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Can Plants be used as Indicators of the Impacts of Livestock Grazing on Carabid Beetles in Upland Calcareous Grasslands?

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Ashley Lyons, Paul Ashton, Ian Powell & Anne Oxbrough



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Calcareous Grassland

- Exceptional diversity of plants and invertebrates
- Europe's most species rich and diverse habitat



Changes in Management Post WWII

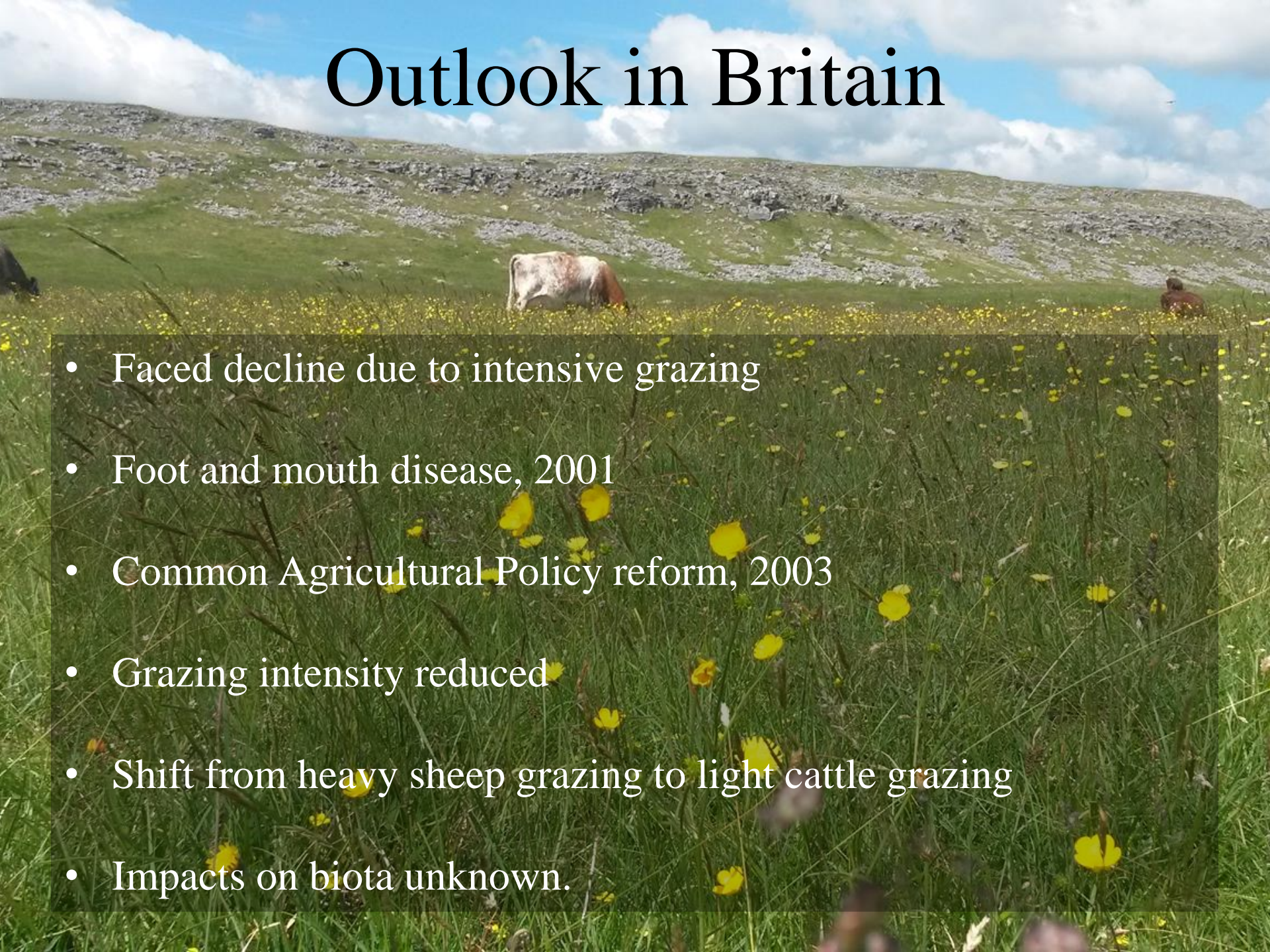
A landscape photograph showing a semi-natural dry grassland. The foreground is filled with green grass and numerous bright yellow flowers. In the middle ground, a cow with white and brown patches is grazing. The background consists of rolling hills with rocky outcrops under a blue sky with scattered white clouds.

- Agricultural intensification resulted in dramatic loss of plant species richness
- Large areas lost
- EU Habitats Directive Annex 1 habitat (6210: Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*))

Current Extent

Location	Area
Europe	595973ha
United Kingdom	33419ha
Upland Britain	60-75%

Outlook in Britain

A landscape photograph of a grassy field with yellow flowers and a cow grazing, under a blue sky with clouds. The field is filled with green grass and numerous bright yellow flowers. In the middle ground, a cow with white and brown patches is grazing. The background shows rolling hills with rocky outcrops under a blue sky with scattered white clouds.

- Faced decline due to intensive grazing
- Foot and mouth disease, 2001
- Common Agricultural Policy reform, 2003
- Grazing intensity reduced
- Shift from heavy sheep grazing to light cattle grazing
- Impacts on biota unknown.

