Variations in N, fibre and phenols of trees at the Nkuhlu Exclosures

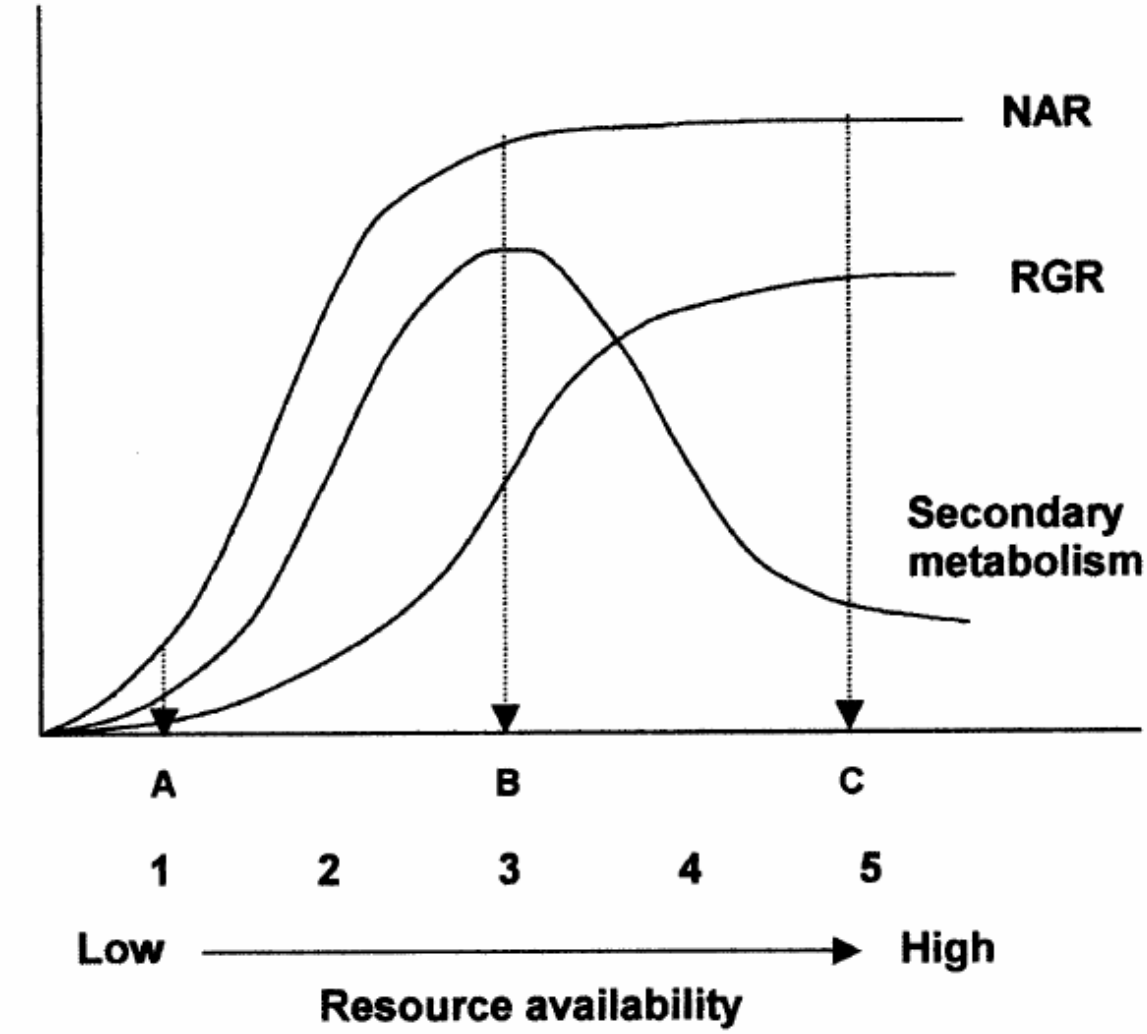
Scogings, P.F.[1], Rooke, T.[2], Dziba, L.E.[3], Hattas, D.[4], Eckhardt, H.[5], Skarpe, C.[6], Zobolo, A.[1], Hjältén, J.[2]

[1]University of Zululand, South Africa, [2]Swedish University of Agriculture, Sweden, [3]Agricultural Research Council, South Africa, [4]University of Cape Town, South Africa, [5]SANParks, South Africa, [6]Norwegian Institute of Nature Research, Norway

Introduction

- Variation in forage quality of savanna woody plants is poorly understood
- Carbon/nutrient balance (CNB) and growth rate (GR) hypotheses (Bryant *et al.* 1991, Coley 1988)
- Assume C-based secondary metabolites (e.g., cond. tannins, lignin) = defensive
- Predictions of forage quality i.t.o. species traits not reliable (e.g., deciduous ≠ better)

Growth deffirentiation balance (GDB) hypothysis (Herms & Mattson 1992)



Relationship of net assimilation rate (NAR), relative growth rate (RGR), and differentiation (specifically secondary metabolism) across a resource gradient, for which the resource affects growth more than it does photosynthesis. Arrow A: both growth and photosynthesis are constrained by low resource availability. Arrow B: growth is more constrained than photosynthesis and thus there is more allocation to differentiation (and specifically to secondary metabolism). Arrow C: growth is less constrained and thus there is more allocation to growth. Adapted from Herms and Mattson (1992).

Introduction

GDB - Kruger context:

