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SHORT COMMUNICATION

MINERAL ELEMENT CONCENTRATIONS IN FOLIAGE AND BARK OF WOODY SPECIES ON AUCKLAND ISLAND, NEW ZEALAND.

Summary: Mineral element concentrations are presented in leaf and bark material from six woody species growing at a single site on the subantarctic Auckland Islands. Foliar total mineral element concentrations range from 5.81% *(Olearia lyallii)* to 2.71 % *(Dracophyllum longifolium),* the lowest concentrations occurring in slow growing species tolerant of nutrient-poor soils. The browse preference of introduced goats is correlated with high foliar potassium levels while species that are preferentially debarked *(Pseudopanax simplex* and *Myrsine divaricata)* have the highest bark calcium concentrations.

Keywords: Mineral element concentrations; woody species; goat browse; Auckland Island; New Zealand.

Introduction

The aims of this introductory study were to provide information on plant nutrient concentrations, and how these varied for foliage and bark of different species at one site on the Auckland Islands. Relationships were sought between nutrient concentrations and feeding preferences of the small population of feral goats. Despite the limitations of the data, the results are reported because of the dearth of information on plant element concentrations on the Auckland Islands in particular and in New Zealand generally.

At a latitude of 50º35' south, the subantarctic - cool temperate Auckland Islands are the southern limit of tall tree species in the New Zealand biogeographic region, and contain a woody flora of fewer than 20 species (Johnson and Campbell, 1975). The two forest dominants, *Olearia lyallii* and *Metrosideros umbellata,* occupy sheltered sites along the eastern coast, while the other woody species are found in forest or on more exposed sites on coastal headlands or at higher altitudes (Godley, 1965; Rudge and Campbell, 1977).

Samples were collected near Victoria Tree at Erebus Cove, Port Ross, at the northern end of Auckland Island in March 1982 (Fig. 1). This site is a small headland within a relatively sheltered bay, and supports low *Olearia lyallii - Metrosideros umbellata* forest which has established since 1852 when the Enderby settlement was abandoned (Rudge and Campbell, 1977). The area slopes gently (15∞) to the north-east, and is underlain to a depth of > 2m by blanket peat similar to that described by Leamy and Blakemore (1960).

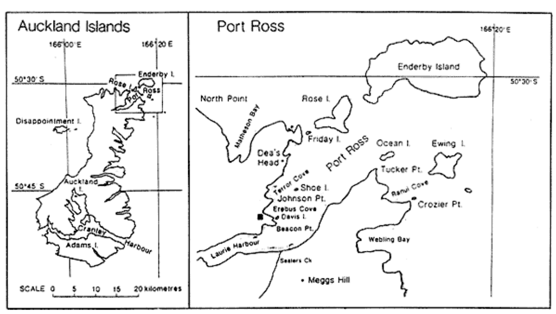

Figure 1: Location map of sampling site (■) at Erebus Cove, Auckland Islands

Sampling and Nutrient Analysis

Undamaged shade foliage from several parts of the inner canopy, and bark .samples cut down to the cambium from several lateral branches, were collected from two replicate plants of six woody species growing in a 20 x 20 m plot. Attached senescent leaves were also collected from the two tall tree species.

Plant material was placed in open ventilated paper bags and kept dry for the 3 day trip from the islands back to Dunedin, where they were oven dried for 48 hours at 80∞C, ground to a powder, and analysed for nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and sodium following the methods outlined in Williams *et al.* (1976).

Results and Discussion

Most elements show at least a 3-fold difference between species (Table 1), the exceptions being calcium and magnesium. Total mineral element concentrations in leaves range from 5.81070 *(Olearia lyallii)* to 2.71% *(Dracophyllum longifolium)*. Those species with the lowest total concentrations in their foliage, namely *Dracophyllum longifolium* and *Metrosideros umbellata,* are slow growing species characteristic of, though not confined to, nutrient-poor sites elsewhere in New Zealand (Wardle, 1963; Wardle, 1977). Within the plot there was no evidence of a gradient in soil conditions that would account for the range of foliar element concentrations found in the different species.

