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COMMENTARY

Land-use legacies and the role of persistence traits in species recovery

Jennifer M. Fraterrigo

Fraterrigo, J.M. (jmf@illinois.edu)

Department of Natural Resources and Environmental Sciences and Program in Ecology and Evolution, University of Illinois, Urbana, IL 61810, USA

Abstract

Modern-day plant communities often retain imprints of intensive past land use. Do low-intensity land-use practices also produce legacies? In this issue, Jonason et al. (*Applied Vegetation Science*) demonstrate that, 80 yrs after grassland abandonment, meadow species can recover if habitat improves. I interpret these findings in the context of the spatiotemporal processes that shape regional-scale population dynamics.

Commentary

Humans have long used the land in ways that modify native ecosystems, and a large body of work now demonstrates that the changes associated with intensive land-use practices can persist long after human activities cease. Shifts in plant diversity and community composition are among the most profound and lasting effects of intensive human practices. Studies show that intensive past land use can persistently influence the richness and relative abundance of plant species of contemporary ecosystems, with native herbaceous plant communities being among the taxa most severely impacted (e.g. Fraterrigo 2013). Previous agriculture, in particular, has led to striking changes in understorey plant assemblages, a prominent and consistent feature of which is the reduced abundance or absence of native herbaceous species for a century or more (Peterken & Game 1984; Flinn & Vellend 2005; Hermy & Verheyen 2007).

The long-term effects of traditional, low-intensity land-use practices on contemporary floristic patterns are less clear. Traditional practices such as forest grazing, pollarding or coppicing and mowing for hay, have created cultural landscapes consisting of semi-natural habitats that contain high biodiversity and provide important ecosystem services (Hopkins & Holz 2006). Over the past century, however, land-use intensification has transformed many of these landscapes, leading to the replacement of semi-natural areas by forest plantations and arable fields. Semi-natural grasslands are among the habitats most severely affected (Jonason et al. 2016). Widespread losses in grassland habitat present a major challenge to conserving grassland plant species (Cousins et al. 2007) and also threaten the persistence of grassland-obligate wildlife, such as butterflies and birds (Nilsson et al. 2013). If the traditional practices that created semi-natural grasslands have lasting legacies, however, then populations of some grassland plant species may endure, raising the possibility that grassland habitats could be restored and biodiversity enhanced.

In this issue of *Applied Vegetation Science*, Jonason et al. present findings from their investigation of the long-term effects of traditional, low-intensity land-use practices on the flora of recently clear-cut forest plantations in southern Sweden. Two to 4 yrs after logging, they found 56% higher plant species richness and 73% more grassland indicator species in clear cuts historically managed as meadows than in those continuously in forest. These patterns did not appreciably change 6–8 yrs after logging. The odds of finding a grassland indicator species, however, declined with time-since-logging, whereas the opposite was true for forest species (Jonason et al. 2016). They conclude that historical, low-intensity land use has a lasting influence on plant assemblages that can benefit the recovery of grassland plant communities following disturbances that create suitable habitat. As habitat becomes less suitable, however, these communities may again vanish from the landscape.

Multiple mechanisms drive land-use legacies, but Jonason et al. speculated that the presence of remnant populations of grassland species was the most important factor facilitating the recovery of grassland flora following clear cutting. The results of Jonason et al. thus support the hypothesized importance of remnant populations for regional-scale population dynamics (Eriksson 1996). Specifically, by persisting during unfavourable phases of successional development, remnant plant populations serve a critical function in preventing regional extinction.

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What determines whether a species will be endure in a remnant population, and thus potentially recover when conditions become more suitable? Studies increasingly demonstrate that persistence traits (e.g. seed mass, seed bank longevity, resprouting ability, clonality) are correlated with the maintenance and regeneration of local plant populations (Vile et al. 2006; Johansson et al. 2011). In calcareous grassland fragments, for example, plant species with longer-lived seeds have lower rates of local extinction than species with shorter-lived seeds (Stocklin & Fischer 1999). Knowing whether a species possesses persistence traits could therefore enhance capacity to predict not only its likelihood of recovery from disturbance, but also its likelihood of resisting regional extinction.

Grassland species forming remnant populations are also characterized by a lack of dispersal attributes promoting long-distance dispersal (Johansson et al. 2011). This finding likely reflects a life-history trade-off between seed size and seed number (Jakobsson & Eriksson 2000). Plants with large seeds produce fewer seeds that are generally not equipped to disperse as far as large numbers of small seeds; however, large seeds contain more reserves for seedling establishment, resulting in higher rates of recruitment, especially under hazardous conditions (e.g. shade; Westoby et al. 1996). Large seed size and, by corollary, limited dispersal capacity, may thus be adaptive for grassland species which face strong competition for recruitment sites.

Although remnant grassland populations are more strongly associated with plants with large seeds and short-distance dispersal, forest understorey herbs with long-distance dispersal capacity tend to recover more rapidly following abandoned from agriculture (Brunet & von Oheimb 1998; Bossuyt et al. 1999). This discrepancy between traits advantageous for recovery likely reflects differences in the ecological sorting processes associated with low-intensity land-use practices, such as grazing and mowing for hay, versus high-intensity practices.

In conclusion, trait-based approaches for predicting species responses to human activities hold much promise, but researchers should consider how the nature and strength of ecological sorting processes vary with different types of disturbance. We should not expect that the traits that favour recovery and/or delay regional extinction would be the same when disturbance characteristics vary widely. Given substantial evidence indicating that regional-scale population dynamics are influenced by processes that play out in both time and space (Eriksson 1996), future research should aim to identify the traits that promote the persistence of remnant populations and re-colonization of empty niches under different disturbance and environmental conditions.

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