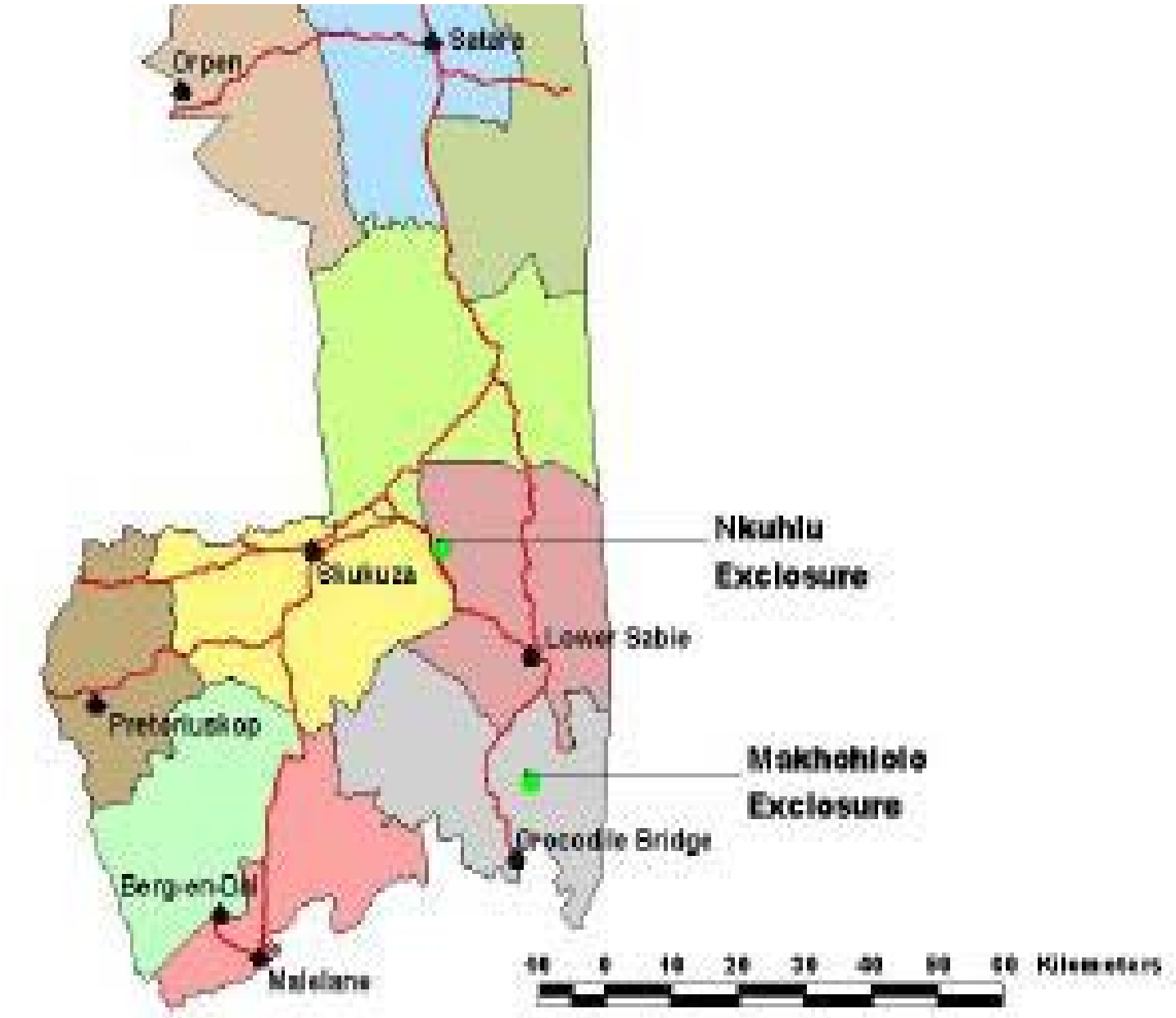
- Nutrients decrease during wet season
- C-based secondary metabolites increase during wet season (esp. in less defended)
- Forage quality varies seasonally

