Long-term changes in mopane woodland vegetation structure: A case study of the Linyanti region, Botswana.

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Context of the study

•Trees as ‘keystone structures’ in landscapes

• Structural changes to woody vegetation change ecosystem functions

Colophospermum mopane

- Southern Africa
- Altitude: 400 – 700 m.a.m.s.l
- Rainfall: 200 – 800 mm p.a

Colophospermum mopane

Mopane is important forage for different browsers in different seasons

Wet Season

- **water-stressed browsers**

End of Dry Season

- **non-water stressed browsers**
- **utilise early flush during critical period**


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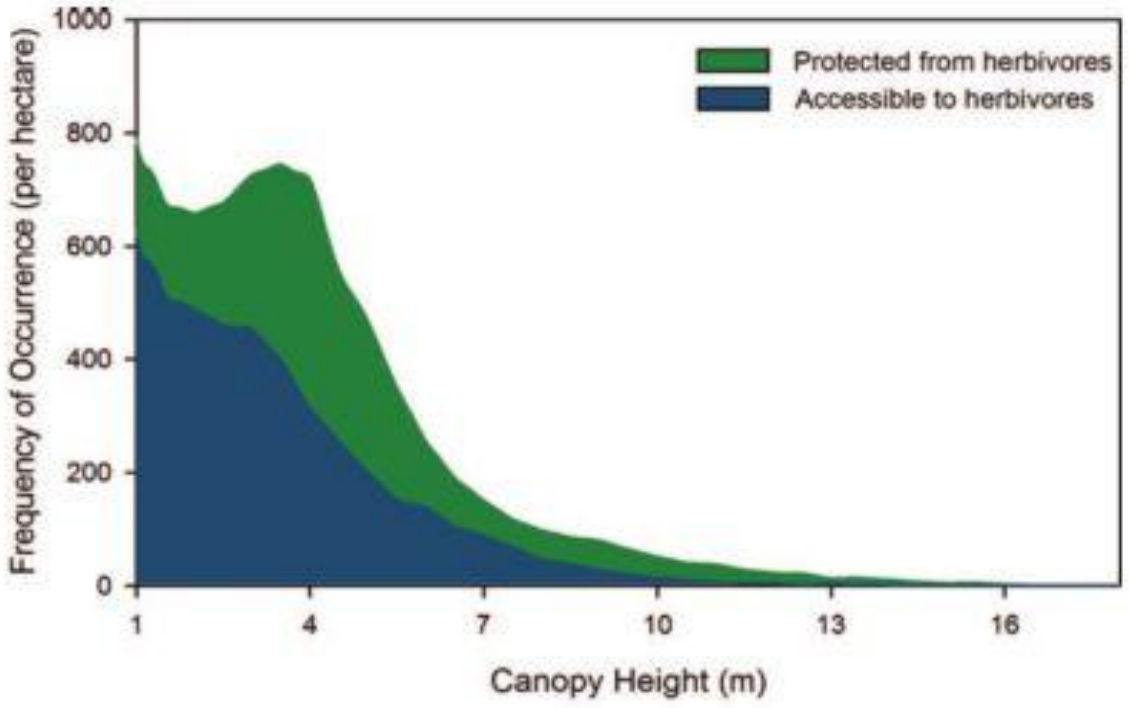
Colophospermum mopane

- Coppice on felled logs

Agents of structural change

- Elephants change woody vegetation structure



Asner *et al.* 2009. *PNAS*.

Linyanti Region

Linyanti

Monospecific mopane woodland

Elephant densities

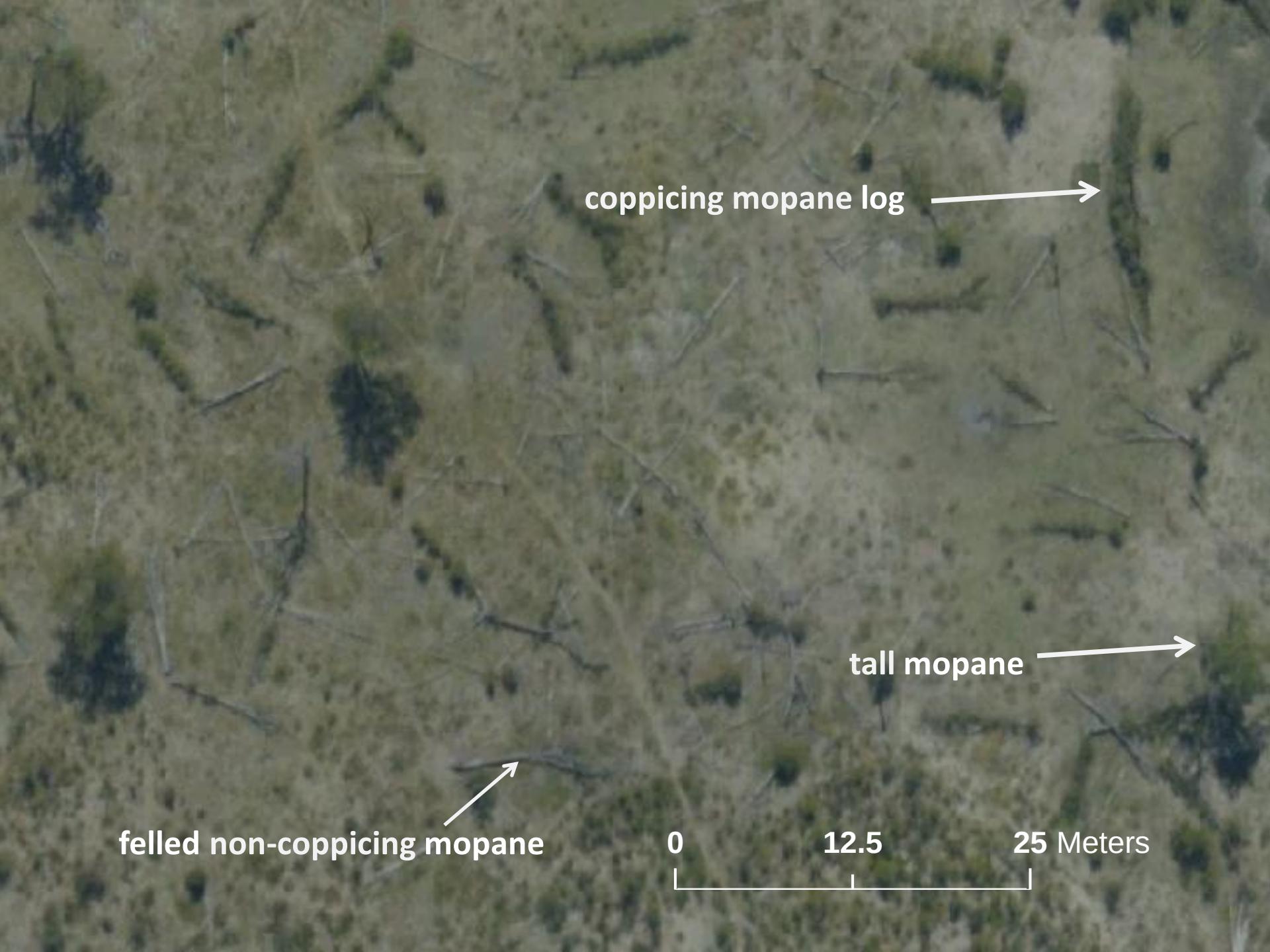
Botswana has highest elephant densities globally