Questions

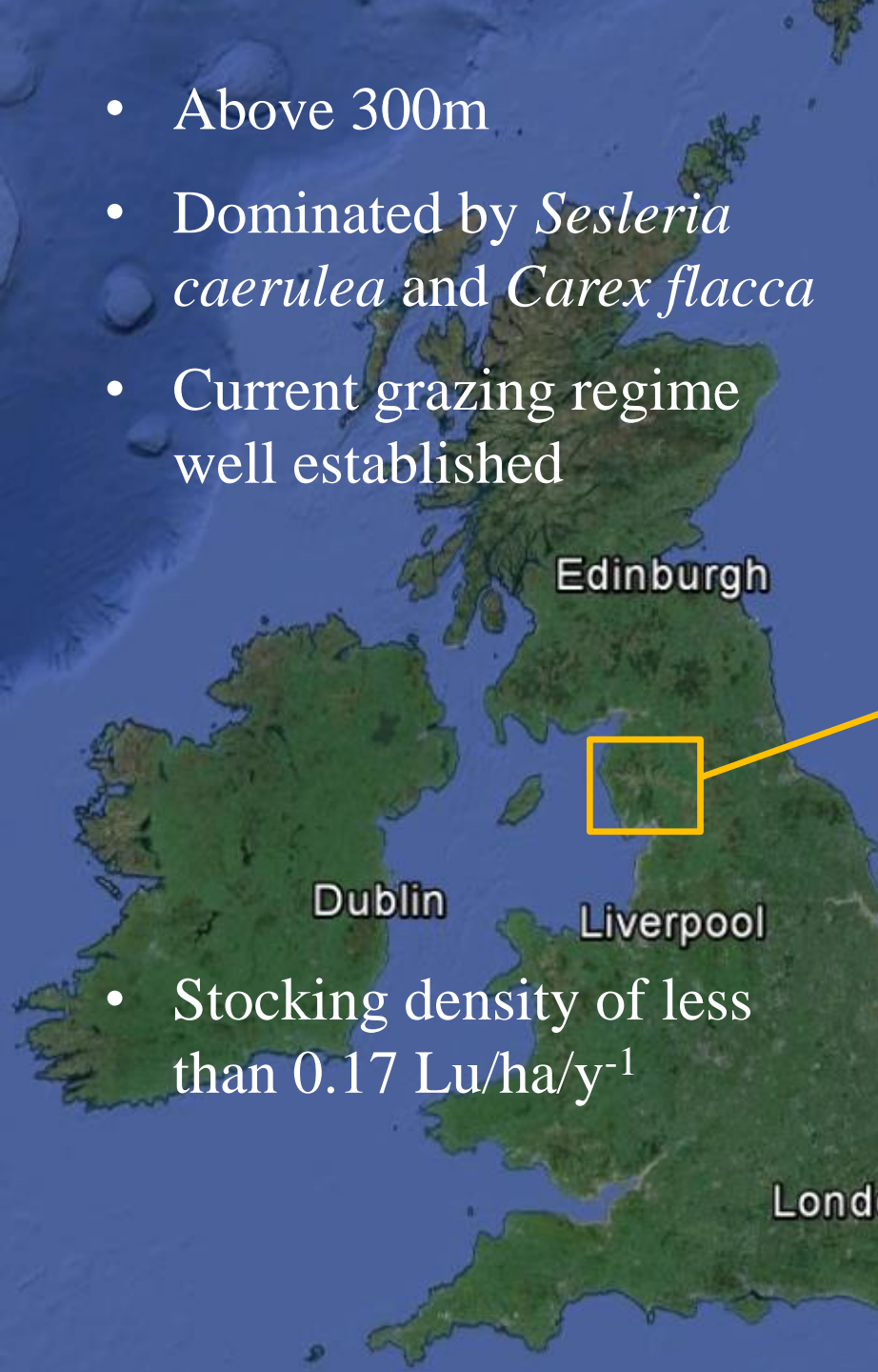
Sheep

Cattle

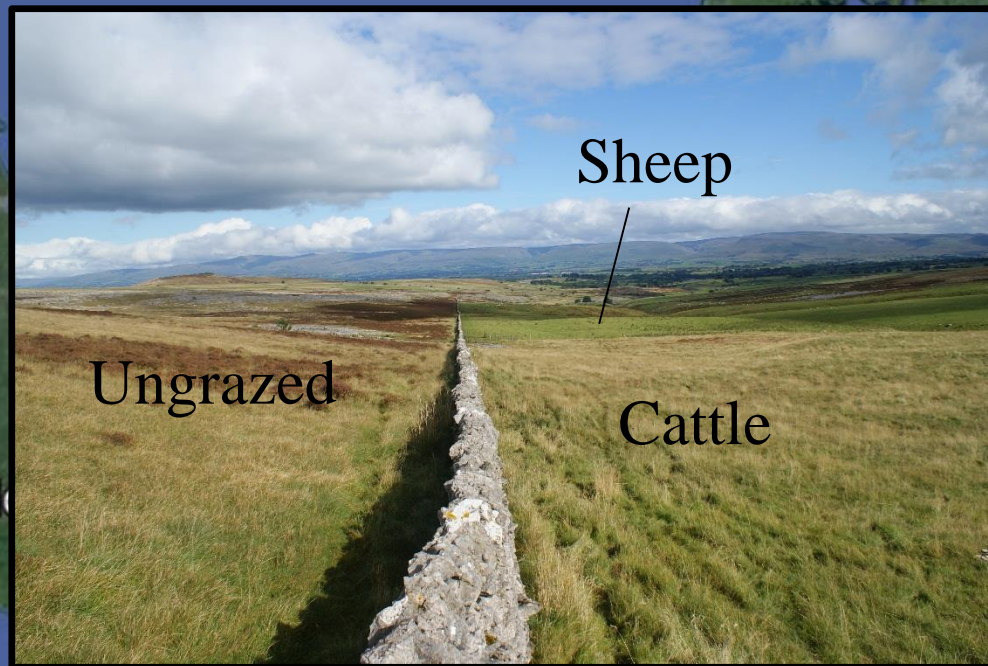
No
Grazing

- Do plant or carabid beetle species richness differ?
- Do plant or carabid beetle communities differ?