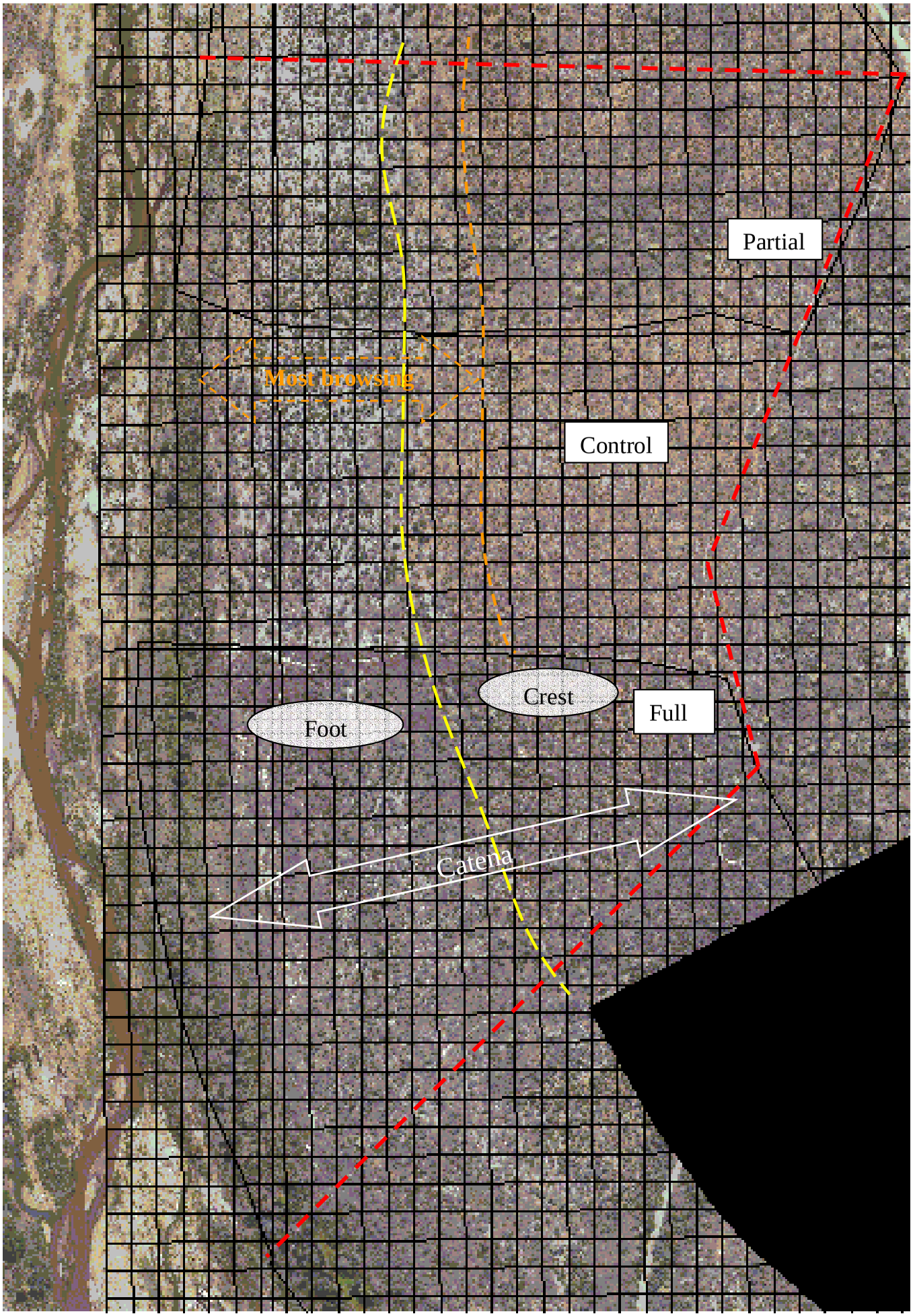
Aim

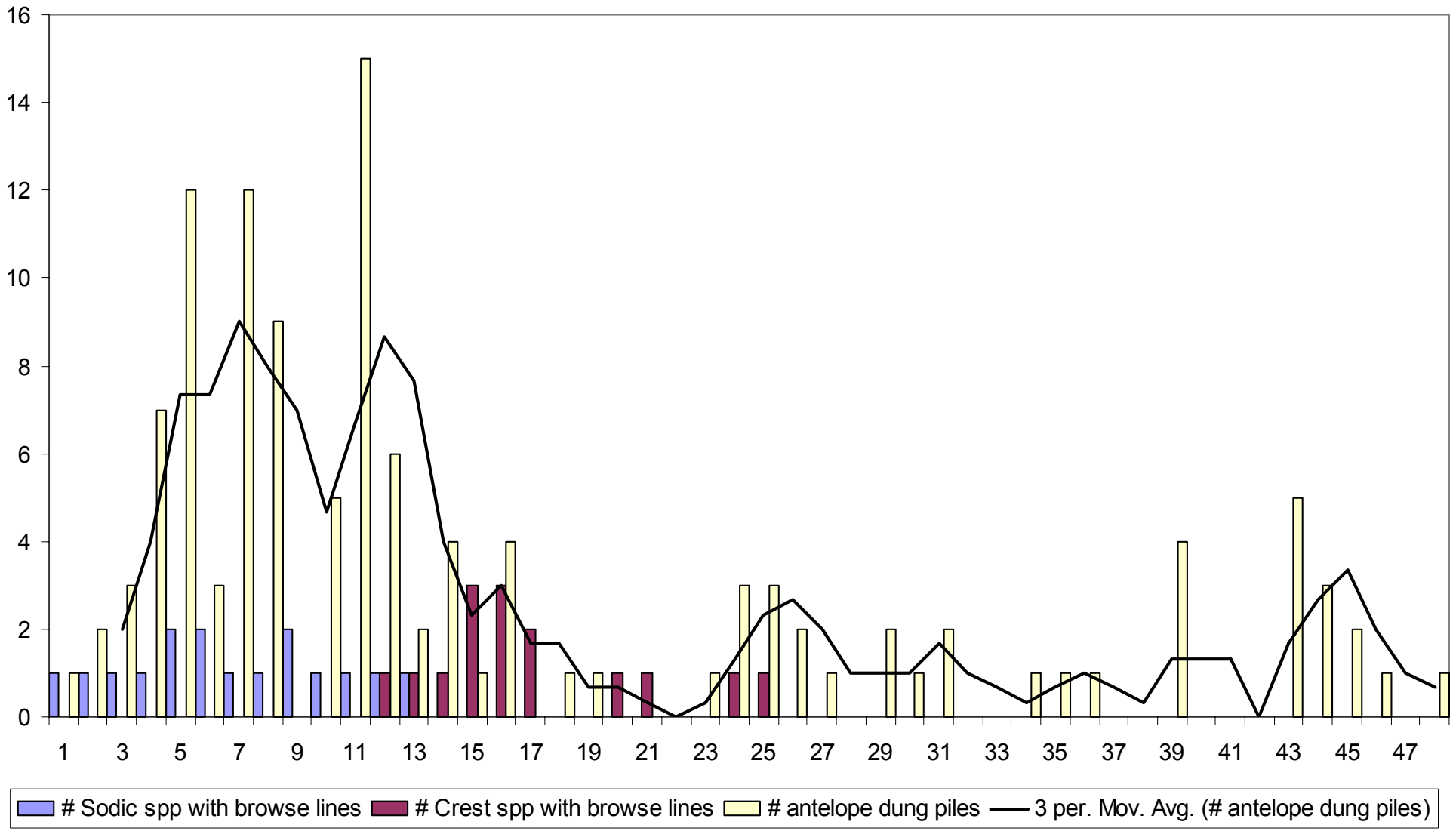
The aim of our study is to understand how structural, chemical and physical traits that affect mammalian herbivory in woody species are affected by variations in browsing and season.

Main Question

How are physical and chemical anti-herbivore traits affected by changes in season and herbivory?

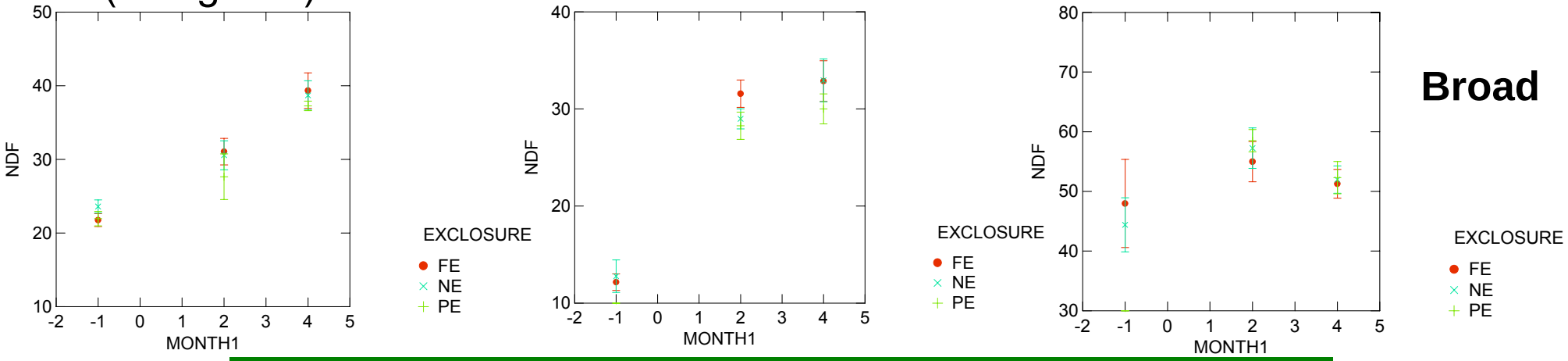

Orpen
Sabie
Skukuza
Nkuhlu
Exclosure
Lower Sabie
Pretoriuskop
Makhohlolo
Exclosure
Crocodile Bridge
Berg-en-Dal
Malelane
0 5 10 20 30 40 50 60 Kilometers