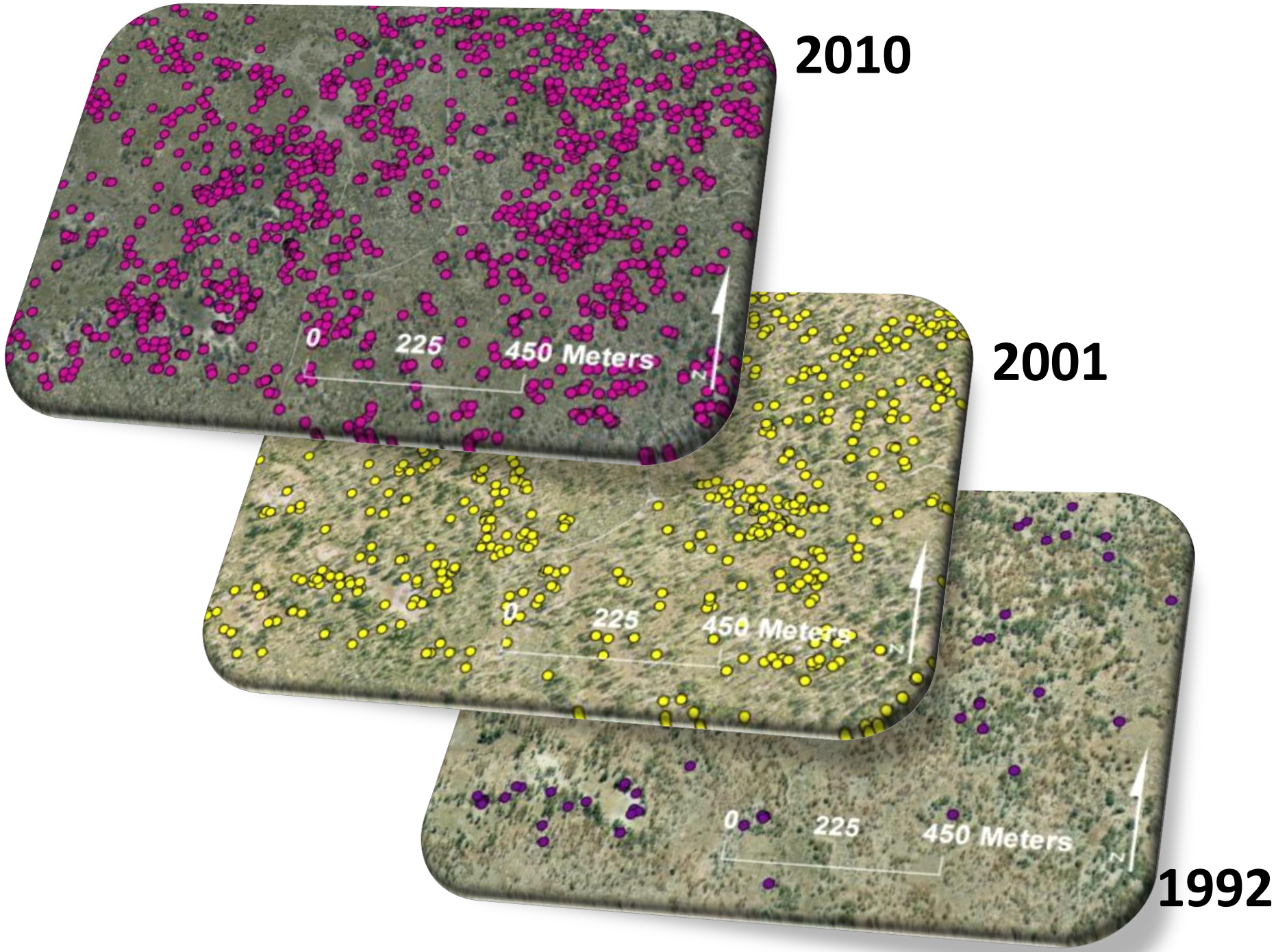
Average Linyanti density:

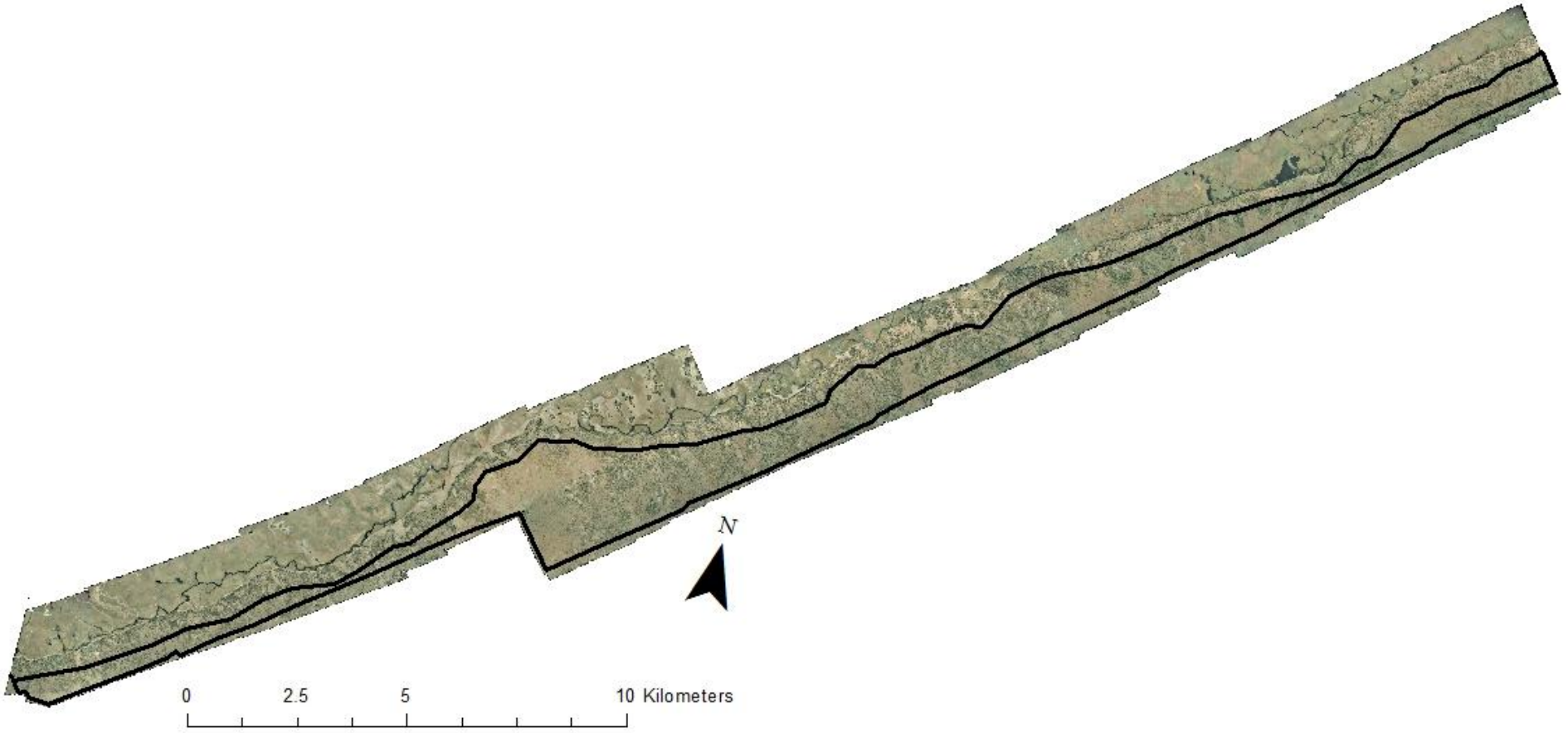
up to 12 elephants/km^2

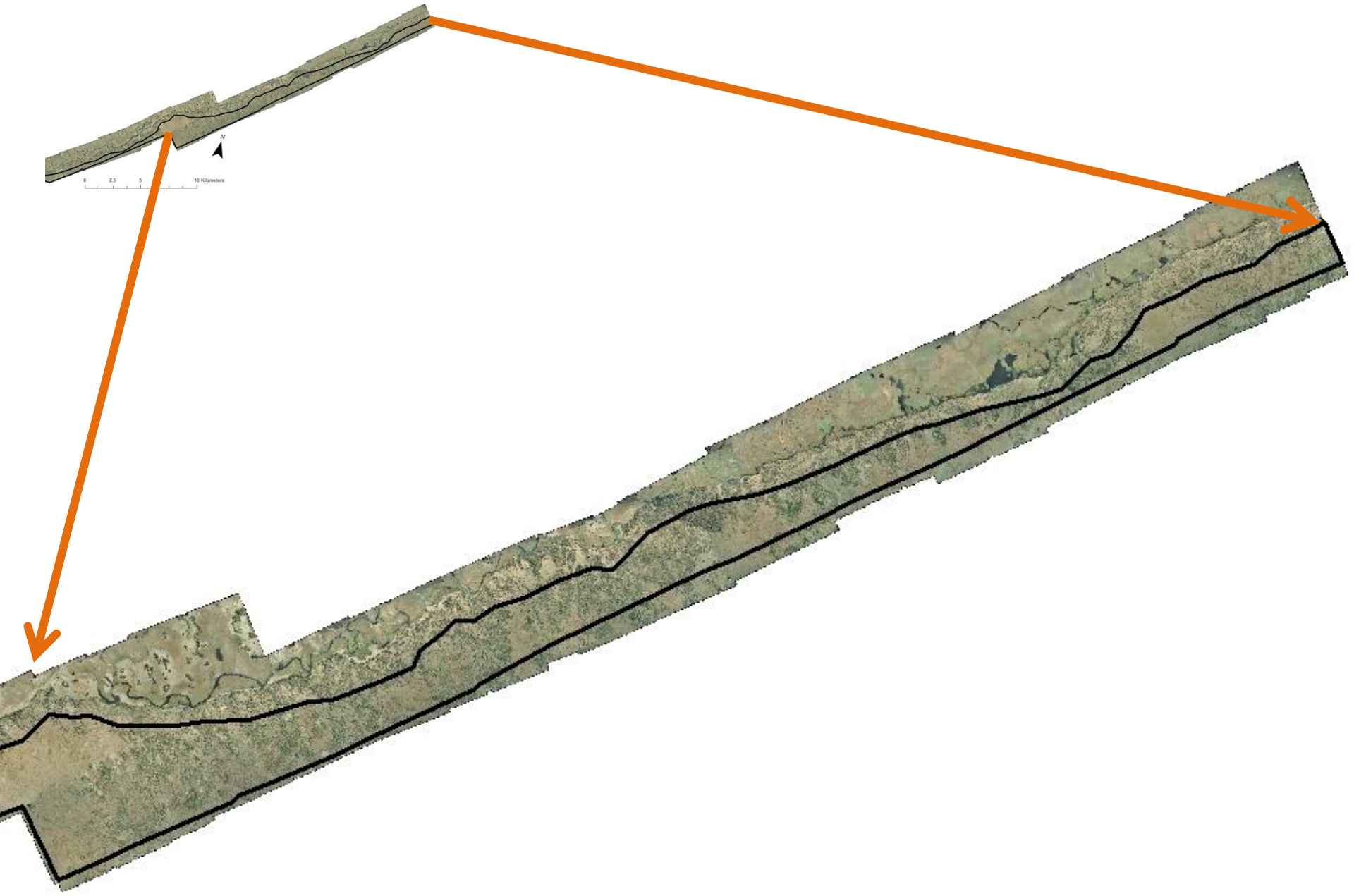
What are the changes in spatial patterns of