- Do plant communities indicate grazing impacts on carabid beetle communities?

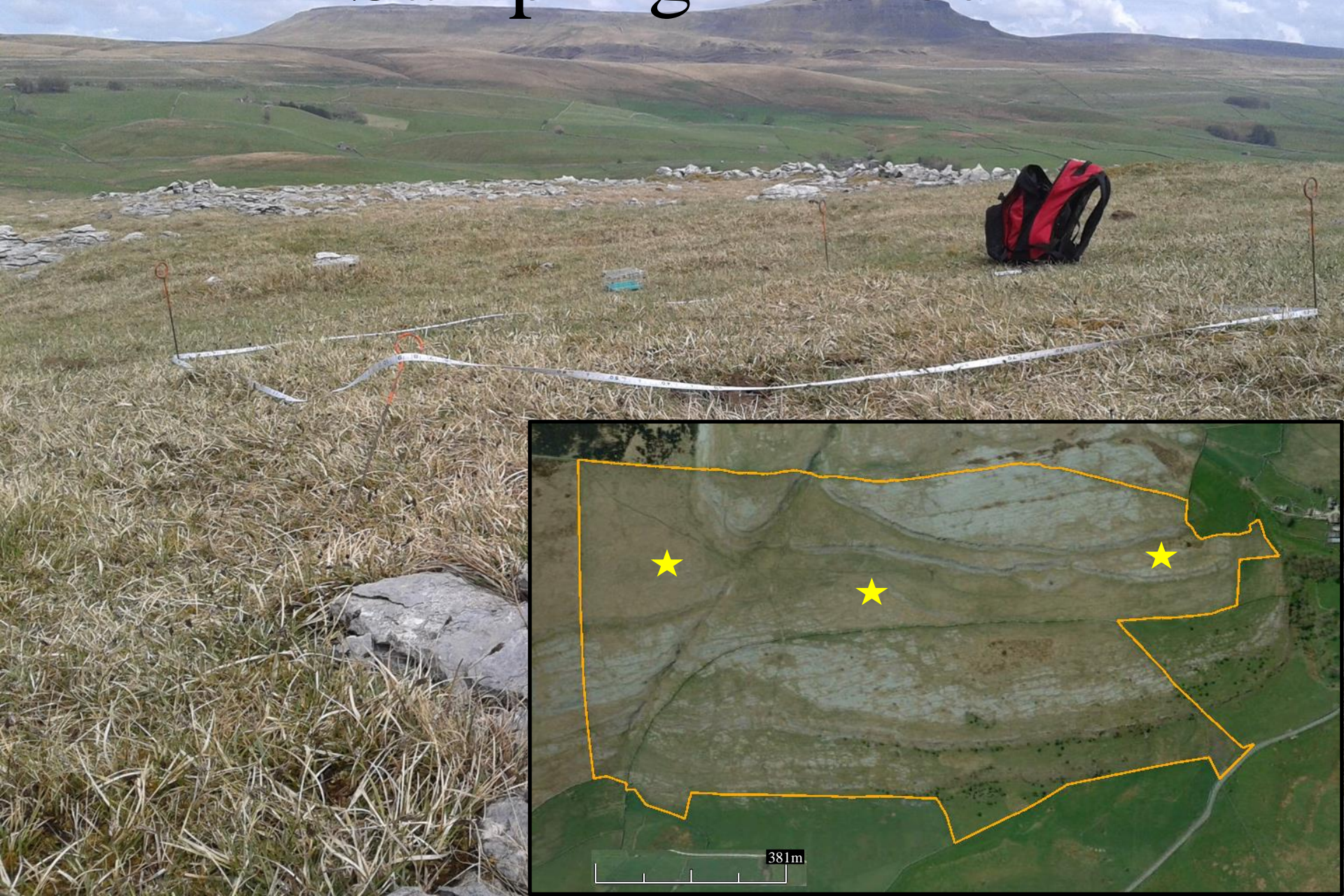
- Above 300m
- Dominated by *Sesleria caerulea* and *Carex flacca*
- Current grazing regime well established