Partial
Most browsing
Control
Crest
Full
Foot
Catena


16
14
12
10
8
6
4
2
0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
Sodic spp with browse lines
Crest spp with browse lines
antelope dung piles
3 per. Mov. Avg. (# antelope dung piles)

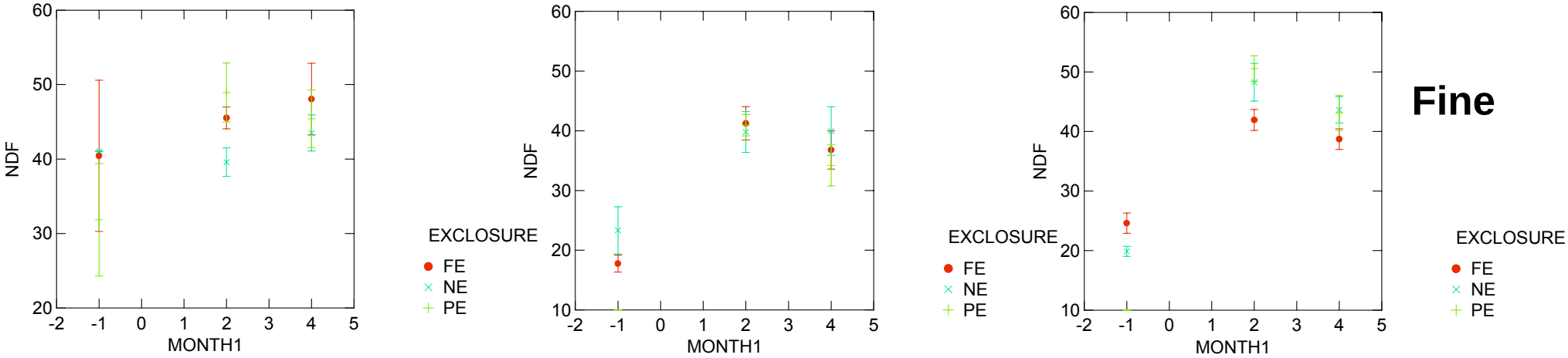
Foot | **Crest** | **Crest**

E. divinorum (evergreen) | C. apiculatum | G. flavescens



Broad

2005-2006 wet season neutral detergent fibre (%)



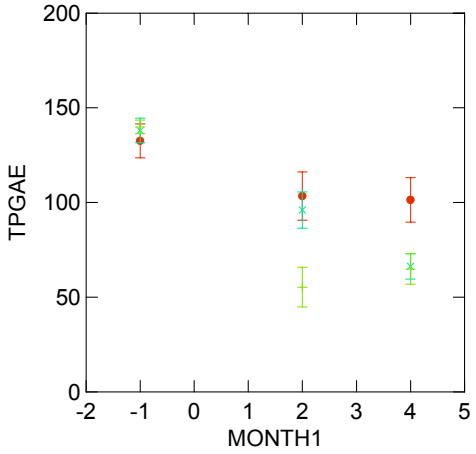
Fine

A. grandicornuta | A. exuvialis | D. cinerea

Foot

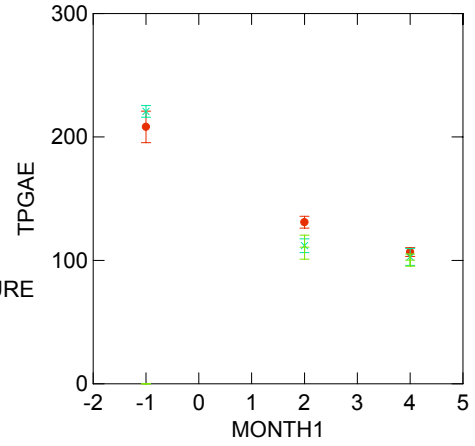
E. divinorum

(evergreen)