tall, standing; coppicing, felled; and dead mopane?

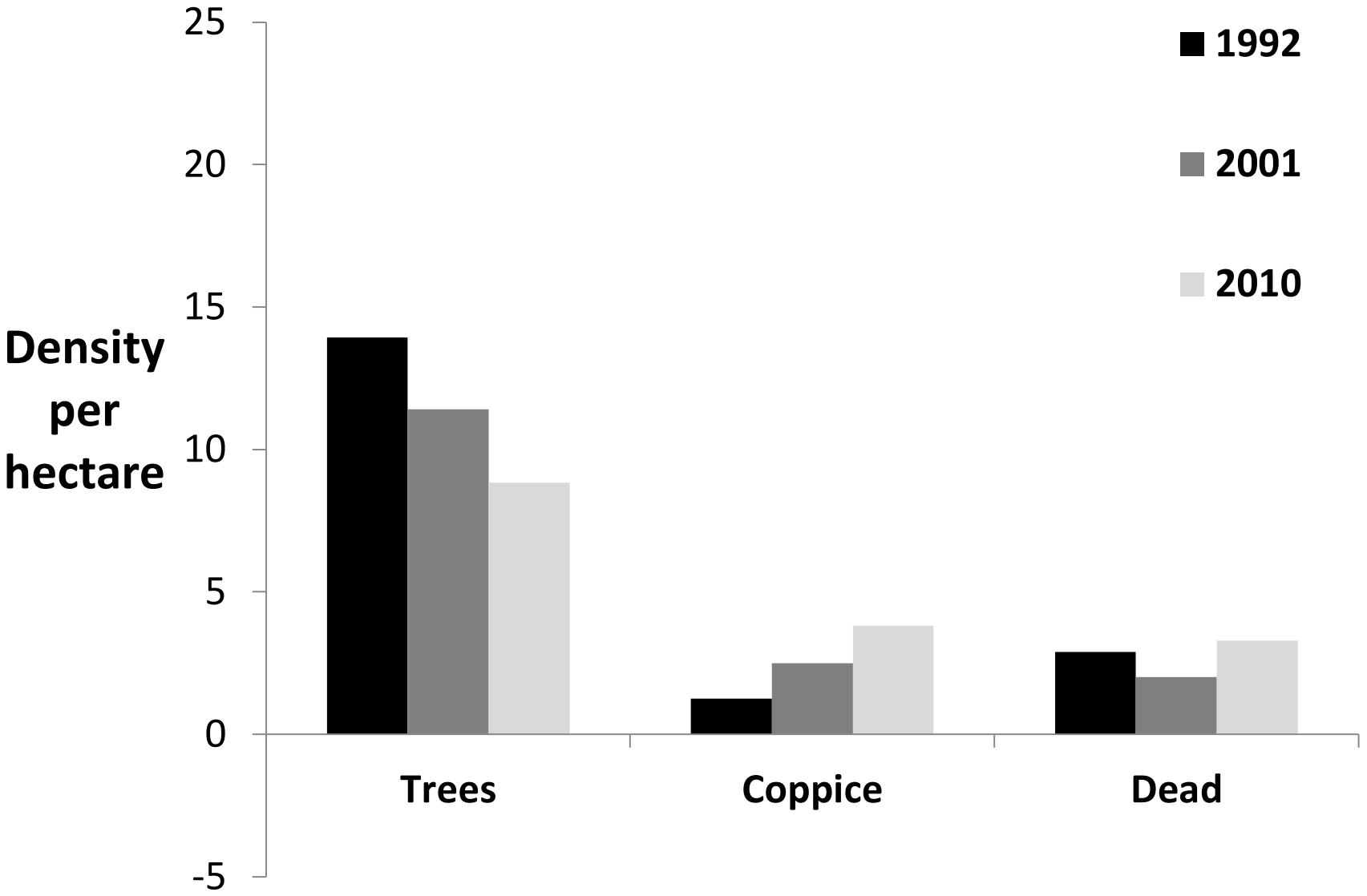

coppicing mopane log
tall mopane
felled non-coppicing mopane
0
12.5
25 Meters


2010
0
225
450 Meters
N
2001
0
225
450 Meters
N
1992
0
225
450 Meters
N

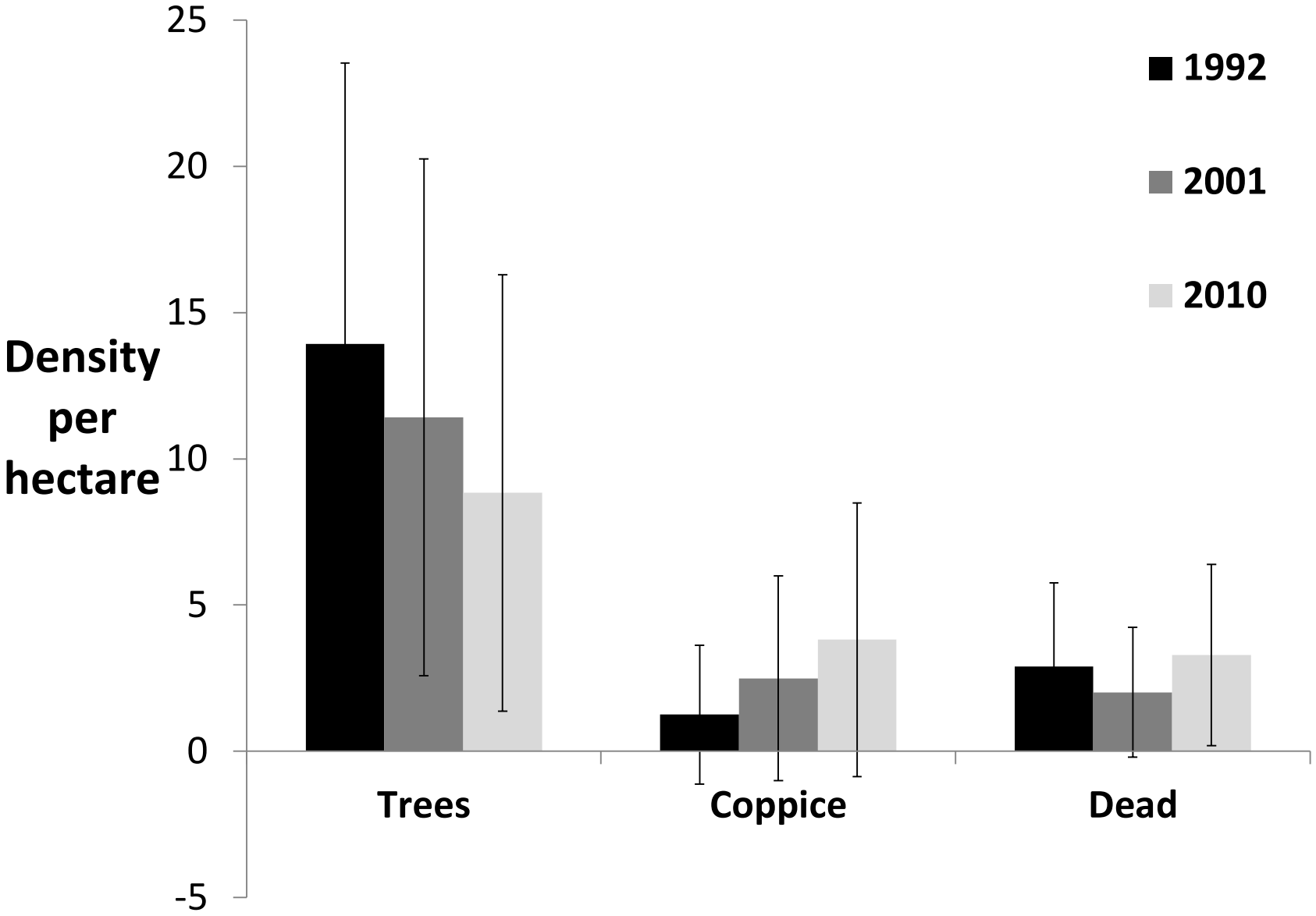

N
0
2.5
5
10 Kilometers


N
0
2.5
5
10 Kilometers

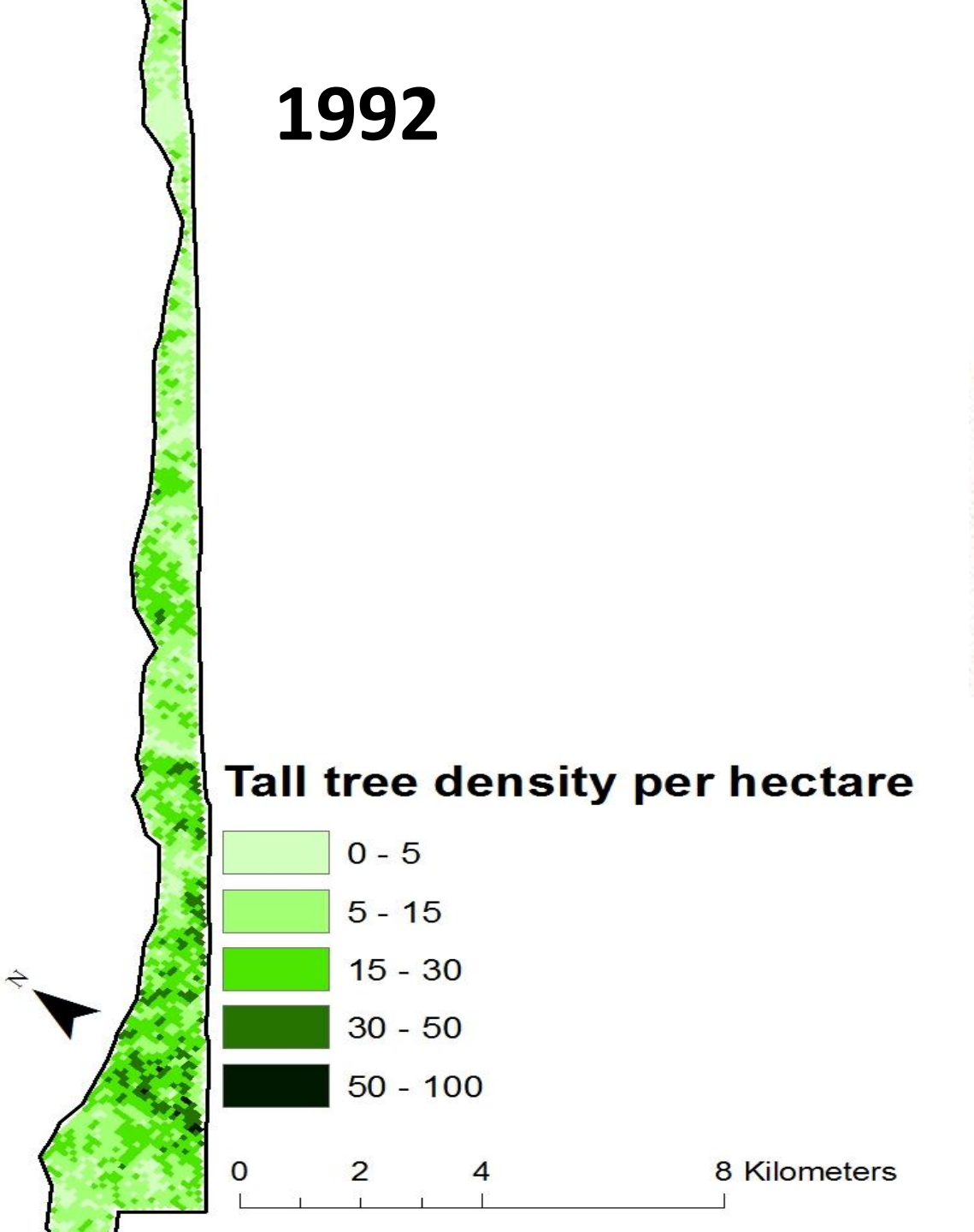
Average densities of mopane growth forms

