Modelling Community Productivity, Species Abundance and Richness in a Naturalised Pasture Ecosystem

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Abstract

This study focuses on modelling community productivity, species abundance and richness, and the impact of climate change and alternative phosphorous fertiliser application strategies on pasture productivity by integration of decision tree and regression modelling approaches with a geographical information system (GIS) in a naturalised hill-pasture ecosystem in the North Island, New Zealand, using data derived from research conducted on hill-pastures over the last several decades.

The results indicated that the decision tree models had a high predictive capability and clearly revealed the relative importance of environmental and management factors in influencing community productivity, species abundance and richness. Spring rainfall was the most significant factor influencing annual pasture productivity in the North Island, while hill slope was the most significant factor influencing spring and winter pasture productivity. Annual P fertiliser input and autumn rainfall were the most significant factors influencing summer and autumn pasture productivity, respectively. For species functional group abundance, soil Olsen P was the most significant factor influencing the relative abundance of low fertility tolerance grasses (LFTG) and moss, while soil bulk density, slope and annual P fertiliser input were the most significant factors influencing the relative abundance of legume, high fertility response grasses (HFRG) and flatweeds, respectively. Legume abundance was the most significant factor influencing species richness in the hill-pasture. Species richness increased with an increase in legume abundance and showed a tendency for a hump-shaped response. Grazing animal species also had a significant effect on species richness; pasture grazed by sheep had more species than pasture grazed by cattle. Climate change scenarios of temperature increases of 1-2 ^{o}C and rainfall changes of -20% to +20% would have a great impact (-46.2% to +51.9%) on pasture production in the North Island. Pasture in areas with relatively low rainfall had a higher response to increased P fertiliser input than pastures in areas with a relatively high rainfall.

In conclusion, the integration of a GIS with decision tree and regression models in this study provided an approach for effective predictive modelling of community productivity, species abundance and richness in the hill-pasture. This modelling

approach can also be used as a tool in pasture management such as in assessing the impact of climate change and alternative fertiliser management on pasture production.

Key words: climate change, community productivity, data mining, decision tree, functional group, hill-pasture, geographical information system, GIS-based modelling, multivariate analysis, pasture production, predictive modelling, regression, relative abundance, species richness.

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Table of Contents

List of Tables

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7

List of Figures

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7