Report for funders **Meg Pollock** **22/03/04**

Herbivore preferences for native woody NZ plants

Introduction

The original project proposed was intended to test a model of vegetation succession under grazing, developed in Scotland, against changes in vegetation in NZ, where the history of grazing by mammals has been very short. However, on my arrival it became apparent that information critical to the modeling exercise, namely the preferences of ungulates for native NZ woody plants, was not available. The project was therefore amended to an investigation into the preferences of different herbivores for native NZ woody plants.

The NZ flora evolved in the presence of browsing by Moas, large flightless ratite birds. A few centuries after the arrival of the Polynesians around 800 years ago, the moas became extinct as a result of hunting. The vegetation then experienced a period of several centuries when no browsing by ratites occurred, but following the arrival of Europeans around 200 years ago there has been considerable browsing pressure from red deer, goats and other European mammals. Some current members of the NZ hunting lobby would like to see deer numbers allowed to increase without being culled, on the grounds that deer are performing the same ecological role as moas once did. Research is required to shed light on this argument, and to improve conservation management decisions.

A considerable proportion of the woody flora of NZ has the architectural form described as 'divaricate'; i.e. having a small leaves, a low number of leaves per shoot, wide branching angles and interlacing branches. There are two hypotheses to explain the occurrence of such plants. The first is that the architecture reduced the extent of browsing by moas, and the second is that it protects the plant from the extremes of climate.

The aim of the work was to determine the preferences of ratites and ungulates for native NZ woody plants with a range of different architectures and from a range of taxonomic groups, and to determine whether the preferences were more related to chemical or physical plant traits. A paper is being completed on this work; it will be submitted to the NZ Journal of Ecology.

Methods

There are living relatives of the moa in Australia (the emu), Southern Africa (the ostrich) and South America (the rhea). As ostriches are farmed in NZ, it was decided to compare the preferences of this ratite with those of deer and goats. A set of fourteen plant species was selected; angiosperm genera, with one divaricating and one non-divaricating species from each, and two gymnosperm species. Replicated field trials were set up where each of the herbivores had access to potted plants. Before and after the feeding trials, the numbers of undamaged shoots on each individual were counted, allowing the proportion of browsed shoots to be calculated. Information on chemical and physical plant traits was collected: samples of leaf and stem were sent to the lab for Nitrogen, Phosphorus and phenolics analysis; shoot tensile strength was measured; a index of divarication was utilsed to quantify architecture; plant height, leaf area, leaf weight were measured. The data were analysed by using GLM to determine the amount of variation explained by non-correlated plant traits in the proportion of shoots browsed by each herbivore.

Results

All of the herbivores preferred non-divaricating plants over divaricating ones. The gymnosperms were generally avoided, but not so much as the divaricating plants. The analysis of proportion of shoots browsed confirmed that divaricating plants were avoided, especially by ostriches. Proportion of shoots browsed increased with increasing stem phosphorus, especially for ostriches. Stem tensile strength was the other factor that influenced the herbivores, with all herbivores avoiding plants with strong shoots, particularly deer.

Table 1. Parameter estimates generated by GLM. All terms were significant at the 0.001 level, except for Nitrogen in stem for deer where P = 0.004. Missing values for plant traits were dropped by the step-down process because they were not significant.

Term	Deer	Goat	Ostrich
Constant	4.114	4.374	7.66
Divarication_index	-0.19	-0.21	-0.683
Nitrogen stem	-0.713		
Phosphorus leaf	7.5	12.08	15.36
Phenolics stem		0.5608	0.5288
Shoot tensile strength	-0.193	-0.107	-0.068
Square root of leaf area			0.0683
Initial height		-0.088	

Note: These values are on the logit scale and must be back-transformed before being used to make predictions.

It is interesting to note that stem phosphorus was the only chemical plant trait where the expected relationship occurred. Stem Nitrogen was negatively related to deer preference, and not significant for the other herbivores. Stem phenolic content was not significant for deer, and was positively related to goat and ostrich browsing proportion.

Conclusions

Ungulates and ratites have similar preferences for non-divaricating plants. However, the avoidance of non-divaricating plants by ratites is greater than that by deer, suggesting that divaricating plants may be at risk from browsing by ungulates.

Workshops and seminars

I presented a poster at the 3rd International Wildlife Management Conference (1-5th Dec 2003) on some of the modelling work from my PhD. I also attended workshops on multi model inference and adaptive management, and a session on experimental design. On March 10th I gave a talk to the University of Otago Botany Department on work from my PhD (grazed woodlands) and the work undertaken in NZ.

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