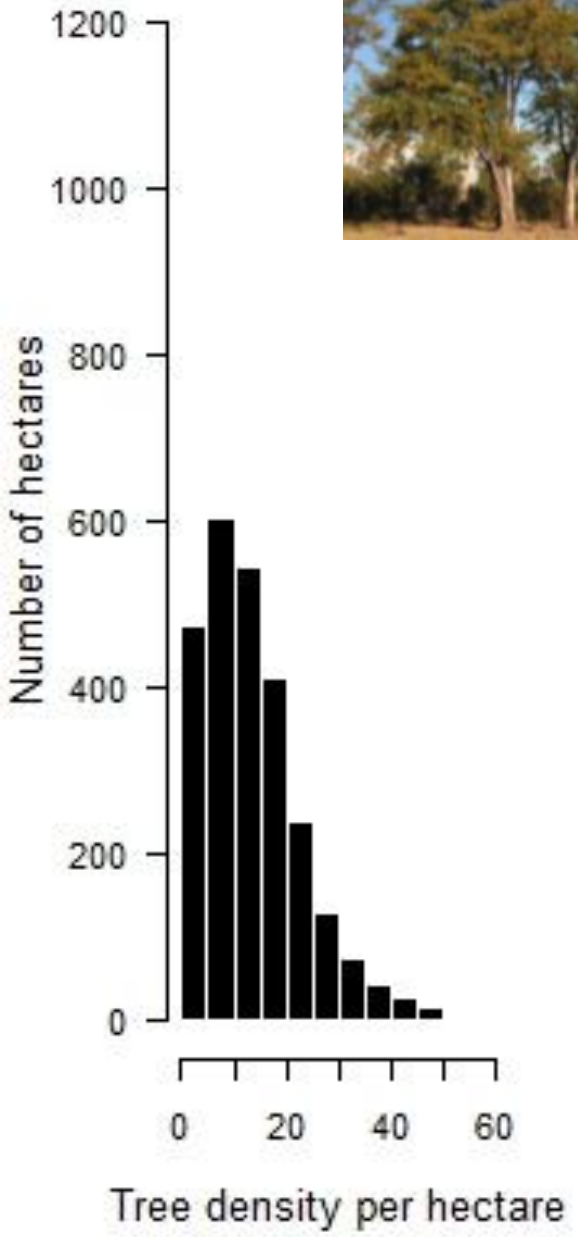


Average densities of mopane growth forms



1992

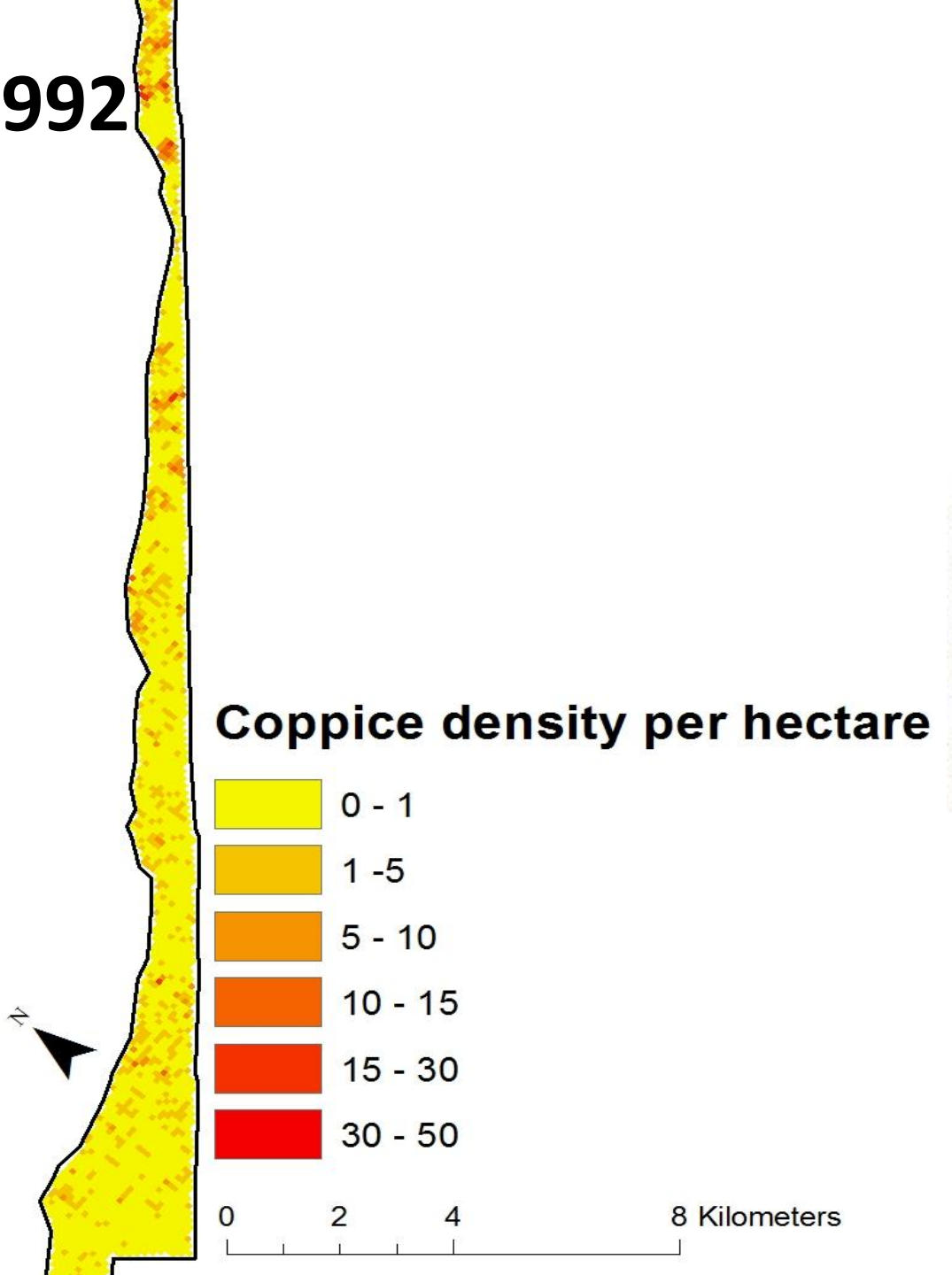

Tall tree density per hectare
0 - 5
5 - 15
15 - 30
30 - 50
50 - 100
N
0
2
4
8 Kilometers

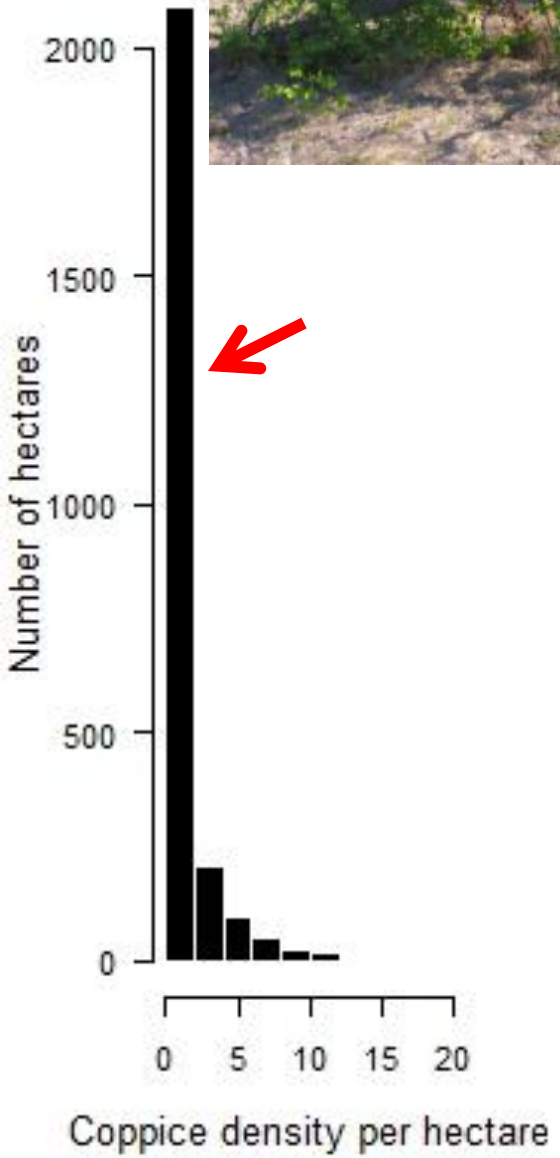

Number of hectares
1200
1000
800
600
400
200
0
0
20
40
60
Tree density per hectare