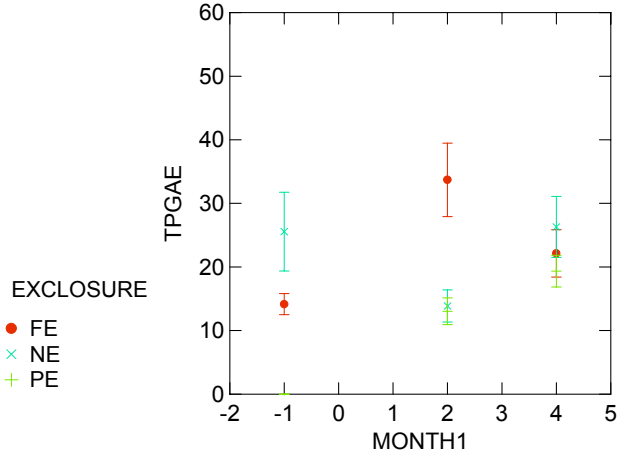
Crest

C. apiculatum



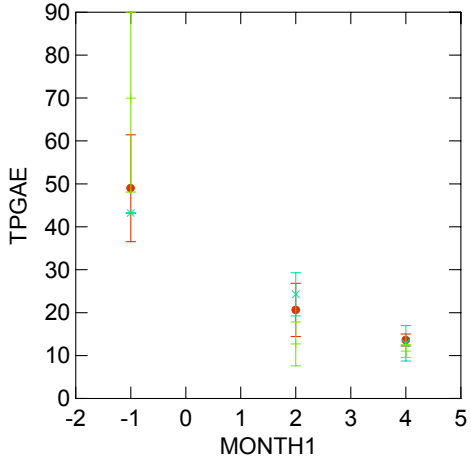
Crest

G. flavescens

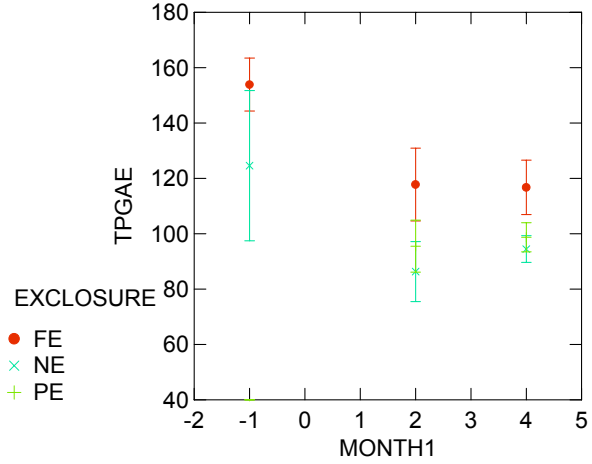


Broad

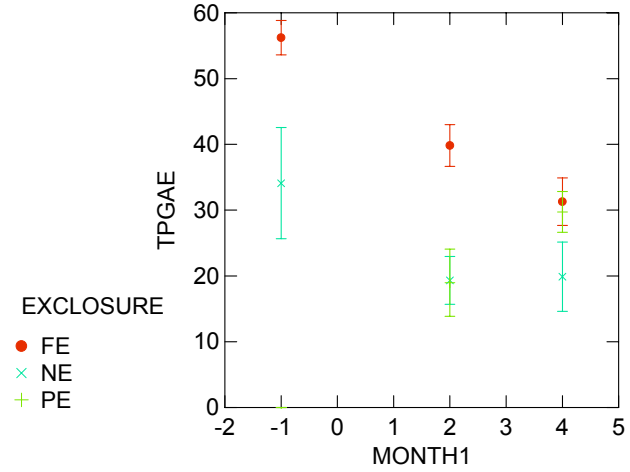
2005-2006 wet season total phenols (%)



A. grandicornuta



A. exuvialis



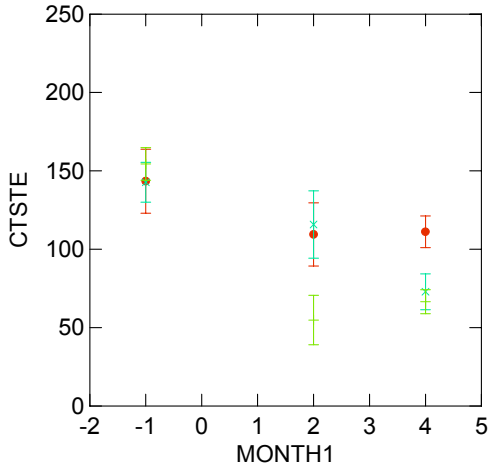
D. cinerea

Fine

Foot

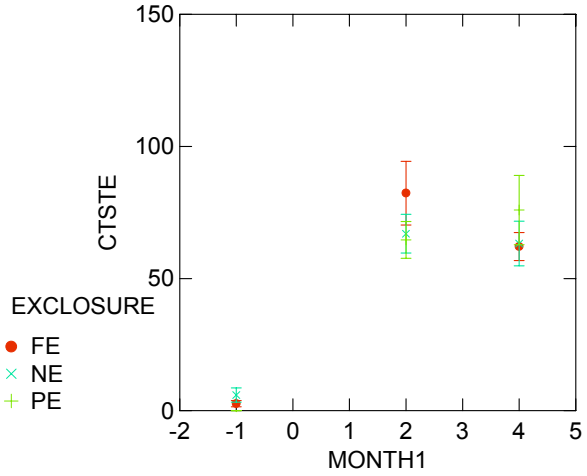
E. divinorum

(evergreen)



