Nassella Tussock Population Dynamics Web Application

Further Information

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The app is built using R-Shiny (R Core Team 2017). It deploys a matrix model, NASSIM, developed for the species by AgResearch scientists (Lamoureaux et al. 2011; Lamoureaux et al. 2015). Links to the PDFs of these two papers are provided under the About tab in the application.

The 2011 paper describes the experiments (conducted on sheep/beef farms in the Hurunui district of the North Canterbury region) that provided the plant demographic data used to construct the matrix model.

The 2015 paper gives comprehensive mathematical descriptions of the model and the spatially explicit framework in which it was implemented to compare the long-term economics of three contrasting grubbing management scenarios in the Hurunui district.

The 2011 and 2015 papers will be of interest to a user wanting to understand the plant ecology, demography, assumptions, and mathematics underpinning this web application. But they are not essential reading.

To enable the app to simulate neighbour effects, we needed some additional analyses which we describe here. For the between farm/block spatial analysis in the app, we needed to determine the percentage of nassella tussock seeds that would disperse annually from a 1.0 km^2 (100 ha) block of land (donor) into a neighbouring block (recipient) of the same size. To that end we conducted simulations using the Gaussian dispersal kernel deployed in NASSIM (Lamoureaux et al. 2015) (Figure 1). This kernel describes how the seeds from a single nassella tussock plant are dispersed around that plant.

Over multiple simulations with a population of 2,000 plants in the ‘donor’ block (20 plants/ha), 6.4% of the seeds produced in the donor block were dispersed into the neighbouring recipient block (Figure 2). In simulations with 20,000 plants in the donor block (200 plants/ha), 6.7% of the seeds were dispersed into the neighbouring ‘recipient’ block. Based on these results we have set the default rate for the ‘Seed dispersal to other block’ parameter in the web app. to 6.7%.

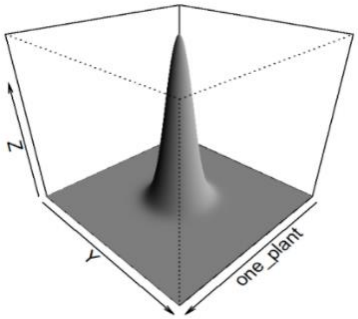

Figure 1. Gaussian dispersal kernel for a single plant of nassella tussock in which 95% of seeds (z) are dispersed within 400 metres (y).

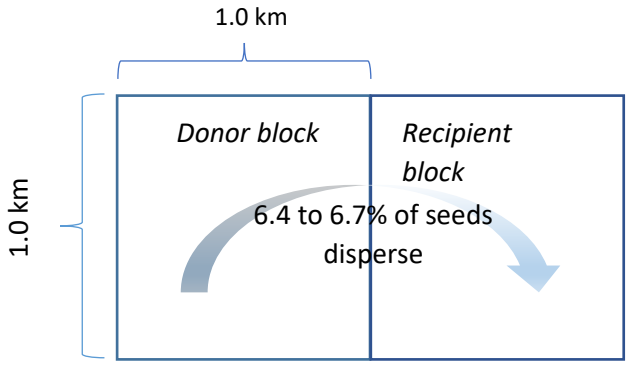

Figure 2. Donor and recipient block simulation environment

Any effects of terrain, wind, atmospheric turbulence, and other factors that may influence the dispersal of nassella tussock seeds were not explicitly accounted for in these simulations. In the app, these effects may be accounted for by adjusting the dispersal rate from its default value of 6.7%. For example, if Block 1 is upwind of Block 2, the 'Seed dispersal to other block' parameter for Block 1 could be increased from the default 6.7% to reflect this. In this case, it might also be appropriate to set the 'Seed dispersal to other block' parameter for downwind Block 2 to zero, reflecting the condition where Block 1 never receives seeds from Block 2.

Lamoureaux SL, Bourdôt GW, Saville DJ 2011. Population growth of Nassella trichotoma in grasslands in New Zealand slower today than in the past. Acta Oecologica 37: 484-494.

Lamoureaux SL, Basse B, Bourdôt GW, Saville DJ 2015. Comparison of management strategies for controlling Nassella trichotoma in modified tussock grasslands in New Zealand; a spatial and economic analysis. Weed Research 55: 449-460.

R Core Team 2017. R: A language and environment for statistical computing. https://www.R-project.org/. 1 December.