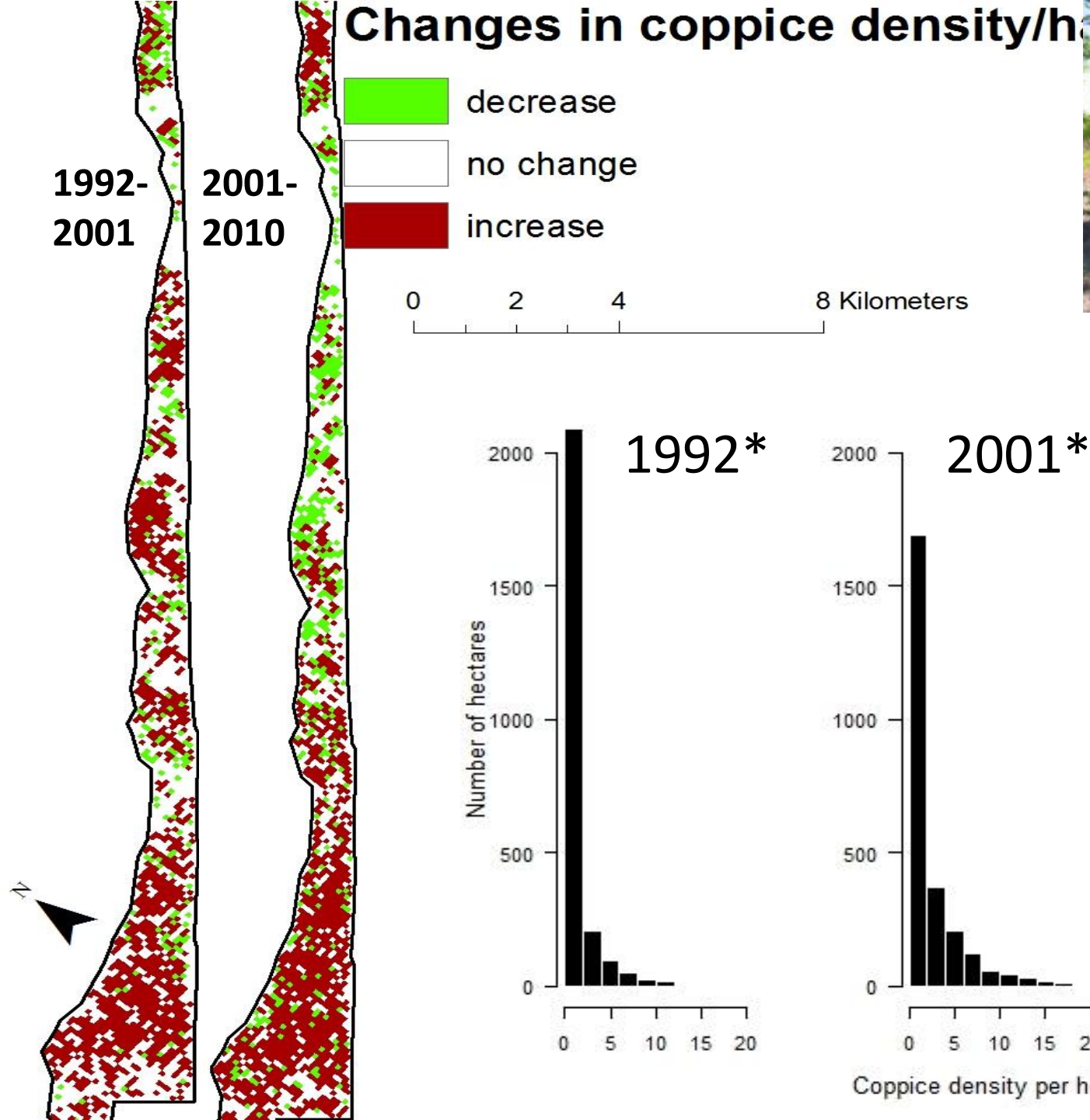
Density changes of tall trees/ha

KS Test *p<0.001

1992

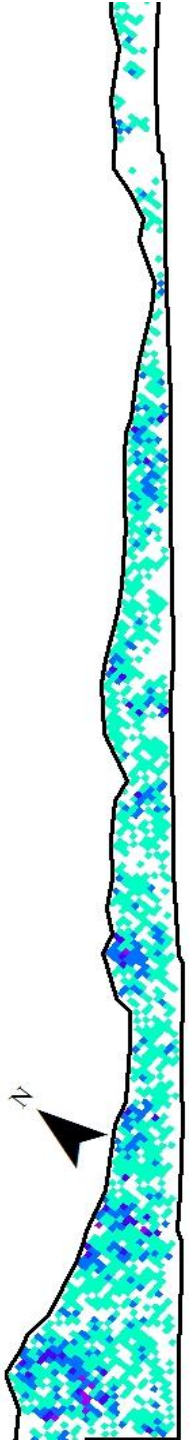

Coppice density per hectare
0 - 1
1 -5
5 - 10
10 - 15
15 - 30
30 - 50
N
0
2
4
8 Kilometers


2000
1500
1000
500
0
Number of hectares
0
5
10
15
20
Coppice density per hectare


Changes in coppice density/ha
decrease
no change
increase