- Stocking density of less than $0.17 \text{ Lu/ha/y}^{-1}$

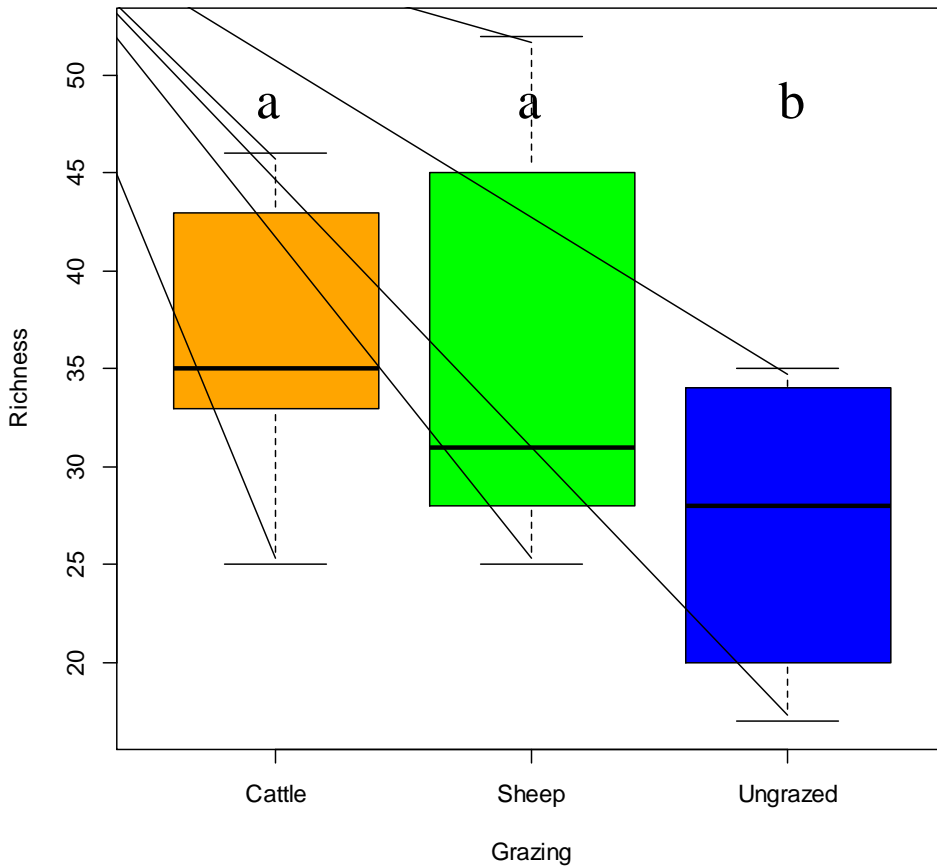


Sampling Method



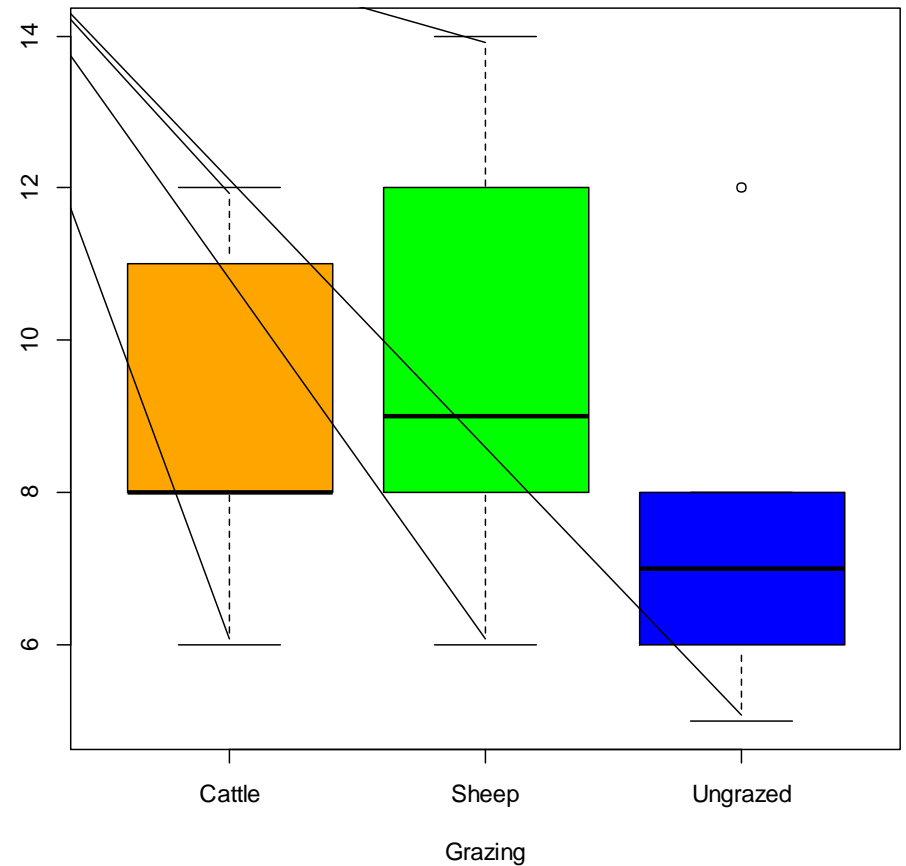
Species Richness

Plant Species Richness Between Grazing Treatments



Wald Chi-Square = 14.03,
 $p < 0.0001$

Carabid Beetle Species Richness Between Grazing Treatments



Wald Chi-Square = 3.31,
 $p > 0.05$ n.s.

