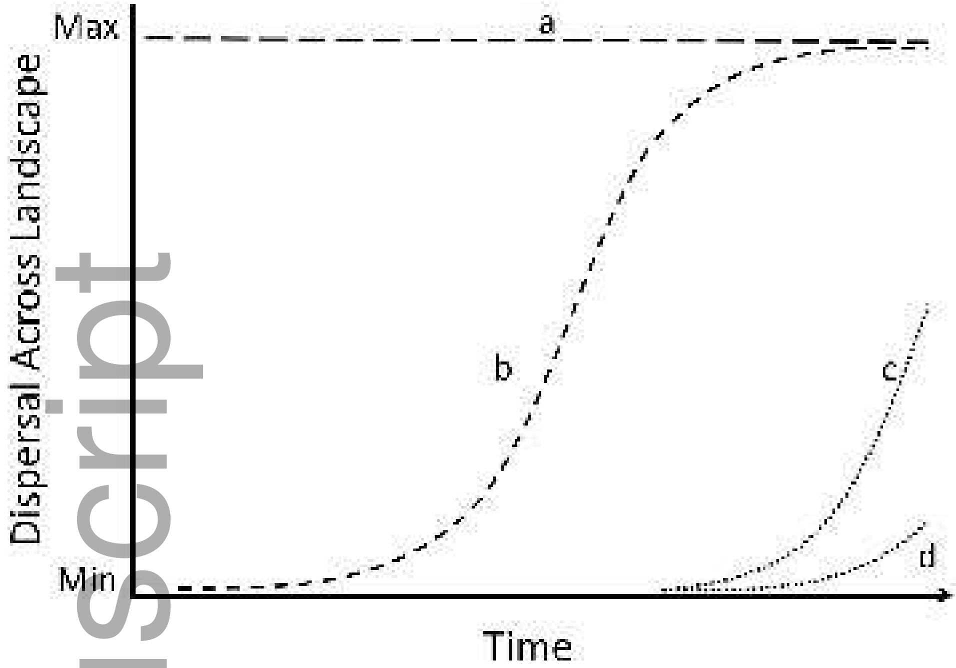

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