1992-2001
2001-2010
0
2
4
8 Kilometers
N

1992*
2001**
2010***
Number of hectares
2000
1500
1000
500
0
0
5
10
15
20
Coppice density per hectar
KS Test *p<0.001

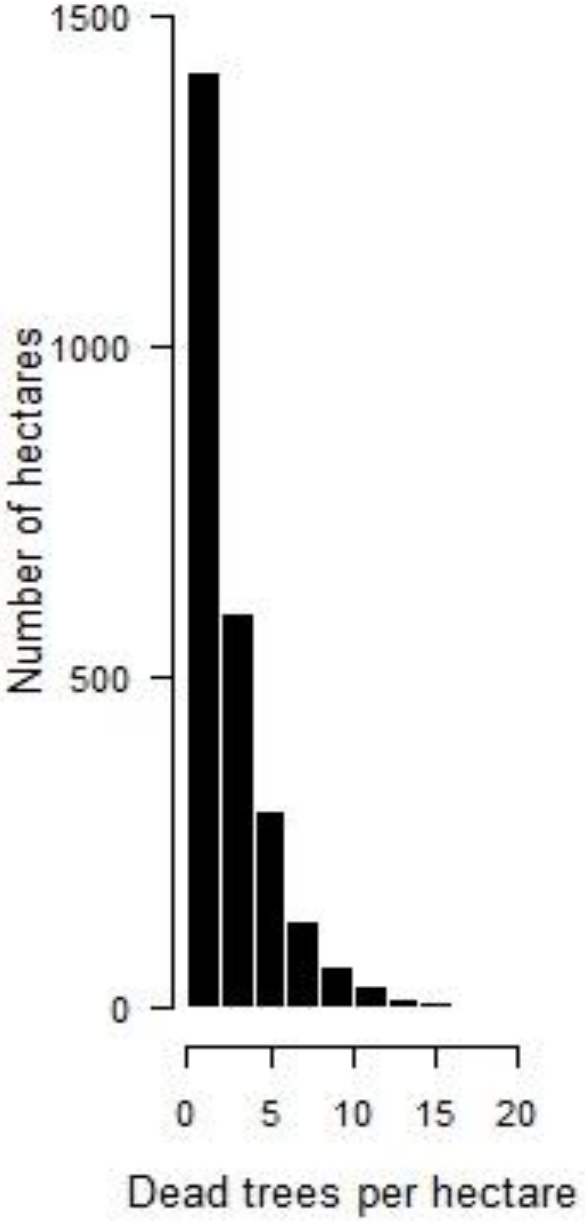
1992



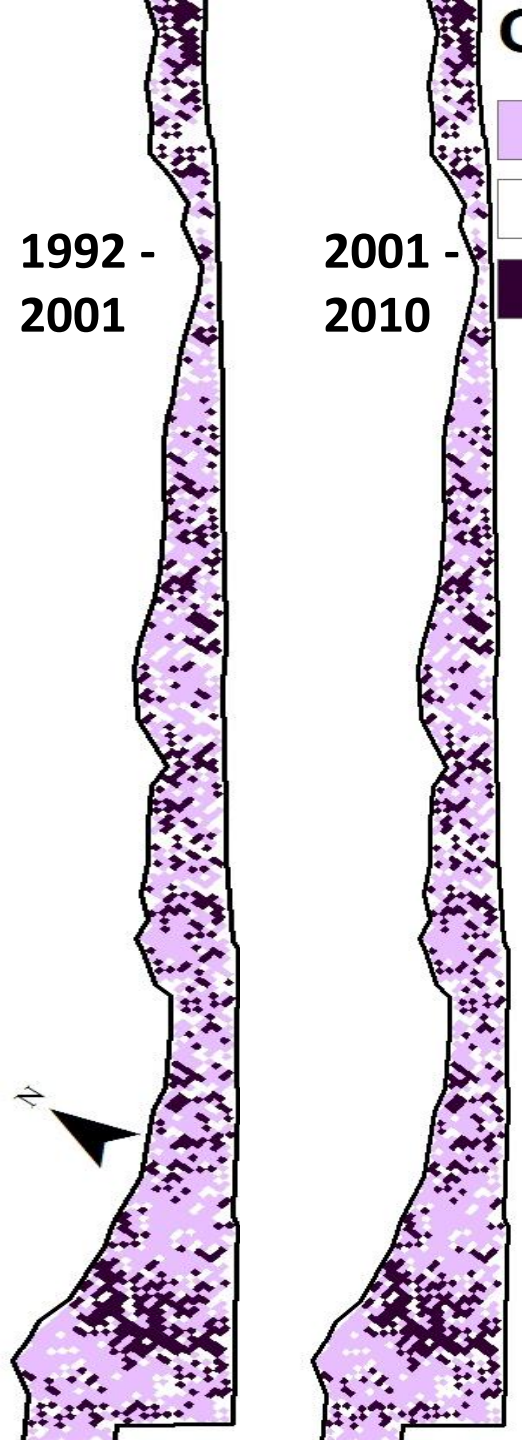
Dead log density per hectare

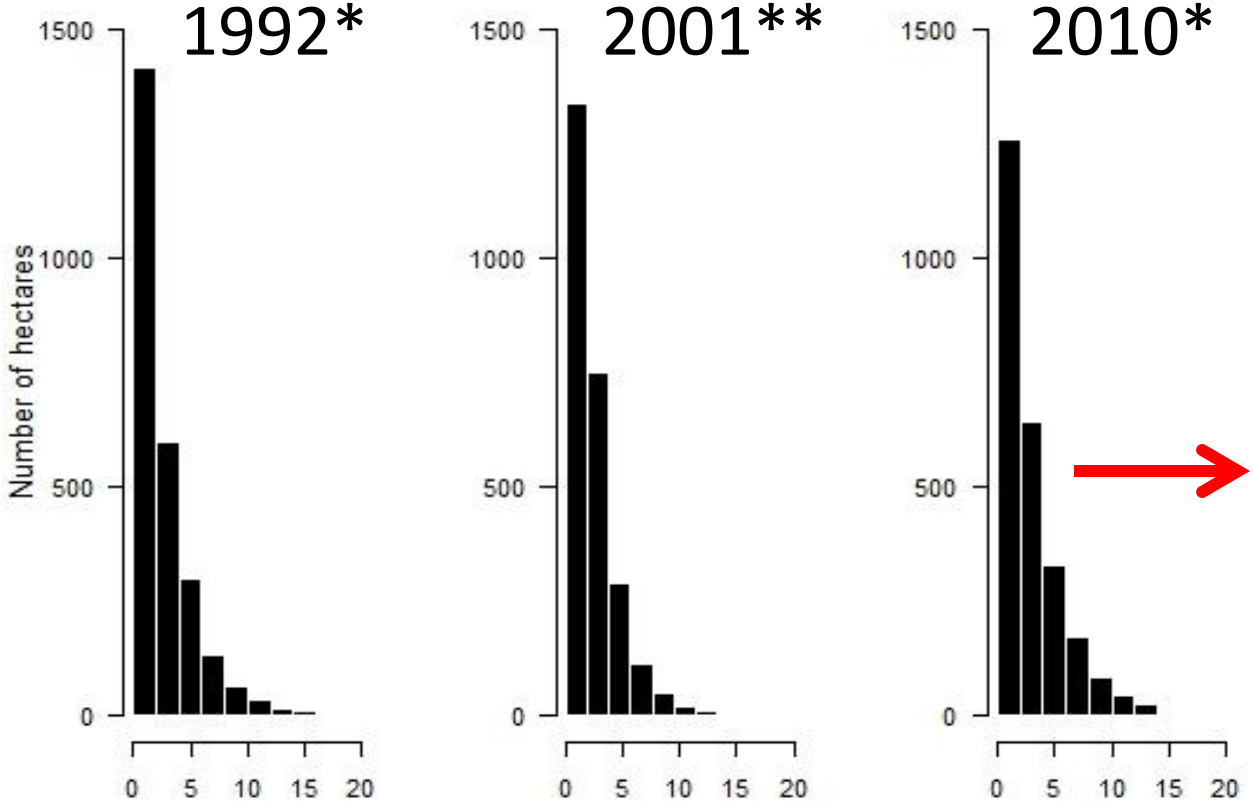
- 0 - 1
- 1 - 5
- 5 - 10
- 10 - 15
- 15 - 30
- 30 - 50