Indicator Species Analysis

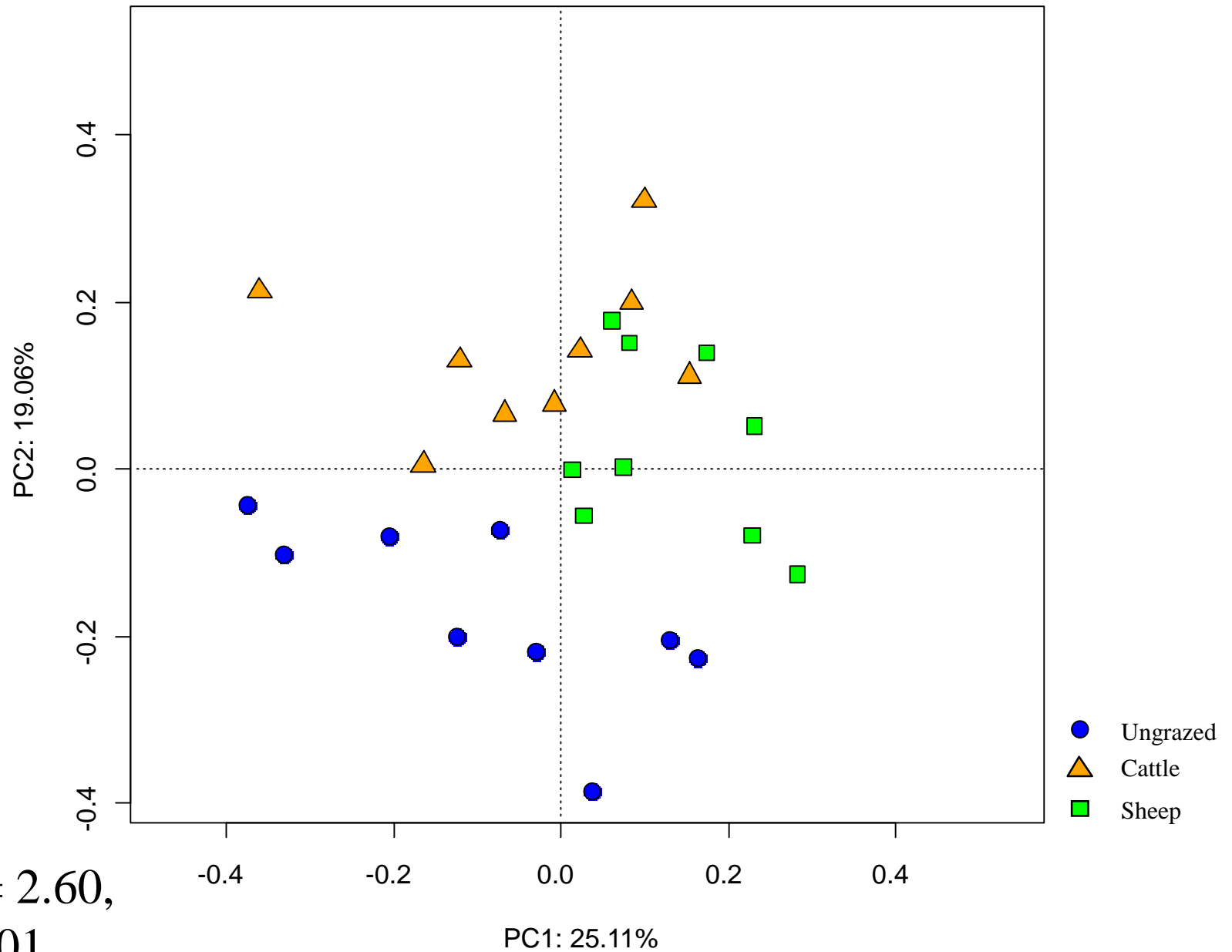
Total no of species = 102

Grazing Treatment	Number of Plant Indicator Species
Cattle	7
Sheep	1
