# Determining Pasture Biodiversity with NIRS

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# DETERMINING PASTURE BIODIVERSITY WITH NIRS

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## Abstract

Research was conducted to assess the potential of using near infrared reflectance spectroscopy (NIRS) to determine botanical composition and measures of species diversity in pasture samples. Samples were collected from six hill country (Ballantrae) and two lowland (Aorangi) pastures in New Zealand. Samples were collected in summer (March) and Autumn (May) and subsamples were dissected to determine botanical composition and species diversity. Measures of diversity included species richness, Shannon's index, and Simpson's index. Reflectance data were collected from a second subsample that had been dried and finely ground. Calibrations were developed using modified partial least squares. Acceptable calibration equations were developed for predicting values of all variables evaluated in the study. It appears feasible that with further refinement NIRS could be used routinely for predicting diversity of pasture samples and for reducing the process time when a large number of samples is required.

**Keywords:** Diversity, Species Richness, Pasture, Grassland

## Introduction

The role of biodiversity in the stability and productivity of grassland ecosystems is a topic of considerable interest (Altieri, 1999; Tilman et al., 1996). The relationship of species diversity to pasture productivity appears to be site specific and these variables have at various times been shown to be positively correlated, uncorrelated, or negatively correlated (Harmoney et al., 1998; Nicholas et al., 1997). Determining the underlying reasons for these differential responses is critical to developing an understanding how species diversity functions in maintaining productivity of pasture ecosystems (Huston, 1994).

For a defined spatial scale there are two aspects of species diversity; the number of species present and the relative distribution or evenness of those species within the community. The number of species present is usually referred to as species richness and is determined as a count within a specified area. There are several diversity indices that are used to describe how species are distributed within a sample (Magurran, 1988). Two of the most commonly used of these are the Shannon and Simpson indices (Peet, 1974; Pielou, 1966). Shannon's index (H') is based on information theory and is a measure of the uncertainty associated with selecting an individual species from a sample. Simpson's index (D) is an estimate of the probability of randomly selecting two members of the same species. Its inverse (1 - D) is often referred to as Simpson's index of diversity (Krebs, 1989). Formulae for the two indices are:

**Table 1 -** Calibration statistics for predicting botanical composition and biodiversity of pastures samples collected in summer and autumn.

| Measurement | N | Mean | Range | SEC[a] | $R^2$ | SEP[b] |
|---|---|---|---|---|---|---|
| <u>Summer</u> | | | | | | |
| Species richness | 44 | 6.9 | 3 - 11 | 0.60 | 0.91 | 1.19 |
| Shannon ($N_1$) | 45 | 4.1 | 1.9 - 6.2 | 0.41 | 0.90 | 0.82 |
| Simpson ($N_2$) | 45 | 3.2 | 1.6 - 5.4 | 0.32 | 0.91 | 0.73 |
| Legume (% LM[c]) | 38 | 10.5 | 0.3 - 28.9 | 2.29 | 0.93 | 3.29 |
| Grass (% LM) | 44 | 82.7 | 40.1 - 100.0 | 4.16 | 0.90 | 6.80 |
| <u>Autumn</u> | | | | | | |
| Species richness | 47 | 7.1 | 3 - 12 | 0.62 | 0.91 | 1.27 |
| Shannon ($N_1$) | 46 | 3.9 | 1.4 - 6.7 | 0.57 | 0.86 | 0.83 |
| Simpson ($N_2$) | 45 | 3.0 | 1.2 - 5.4 | 0.53 | 0.81 | 0.76 |
| Legume (% LM) | 43 | 8.6 | 0.1 - 28.7 | 2.64 | 0.87 | 4.28 |
| Grass (% LM) | 47 | 89.3 | 67.5 - 99.6 | 3.41 | 0.85 | 5.15 |

[a] Standard error of calibration.
[b] Standard error of prediction calculated by cross validation.
[c] Live matter.

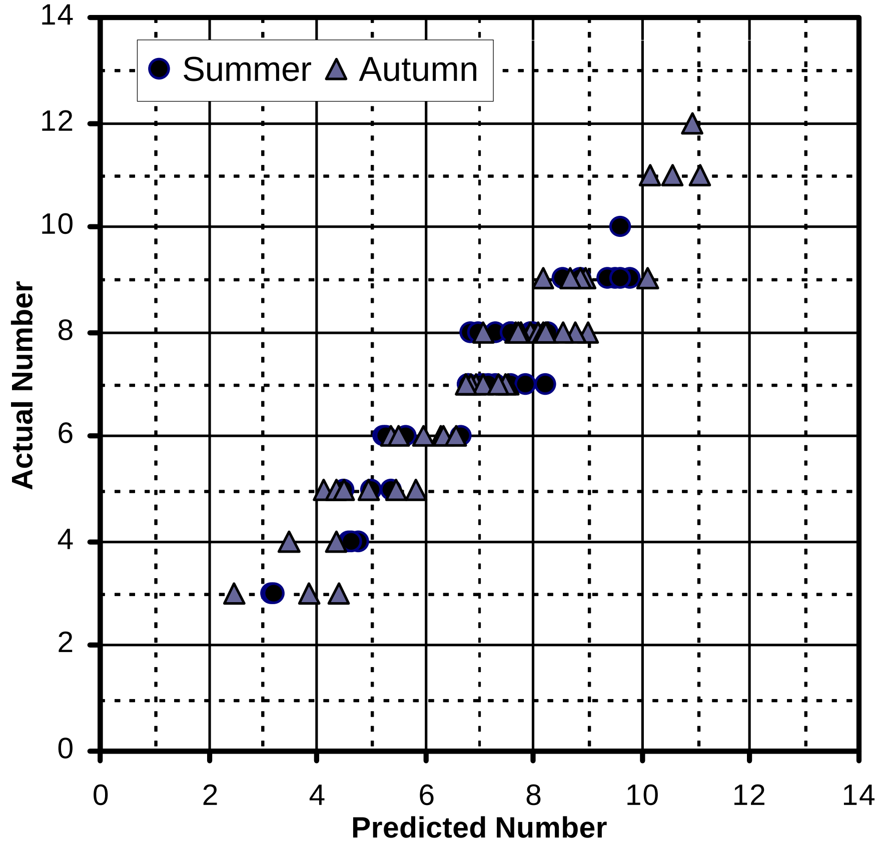


**Figure 1.**
Relationship between actual and predicted number of species in pasture samples collected in summer and autumn. Values were predicted using separate NIRS calibration equations for summer and autumn samples.