How do propagule pressure, climate and land use interact to determine weed abundance and distribution on Banks Peninsula?

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Summary Weed invasions occur within complex landscapes and the distribution and spread of weeds are potentially influenced by a range of environmental, biotic and anthropogenic factors. We aimed to understand the relative importance of these factors in affecting the broadscale distribution of weeds across Banks Peninsula, Canterbury, New Zealand. This area is an ideal study location because it provides a range of highly modified to semi-natural ecosystems in a diverse topographic setting.

Keywords Weeds, climate, bioclimate, land use, propagule pressure, urbanisation, GIS.

INTRODUCTION

The distribution and spread of weeds are potentially influenced by a range of environmental (climate, geology), biotic (species competition) and anthropogenic factors (e.g. land use, human population density). In order to understand the relative importance of these factors in affecting the broadscale distribution of weeds across Banks Peninsula, Canterbury, New Zealand, we used data from a floristic survey of 1227 plots in which all plant species had been recorded. Using these plots we mapped the distribution of exotic weeds across the Peninsula and used a variety of climatic (temperature and precipitation), environmental (soil and geology), and anthropogenic (distance to urban centres and land use) variables to identify the key factors underlying current weed distributions. These results will be used to forecast the potential distribution of weeds under future climate change scenarios, derived from climate modelling using General Circulation Models (CSIRO, Hadley Centre Coupled Model, version 3, HadCM3), and land use scenarios in the next 2 years as part of a PhD study.

MATERIALS AND METHODS

We used data from a floristic survey of 1227 plots, systematically located at the intersections of a 1 × 1 km grid drawn over a topographical map of Banks Peninsula. Each plot was 6 × 6 m in size, within which all vascular plant species had been recorded (Wilson 1992). We used these data to calculate the richness and diversity of exotic plant species across the Peninsula. We then constructed statistical models to explain variation in exotic richness and diversity in relation to climate (temperature and precipitation), environmental variables (elevation, aspect, slope, soil and geology), and anthropogenic factors including human population density (Hulme *et al.* 2008, McKinney 2004, Pysek *et al.* 2010), the degree of urbanisation (area of built-up cover) (Botham *et al.* 2009), and distance to urban nuclei (Sullivan *et al.* 2005) and to the closest roads as indicators of disturbance and propagule pressure. In addition to examining total exotic richness and diversity, we also examined variation within particular functional groups.

RESULTS

At this preliminary stage, we predict that anthropogenic factors, such as degree of urbanisation and road density, will be key determinants of exotic species richness, with exotic species particularly common at a lower elevation in more highly disturbed sites. Having constructed a model that accounts for the distribution of exotic species in relation to climate, environment and anthropogenic factors, we aim to use this model to explore how changes in climate and land use are likely to affect future distributions.

Future projections of weed distribution will be made for the years 2050 and 2090 using climate scenarios derived from the HadCM3 General Circulation Model (Mitchell *et al.* 2004), combined with likely land use changes. We will also consider how different factors, such as climate, topography, land cover and land use, may have effects that operate more strongly at different spatial scales (Milbau *et al.* (2009).

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