Ungrazed	1

Total no of species = 23

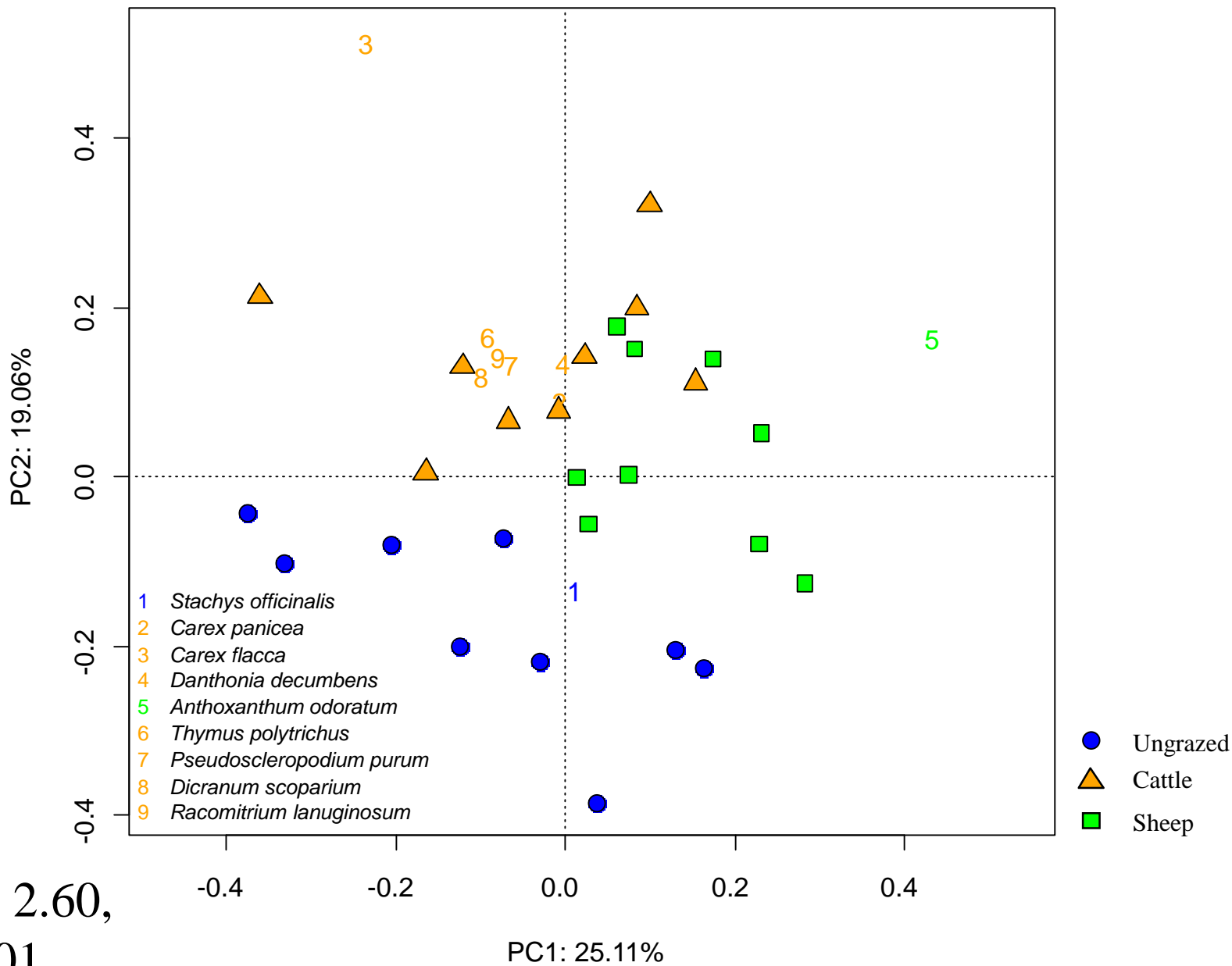
Grazing Treatment	Number of Carabid Beetle Indicator Species
Cattle	1
Sheep	2
Ungrazed	0