0 2 4 8 Kilometers



Changes in dead log densities/ha





KS Test *p<0.05

Summary

- Decreasing overall tree **densities**
- Point-pattern analysis: tree **spatial patterns** have not changed

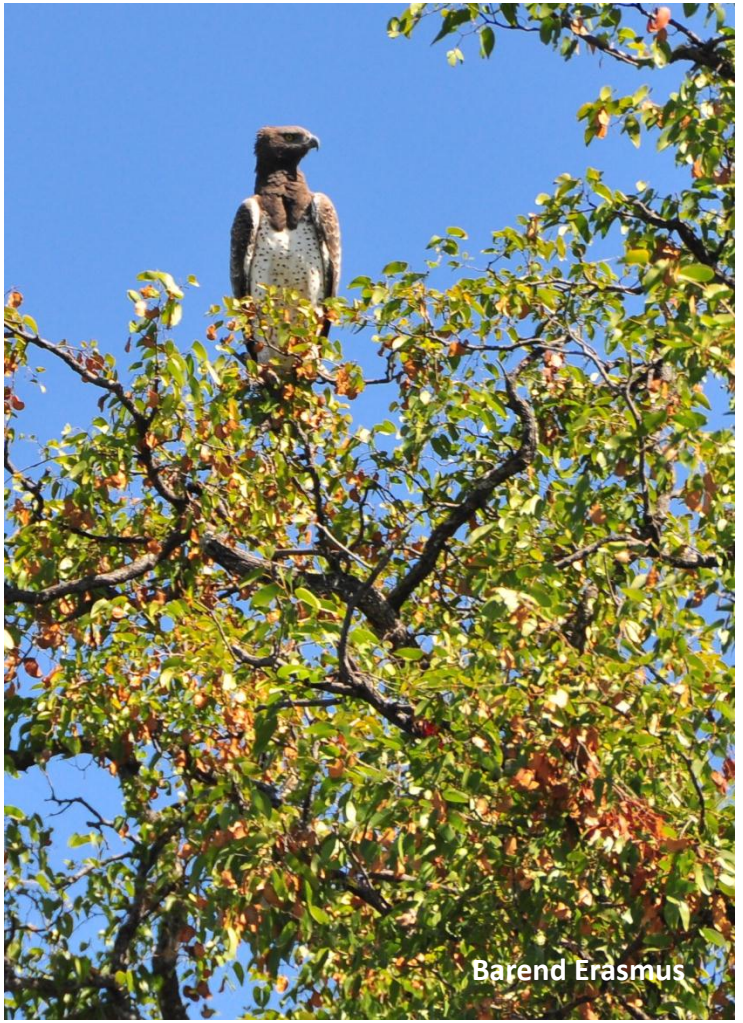
Summary

- Decreasing overall tree densities
- Point-pattern analysis: tree spatial patterns have not changed
- Coppicing and dead logs have increased in **density** and **evenness**

Structural changes affect ecosystem function

Cons of losing big trees

- Reduce abundance of woodland birds



Structural changes affect ecosystem function

Cons of losing big trees

- Reduce abundance of woodland birds
- Loss of shade

Structural changes affect ecosystem function

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- Loss of shade
- Larger trees enhance soil nutrients more than smaller trees

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Pros of increased structural diversity

- Seedling germination

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Pros of increased structural diversity

