Spatial pattern analysis of encroaching species in a semi-arid savanna

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Introduction

• Encroachment is the suppression of palatable grass and herbs by undesired woody species

• Factors promoting bush encroachment include:
  – Heavy grazing
  – Fire (presence or absence)
  – Precipitation
  – Global climate change
Sankaran et al. (2005) found that <650 mm MAP, rainfall was key factor.
Key questions

• Is there an effect of grazing on the spatial pattern of woody species?

• Does season of grazing have an effect on the spatial pattern of woody species?

• Can we identify interactive patterns among the common species?
The composition of any mature stand of vegetation is shaped by competition and facilitation.

- Trees compete when their zones of influence overlap.
Facilitation describes species interactions that benefit at least one of the participants.
Spatial pattern analysis allows ecologists to determine the existence of underlying processes.

Random

Regular

Clustered
Programita uses Monte Carlo simulations to compare the actual distribution of trees to completely random distributions.
Interpretation of point patterns

O-ring Statistic

Spatial Scale, m
Interpretation of point patterns

O-ring Statistic

Spatial Scale, m

aggregated = facilitation
random = competition
Interpretation of point patterns

Interpretation of point patterns

O-ring Statistic

Spatial Scale, m

 aggregated
 = facilitation

 random

 regular
 = competition
Grootfontein – oldest grazing trials in southern Africa

- Continuous grazing vs continuous rest
Timing of grazing is also important.
Four common species

- Searsia erosa
- Searsia burchellii
- Diospyros lycioides
- Erioccephalus ericoides
Change of dominance
Continuous rest – *E. ericoides* randomly distributed
Winter grazing – S. erosa vs. others mostly random
Summer grazing – facilitation between \textit{S. erosa} and others
Continuous grazing shows facilitation between S. burchellii and other species.
Conclusions

• Dominance change from continuous rest to continuous grazing
  – Shift from *E. ericoides* to *S. burchellii* & *D. lycioides*

• Seasonal effect of grazing
  – Shift from *S. erosa* (winter) to *S. burchellii* & *D. lycioides* (summer)

• Facilitation more common than expected
O-ring statistic can detect aggregation or regularity at a given distance $h$. 