Regeneration potential of coastal and riparian communities invaded by large herbaceous plant species



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Background

Soil seed banks play a critical role in determining vegetation dynamics. Here, we characterise long-term changes in soil seed banks associated with invasions by four large herbaceous plants (*Gunnera tinctoria*, *Heracleum mantegazzianum*, *Impatiens glandulifera*, and *Reynoutria japonica*) at 15 sites in Irish riparian and coastal habitats.

Methods

We assessed changes in the more persistent component of soil seed banks, by combining seed bank data collected from 15 sites in different years after most germination had occurred in the field (late spring). For each invader, seed bank data were collected from 3 sites (6 sites for *G. tinctoria*), in invaded and uninvaded plots (4 plots per site and invasion condition), extracting 5 soil cores within each plot, from 2 depths (0-5 cm, 5-10 cm), for a total of 1,200 soil samples. Moreover, we showed examples of how different multivariate approaches may help characterising long-term changes in soil seed banks associated with plant invasions.



Fig. 1. NMDS plot showing the impact of *R. japonica*, *G. tinctoria*, *H. mantegazzianum*, and *I. glandulifera* at 15 sites in coastal and riparian Irish habitats (dissimilarity based on the Gower measure.

Results

NMDS analyses showed that all four invaders had substantial impacts on the persistent component of native seed banks. Seed banks invaded by *R. japonica* were well distinct and significantly different from uninvaded ones, despite this invader not setting any viable seed and being present at the study sites for only few years. Riparian communities, both invaded and uninvaded were formed by rather similar seed bank communities, despite the effects on seed bank diversity and composition were higher for R. japonica and H. mantegazzianum and relatively weak for I. glandulifera (Fig. 1). Gunnera tinctoria exerted strong negative effects on the seed bank of diverse communities, but in highly disturbed communities the impact was less evident (Fig. 1), as shown by similar dominance found in both disturbed invaded and uninvaded communities (Fig. 2a,b). Dominance by native weeds was very high in both uninvaded communities and communities invaded by *I. glandulifera*, due to strong anthropogenic and riparian disturbance (Fig. 2c,d).

Sba



Fig. 2. Dominance-diversity plots and cluster analysis plots in disturbed coastal

Discussion

Large herbaceous invasive plants tend to alter even the more persistent component of soil seed banks, thus affecting the long-term regeneration potential of the invaded communities, leading to positive feedbacks between changes in the standing vegetation and those in the seed bank. These effects are strongly species- and site-specific, but also depend on the degradation status/disturbance regime of the invaded communities. Amongst riparian large invasive herbs, *R. japonica* is the species that tend to promote the most rapid and significant changes in the seed bank, while I. glandulifera seems to have the lowest impact, although uninvaded communities were highly degraded prior to invasions.

grassland seed bank communities invaded by *G. tinctoria* (a,b), and in disturbed riparian communities invaded by *I. glandulifera* (c,d).

Conclusions

Our findings indicate that comprehensive characterisations of changes in the soil seed bank of invaded communities provide information that is critical to the development of effective control and restoration measures. Analyses excluding data on the seed bank of the target invasive species are especially important to determine whether the invaded communities were already degraded prior to invasions or were highly altered by the invasion process. This distinction is necessary to make informed decisions about the efforts required to control the invaders and, ultimately, to assess whether the invasive plants are a cause or a consequence of human activities.

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