Vegetation PCA with the Effects of Location Partialled Out



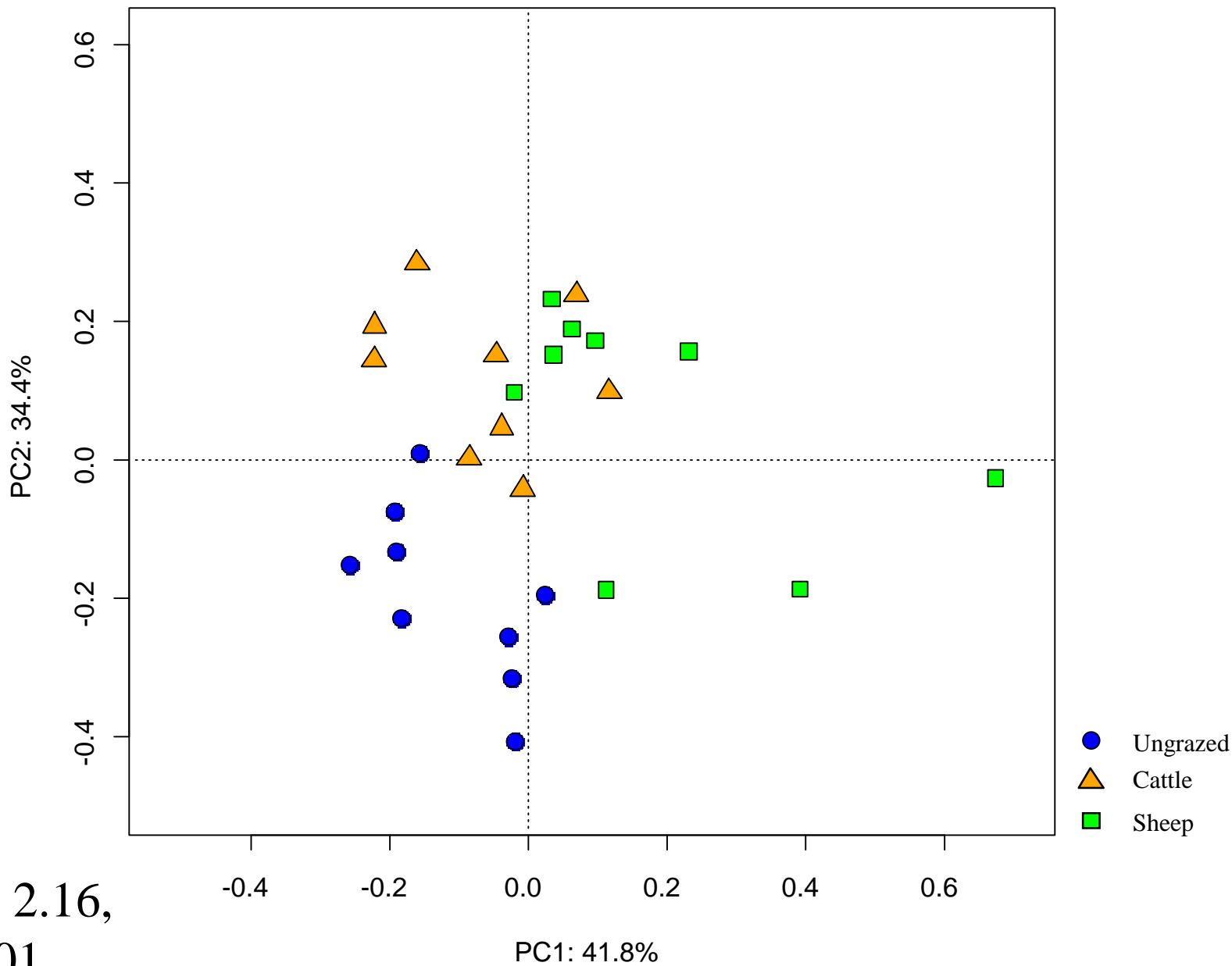
$F_{2,26} = 2.60,$
 $P < 0.001$

Vegetation PCA with the Effects of Location Partialled Out



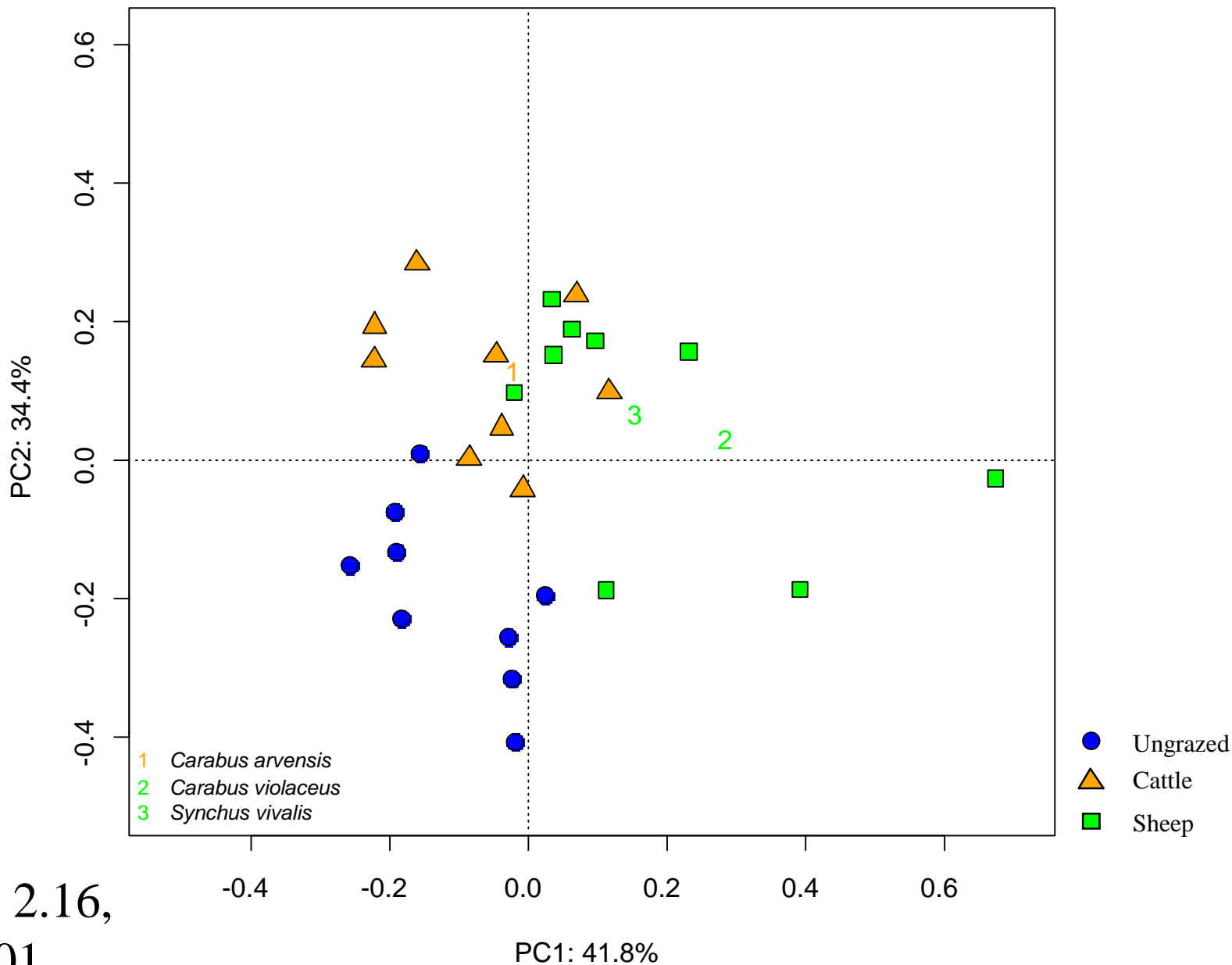
$F_{2, 26} = 2.60,$
 $P < 0.001$

Carabid Beetle PCA with the Effects of Location Partialled Out



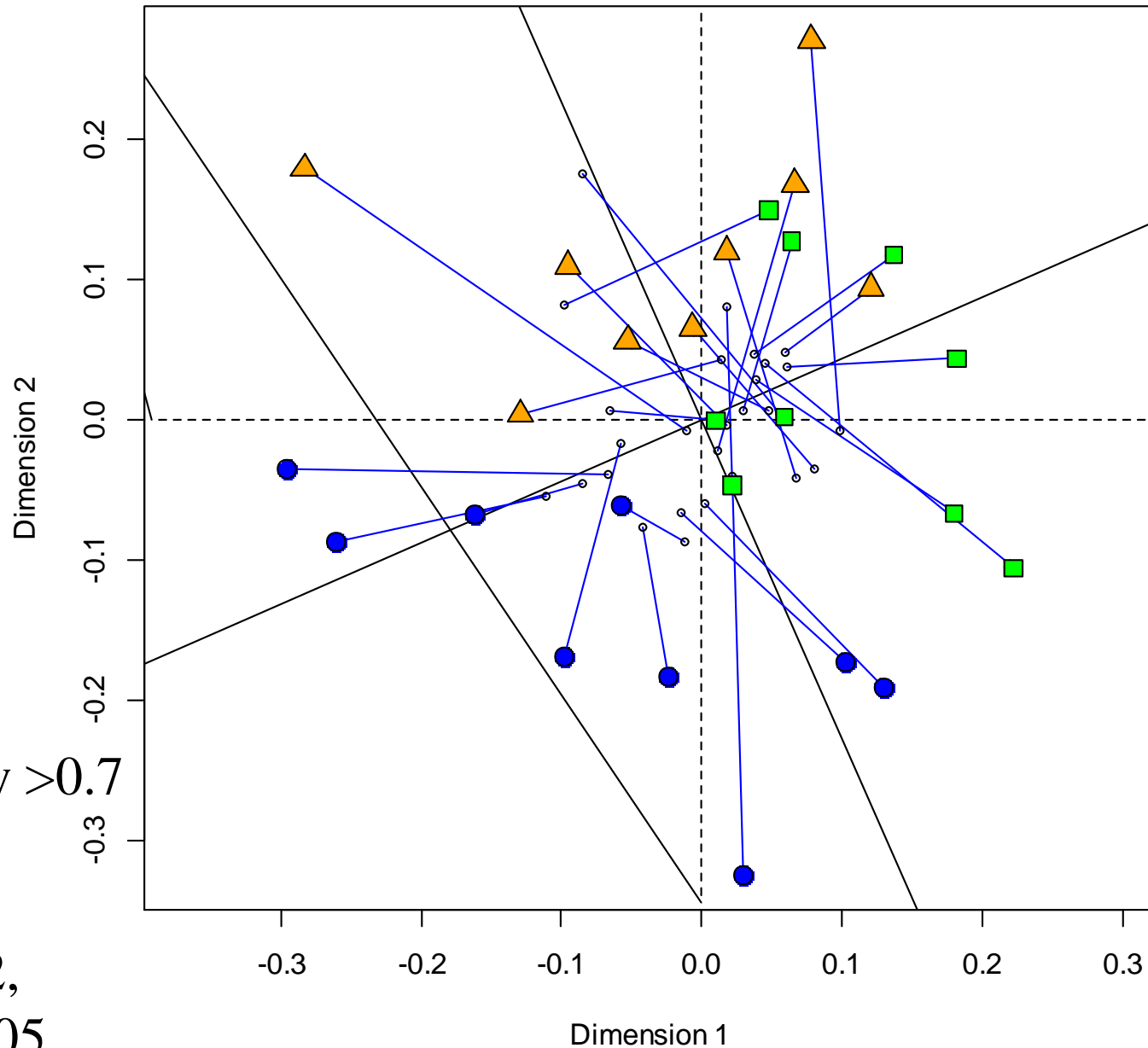
$F_{2,26} = 2.16,$
 $P < 0.001$

Carabid Beetle PCA with the Effects of Location Partialled Out



$F_{2,26} = 2.16,$
 $P < 0.001$

Procrustean Superimposition of PCA Scores of Vegetation and Carabid Beetle Assemblages



Summary

Sheep

Cattle

No
Grazing

- Does plant species richness differ? **Yes**
- Does carabid beetle species richness differ? **No**
- Do plant or carabid beetle communities differ? **Yes**
- Do plant communities indicate grazing impacts on carabid beetle communities? **No**

Management Recommendations

What do conservation bodies want?

High species
richness?

Cattle

Sheep

Plant
heterogeneity?

Cattle

Plant
homogeneity?

Sheep

Carabid beetles must be considered
too!

Future Investigation

- Examination of different taxa: spiders, millipedes, carabid beetles in relation to vegetation architectural complexity.



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@Upland_Grazing

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