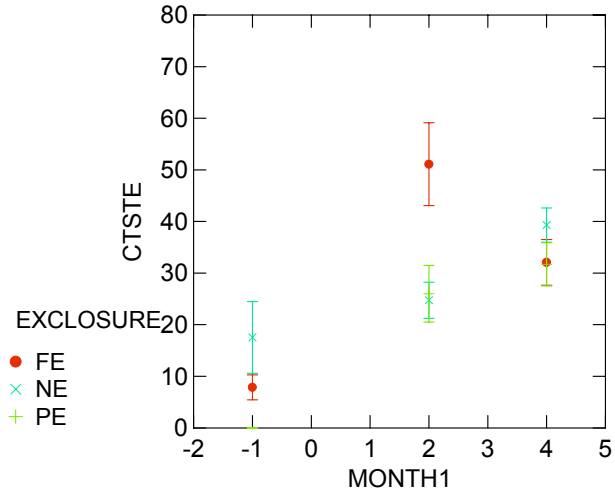
Crest

C. apiculatum

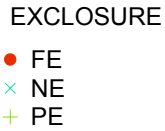


Crest

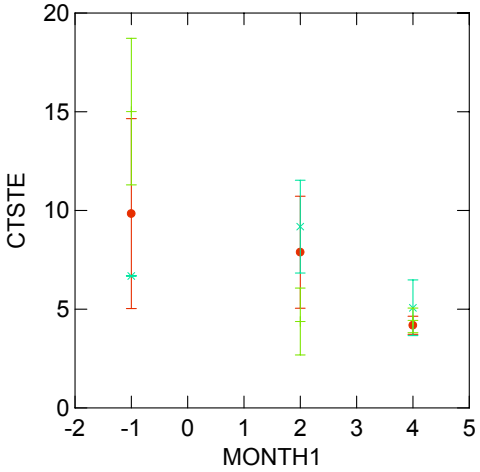
G. flavescens



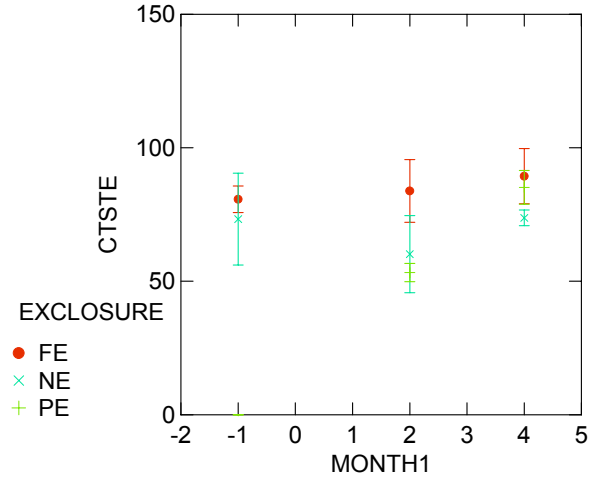
Broad



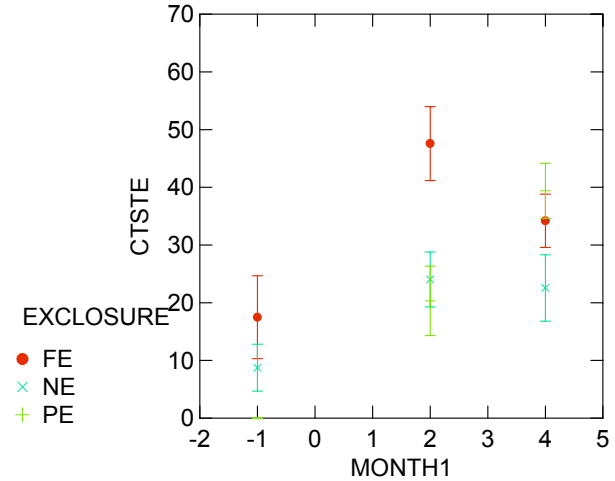
2005-2006 wet season condensed tannins (%)



A. grandicornuta

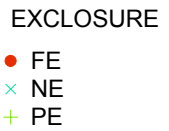


A. exuvialis



D. cinerea

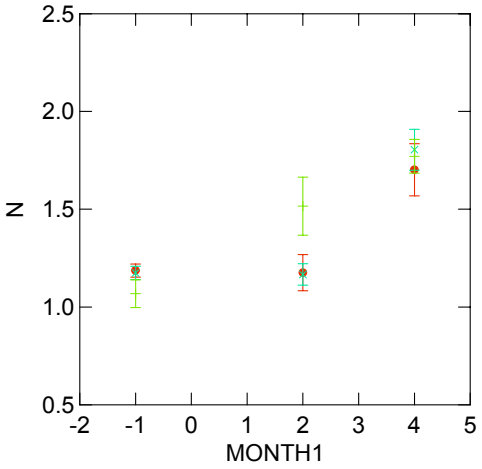
Fine



Foot

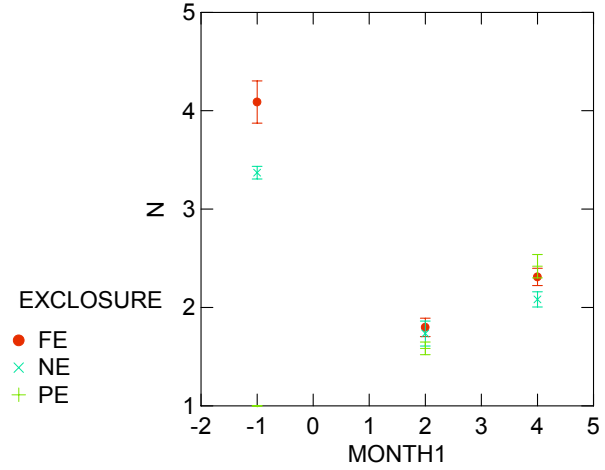
E. divinorum

(evergreen)



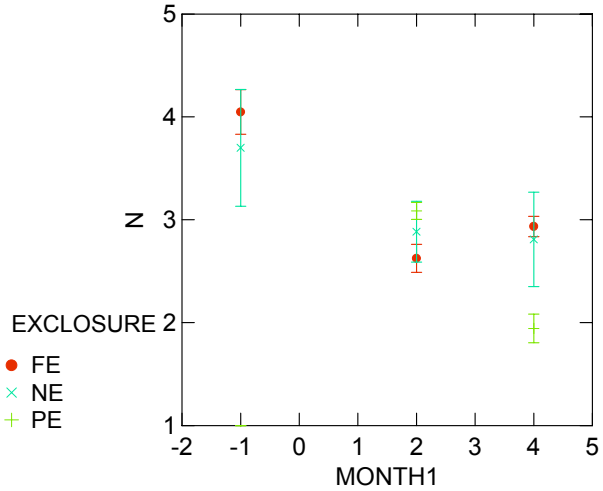
Crest

C. apiculatum



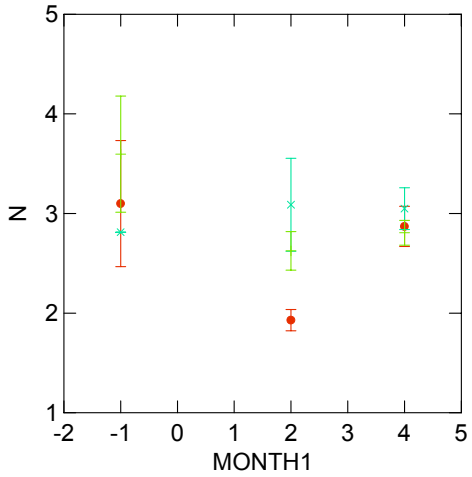
Crest

G. flavescens

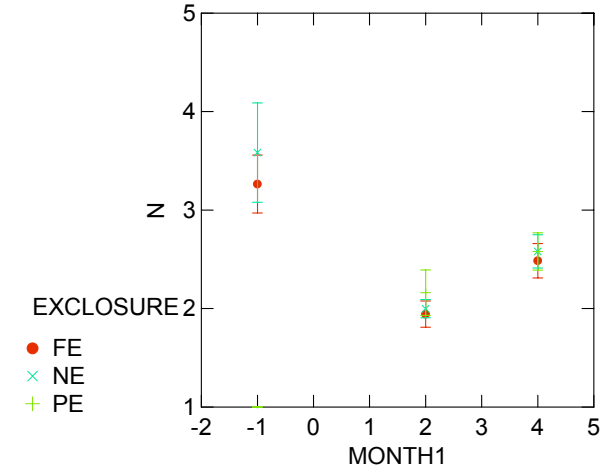


Broad

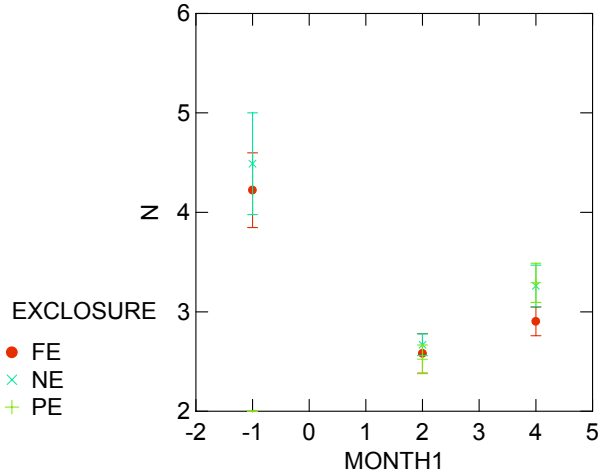
2005-2006 wet season nitrogen (%)



