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

Baisen Zhang

2005
Modelling Community Productivity, Species Abundance and Richness in a Naturalised Pasture Ecosystem

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy
in Plant Science
at Massey University, Palmerston North
New Zealand

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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 °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.
Acknowledgements

I would like to express my sincere thanks to my supervisors Dr. Ian Valentine and Assoc. Prof. Peter Kemp for their guidance, encouragement, friendship and endless reading of my manuscripts throughout my doctoral study.

My thanks to those who generously provided their unpublished and/or raw data to me for developing my models; without this data, I would definitely have not finished my thesis before the scheduled time. They are Dr. Jamie Blennerhassett, Dr John Brock, Dr. Mike Dodd, Dr. Allan Gillingham, Mr Dave Grant, Mr. Maurice Gray, Dr. Greg Lambert, Dr. Ignacio Lopez, Dr. Jim Moir, and Dr. Phillipa Nicholas. Thanks to National Institute of Water & Atmospheric Research (NIWA) New Zealand, with the assistance of Ms. Elaine Fouhy, for providing climate data. I am very appreciative of their contributions toward my study and thesis.

I would like to acknowledge the support of people who helped me in various ways during my study. Thanks to Prof. Richard Aspinall, Assoc. Prof. Alex Chu, Dr. Allan Gillingham, Dr. David Gray, Assoc. Prof. Mike Hedley, Dr. Greg Lambert, Dr. Kerry Harrington, Prof. John Hodgson, Assoc. Prof. Cory Matthew, Prof. Russ Tilman and Dr. Todd White for discussion and comments on my work and thesis manuscripts. Thanks to Mr. Mike Tuohy for providing the DEM of the North Island, Mr. Matthew Irwin and Mr. Des Costall for their help with GIS analyses, Dr. Siva Garnish and Mr. Judi Scheffer for advice on statistics, and Dr. Guisan Antonia and Dr. Louis Iverson for advice on issues of developing ecological models. Thanks to the administrative staff and computer lab staff in Institute of Natural Resources for their assistance during my study.

My thanks to my fellow students Tehseen Aslam, Bhoj Bahadur, Zulfiqar Butt, Zaker Hussain, Jian He, Xiongzhao He, Mofakkarul Islam, Congqi Liu, Qianhe Liu, Ernest Okorley, Tara Pande, Endang Savitri, Haoran Sun, Zulkefly Sulaiman, Edmundo Viegas, Minhua Xu and others for their friendships and/or helpful discussions on my thesis. Special thanks to Entin Daningsih for frequent discussion on statistics, and Tri Priantaroto on GIS.

I would like to express my thanks to the Massey Doctoral Scholarship and the Helen E Akers Ph.D. Scholarship for financial support during this study.
I wish to thank my parents, my sister and brothers for their love, encouragement and support. Very special thanks to my wife Airong and my son Liyu (Oliver) for their love, patience and understanding during my three years’ study.
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