Table 1: *Mineral element concentrations (% dry weight) in foliage and bark from six woody species growing at Erebus Cove, Port Ross, Auckland Islands. n = 2; L = functional leaves, S = senescent leaves and B = bark*

	Met. umb.	Ole. lya.	Cop. foe.	Dra. lon.	Myr. div.	Pse. sim.
Nitrogen						
L	0.90	1.19	1.33	0.57	1.47	0.91
S	0.05	0.05	-	-	-	-
B	0.05	0.32	0.37	0.51	0.48	0.28
Phosphorus						
L	0.11	0.28	0.14	0.06	0.13	0.10
S	0.03	0.18	-	-	-	-
B	0.03	0.04	0.05	0.08	0.06	0.09
Potassium						
L	0.88	2.39	0.71	0.43	0.63	1.29
S	0.26	0.76	-	-	-	-
B	0.13	0.46	0.41	0.14	0.33	0.48
Calcium						
L	0.89	1.02	1.21	1.20	1.08	0.95
S	1.23	1.43	-	-	-	-
B	1.30	0.54	1.32	0.69	2.03	3.88
Magnesium						
L	0.20	0.19	0.35	0.22	0.18	0.33
S	0.20	0.18	-	-	-	-
B	0.13	0.09	0.16	0.11	0.07	0.11
Sulphur						
L	0.14	0.14	0.49	0.11	0.18	0.24
S	0.12	0.14	-	-	-	-
B	0.09	0.30	0.95	0.13	0.10	0.10
Sodium						
L	0.75	0.60	0.22	0.12	0.37	0.21
S	0.30	0.69	-	-	-	-
B	0.26	0.13	0.04	0.04	0.12	0.09
Total						
L	3.87	5.81	4.45	2.71	4.04	4.03
B	1.99	1.88	3.30	1.70	3.19	5.03

Of the two tall tree species, *Olearia lyallii* exhibits leaf concentrations of nitrogen, phosphorus and potassium which are double those found in *Metrosideros umbellata*. However, a comparison of element concentrations in functional and senescent leaves indicates that *Metrosideros umbellata* withdraws a greater proportion of the phosphorus (73% v 36%), from ageing leaves prior to leaf-fall than does *Olearia,* although some losses may have occurred through leaching.

In general total concentrations of elements in bark are lower than in the foliage, although the difference is small in *Dracophyllum longifolium*. *Pseudopanax simplex* is the only species where total bark nutrient concentrations, augmented by the very high calcium concentrations (3.88%), exceed foliar levels. Over all the species, mineral element concentrations in foliage and bark are poorly correlated, the two exceptions being sulphur ($r = 0.898$, $P < 0.05$), which is entirely due to *Coprosma foetidissima* with an exceptionally high value, and sodium ($r = 0.918$, $p < 0.05$), which may reflect aerosol contamination rather than intrinsic nutritional features of the species.

There are few other studies of mineral element concentrations in leaves or bark of small trees and shrubs in New Zealand with which to compare these results. With the exception of sulphur, element concentrations in leaves of *Coprosma foetidissima* on the Auckland Islands are quite similar to the concentrations reported for other *Coprosma* species growing on mineral soils around Dunedin (Lee and Johnson, 1984).

Foliar element concentrations were correlated against the palatability scale of Rudge and Campbell (1977). This scale was calculated from the proportion of foliage tufts nibbled in the zone of mouth-reach of goats in the vegetation of the northern side of Port Ross. Their scale refers to only 5 of the species sampled in this study, *Olearia* being excluded presumably because of its local distribution. The only significant correlation was for potassium, the goats apparently preferring foliage of species with high potassium concentrations ($r = 0.953$, $p < 0.01$). This result is surprising, given that herbivores generally avoid plants with high concentrations of potassium (Chapin *et al.,* 1980) and the goats do not browse *Olearia lyallii,* which has high foliar potassium concentrations (author's personal observations). However, the goats may avoid *Olearia* foliage because of its coarse fibrous texture. The goats preferentially debark *Pseudopanax simplex* and *Myrsine divaricata,* species with high total element concentrations in their bark. *Coprosma foetidissima,* while having similar total element concentrations to these species, also contains high concentrations of sulphur, in both bark and foliage, presumably related to its strong foetid smell. Its bark is not highly preferred by goats, although it is browsed by red deer on the New Zealand mainland (Stewart *et al.,* 1987).

The absence of stronger correlations between the browse preferences of the goats and the nutrient concentrations of plant foliage and bark is not unexpected given the small sample size used in the study and the probable importance for herbivore selection of other plant features such as digestibility and secondary compounds.

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