A. grandicornuta



A. exuvialis



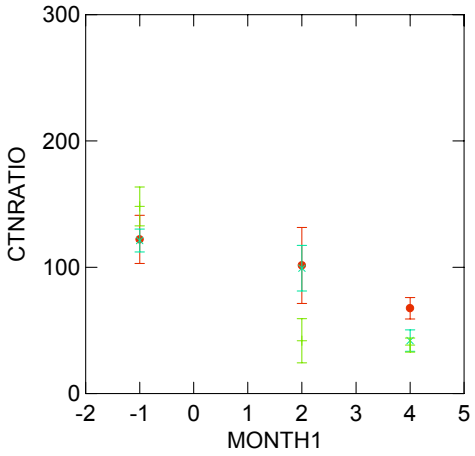
D. cinerea

Fine

Foot

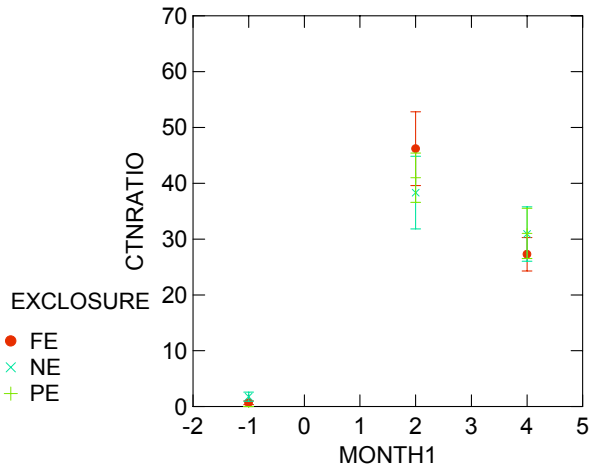
E. divinorum

(evergreen)



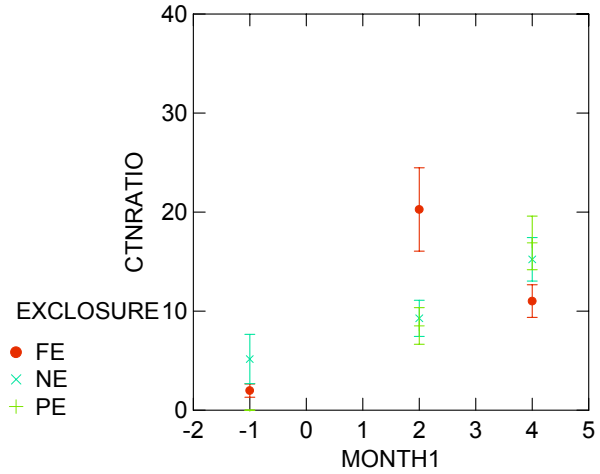
Crest

C. apiculatum



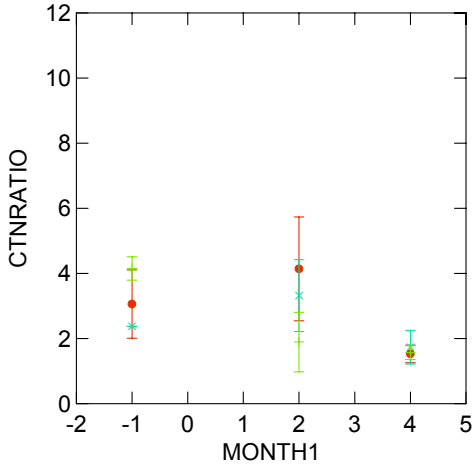
Crest

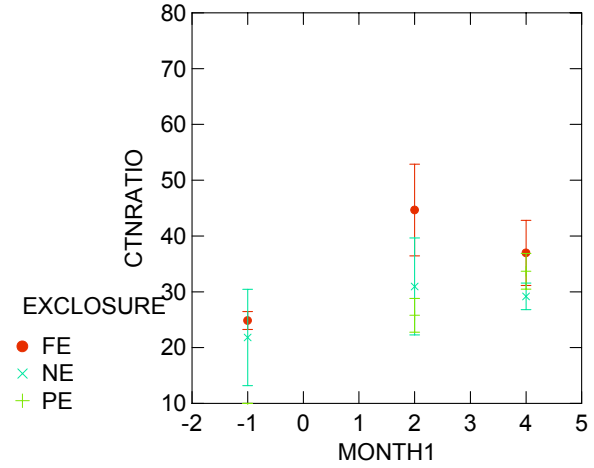
G. flavescens

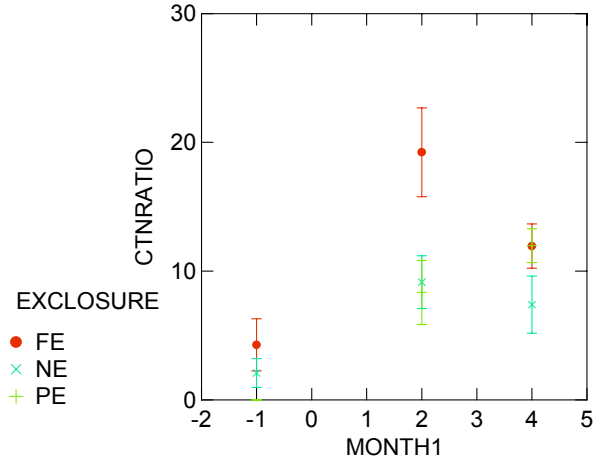


Broad

2005-2006 wet season CT:N







Fine

A. grandicornuta

A. exuvialis

D. cinerea

Summary

- No consistent association between chemistry and spp traits, eg, leaf retention, leaf size/shape, habitat preference, etc
- No clear elevation of defences in less defended species (eg, *A. grandicornuta*) outside full exclosure

Summary: 2005/2006

- NDFsupported predictions
- TP did not
- Crest spp. supported predictions
- Foot spp. did not
- Low CT spp. unch.