- Seedling germination
- Cover for small animals
- Accessible forage

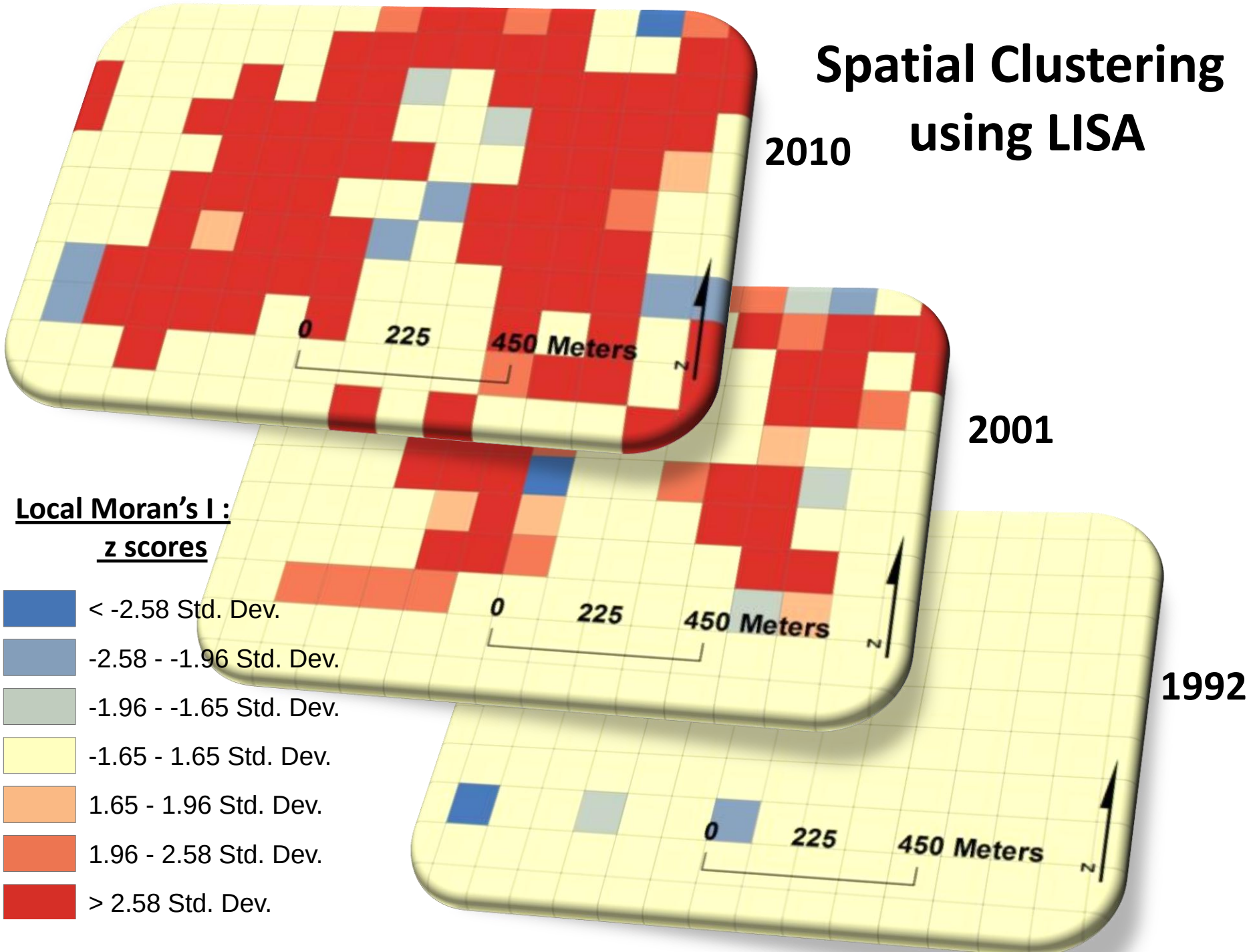
Conclusion

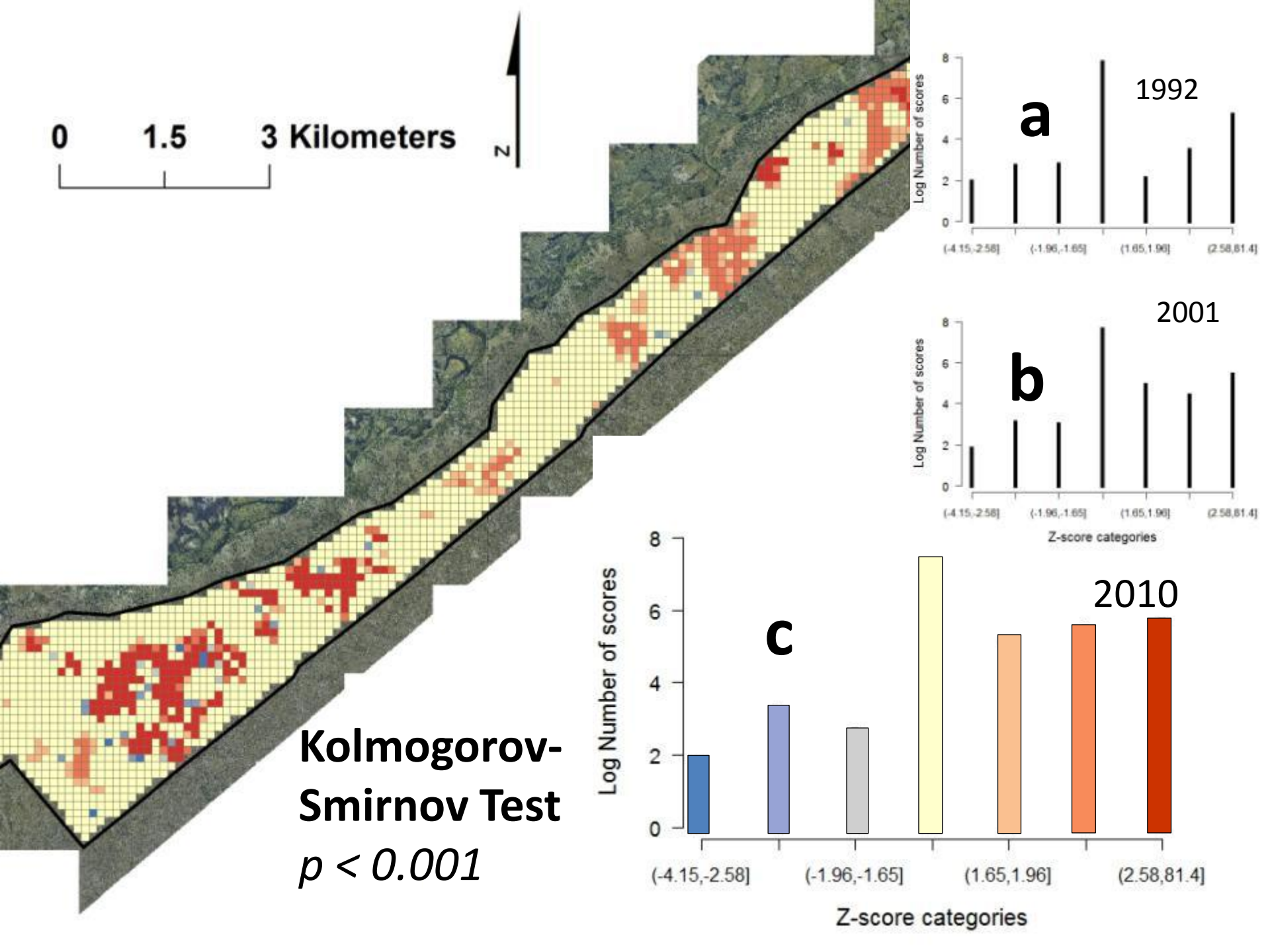
- Changes to vegetation structure over 18 years
- Repercussions on ecosystem functioning

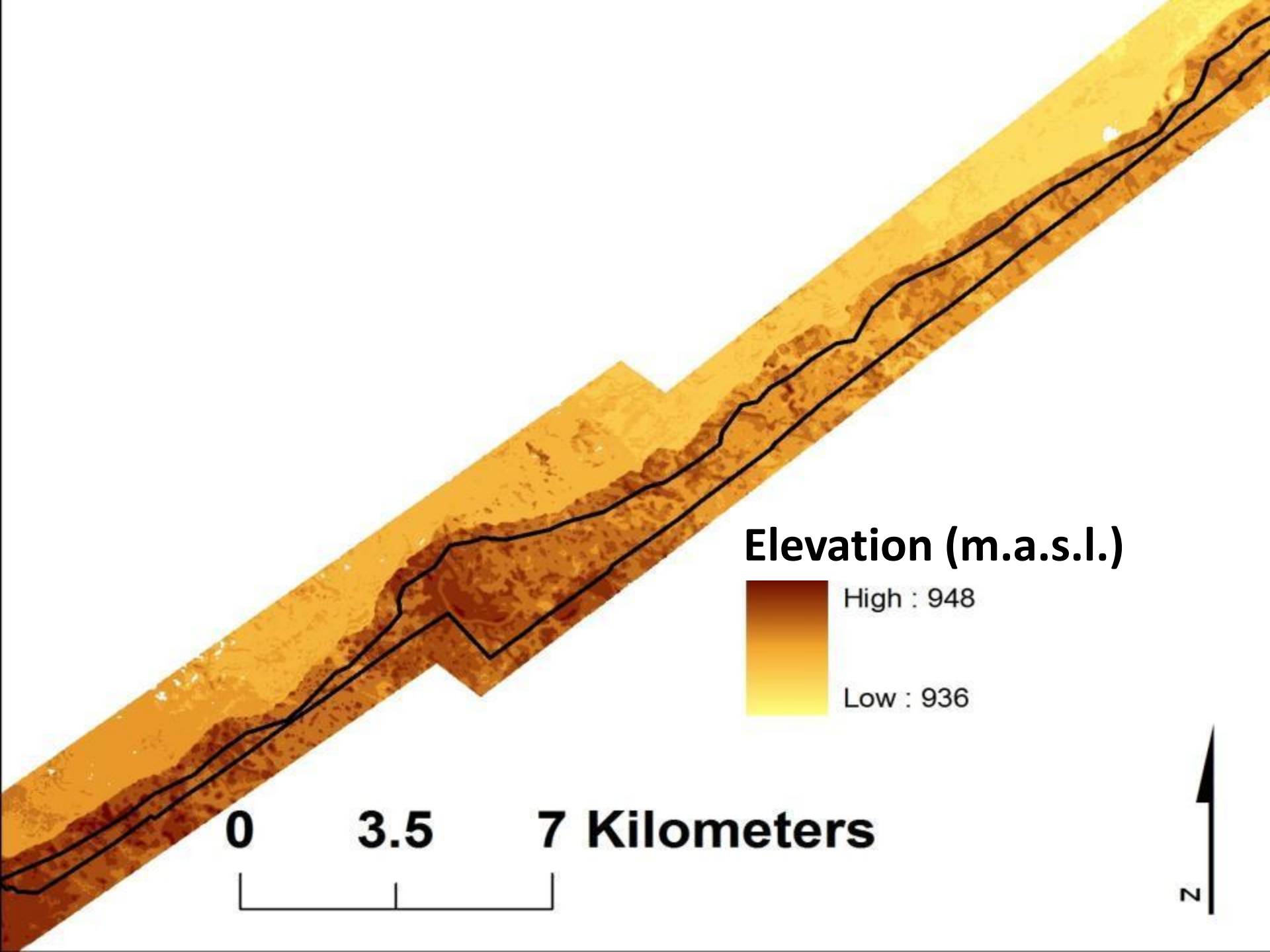
Acknowledgements

- Southern Mapping
- NRF
- Wilderness Wildlife Trust
- University of the Witwatersrand

Spatial Clustering using LISA




0
1.5
3 Kilometers
N
a
1992
b
2001
c
2010
Log Number of scores
Z-score categories
(-4.15,-2.58]
(-1.96,-1.65]
(1.65,1.96]
(2.58,81.4]
Kolmogorov-Smirnov Test
p < 0.001


Elevation (m.a.s.l.)
High : 948
Low : 936
0
3.5
7 Kilometers
N


Barend Erasmus


Barend Erasmus


Barend Erasmus


1992
2001
2010

Ripley's K : Coppice