Foot

E. divinorum

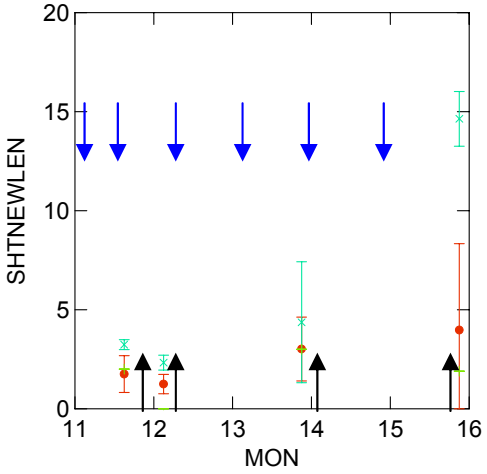
(evergreen)

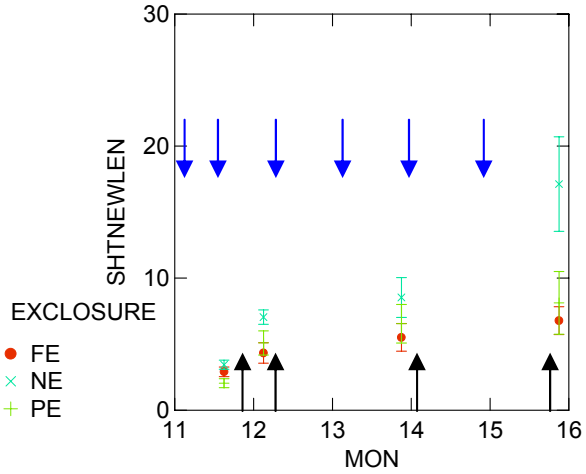
Crest

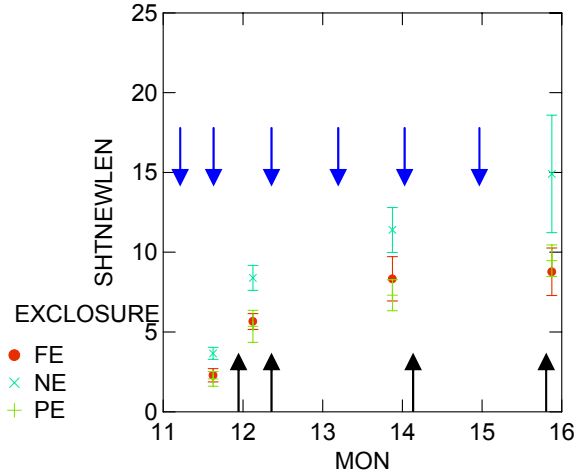
C. apiculatum

Crest

G. flavescens

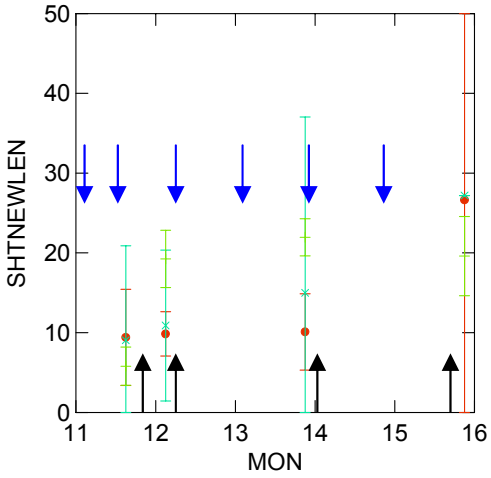


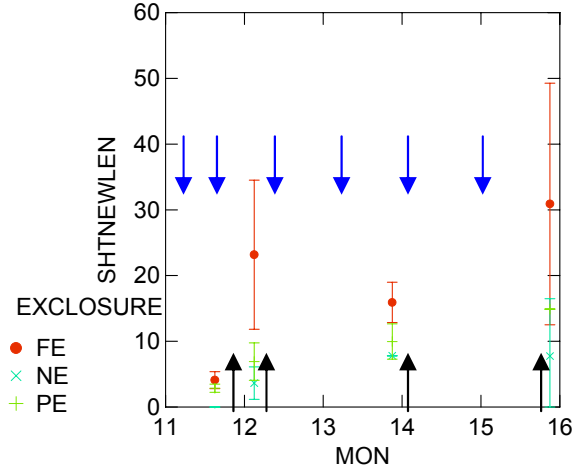


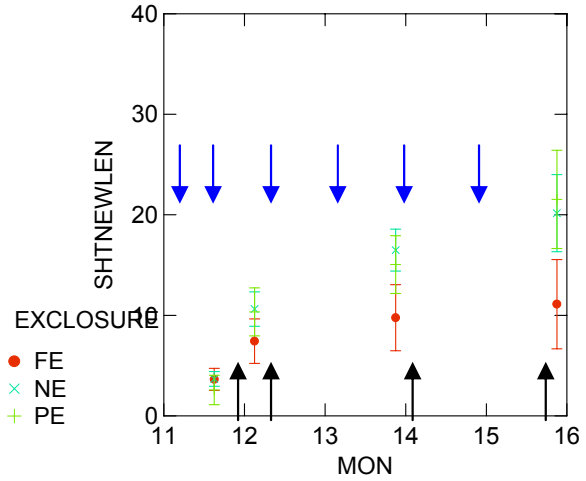


Broad

2006-2007 wet season shoot length (cm)







Fine

A. grandicornuta

A. exuvialis

D. cinerea

What next?

- Complete lab analysis (NDF, ADF, ADL, N, P, CT, TP, PPT) of leaf samples
- Screening for specific low molecular weight phenolics – targeted analysis
- Carbon allocation experiment (^{14}C labeling)
- Controlled browsing experiments
- Impala feeding behaviour experiment

What next?

- Short (<2m) trees in lower half (most browsed) of treatments in 2007/8
- Validate apparent effects (2005-2007) in 3-4 spp. (increase sample sizes)
- Population structure of main spp.

Acknowledgements

- National Research Foundation
- University of Zululand
- Agricultural Research Council
- Swedish Research Council
- Swedish International Development Agency