Impact of Superficial Lateral Drainage on Tree Root Distribution and Forest Community Structure in Paracou, French Guiana

A Study on Drainage Barrier Depth

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TROPIMUNDO

ERASMUS MUNDUS JOINT MASTER DEGREE IN TROPICAL BIODIVERSITY AND ECOSYSTEMS

Roots matter

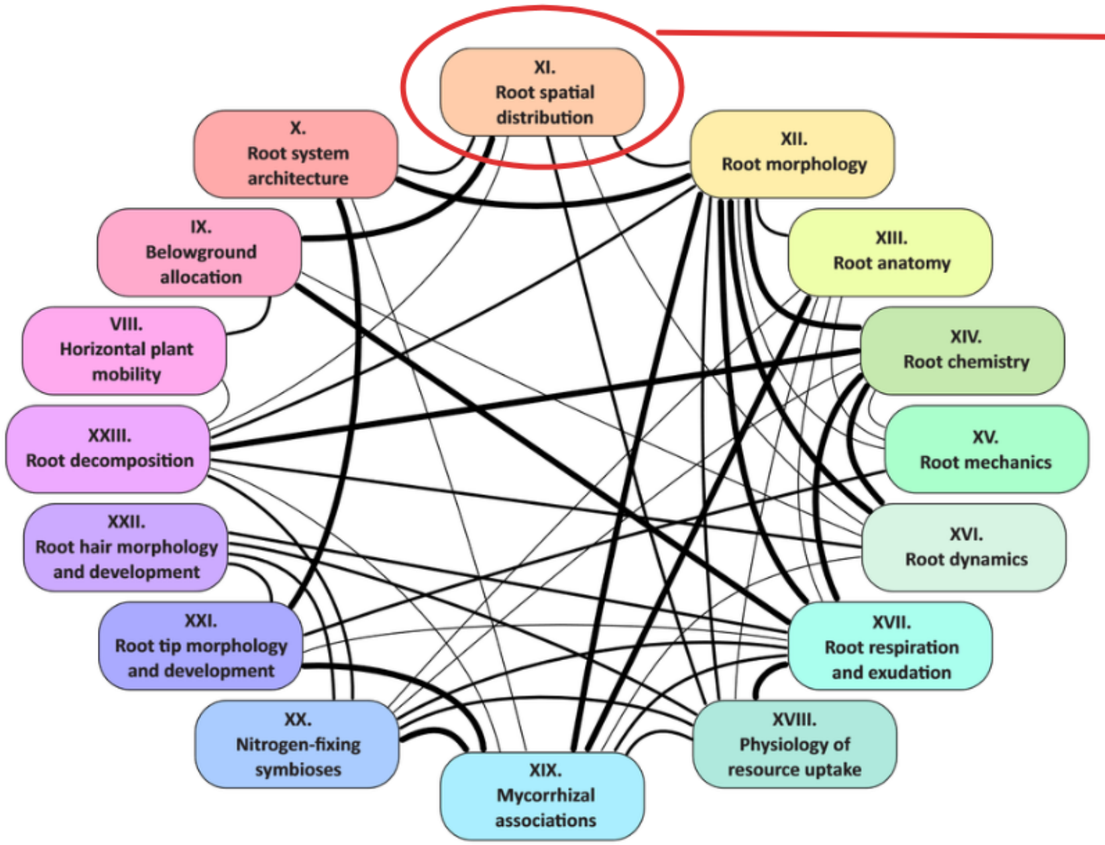
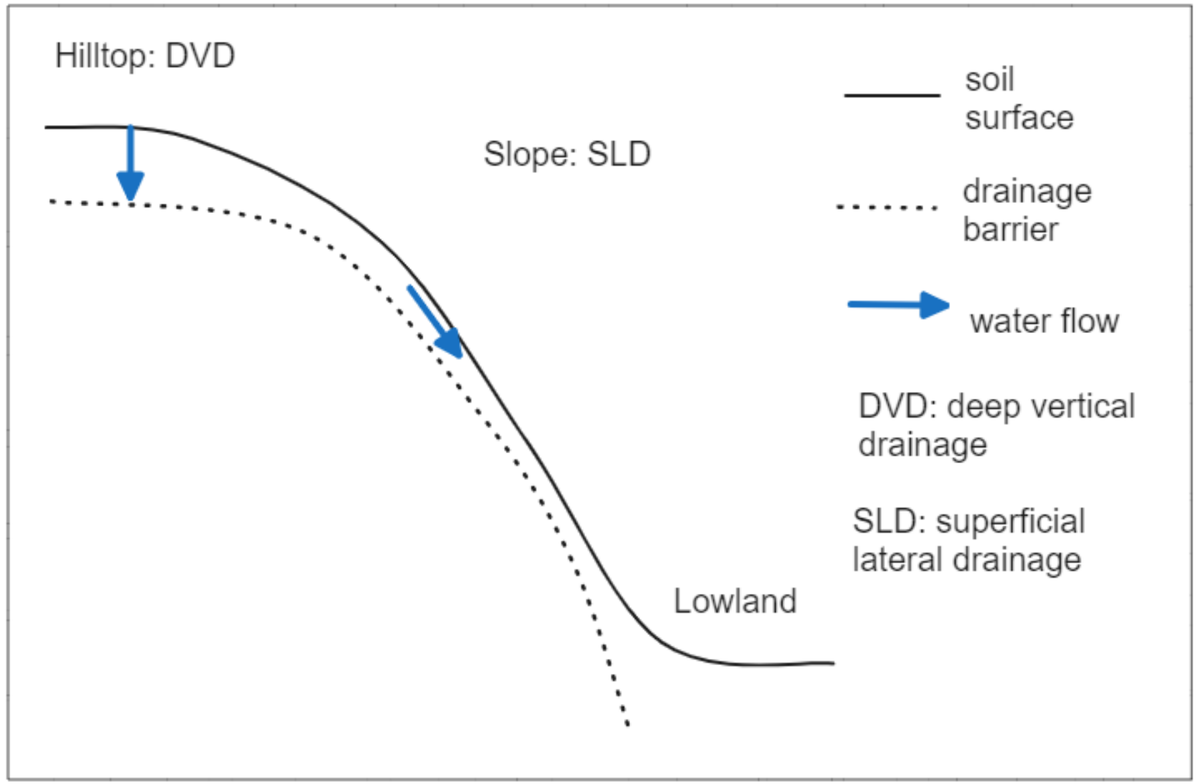
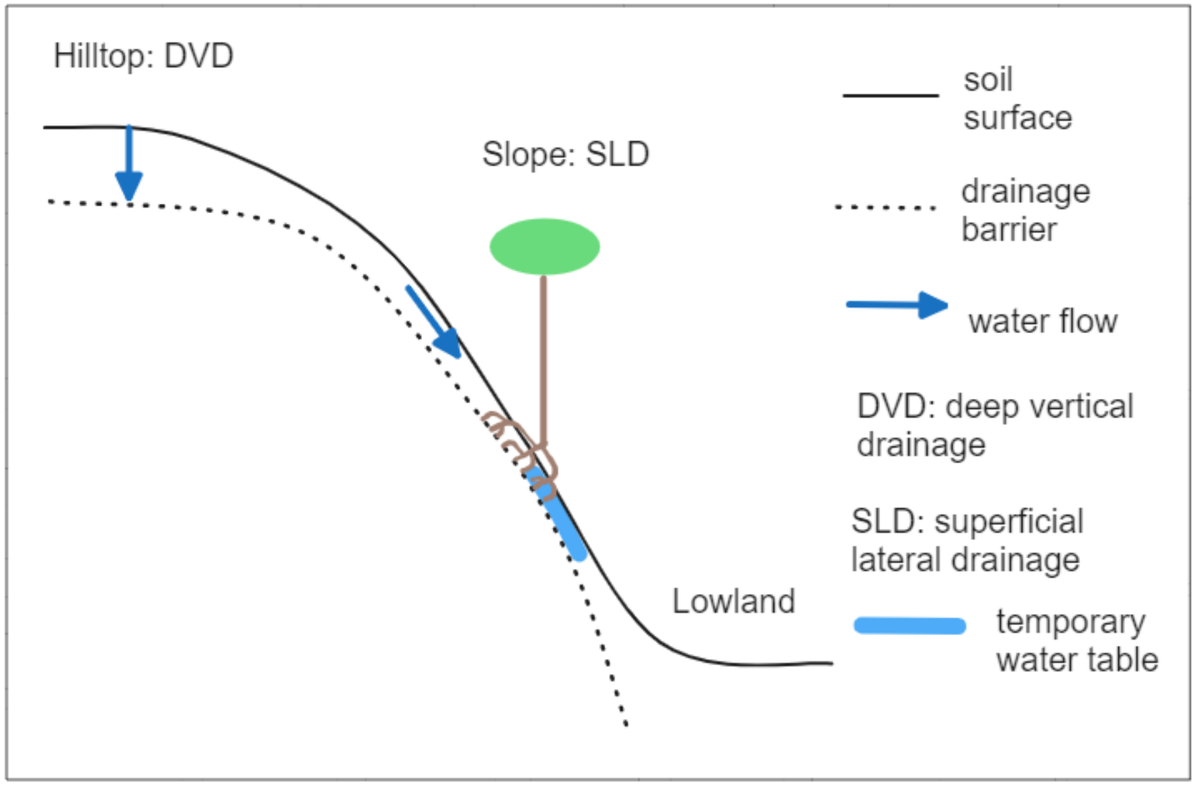


Fig. 1 Map of trait categories included in this guide and approximate frequency at which these categories have been studied together. While not all categories are necessarily relevant to study together, this diagram can be used to identify the (lack of) connections between these 'fields' of research. The width of connectors depicts weak-to-strong linkages between categories. No connector, no or very few studies looking at both fields jointly; thin connectors, few studies; medium connectors, fields sharing substantial number of studies; thick connectors, fields that are frequently studied together. This diagram represents the authors' expert assessment only and is imperfect as no exhaustive review of the literature was carried out.

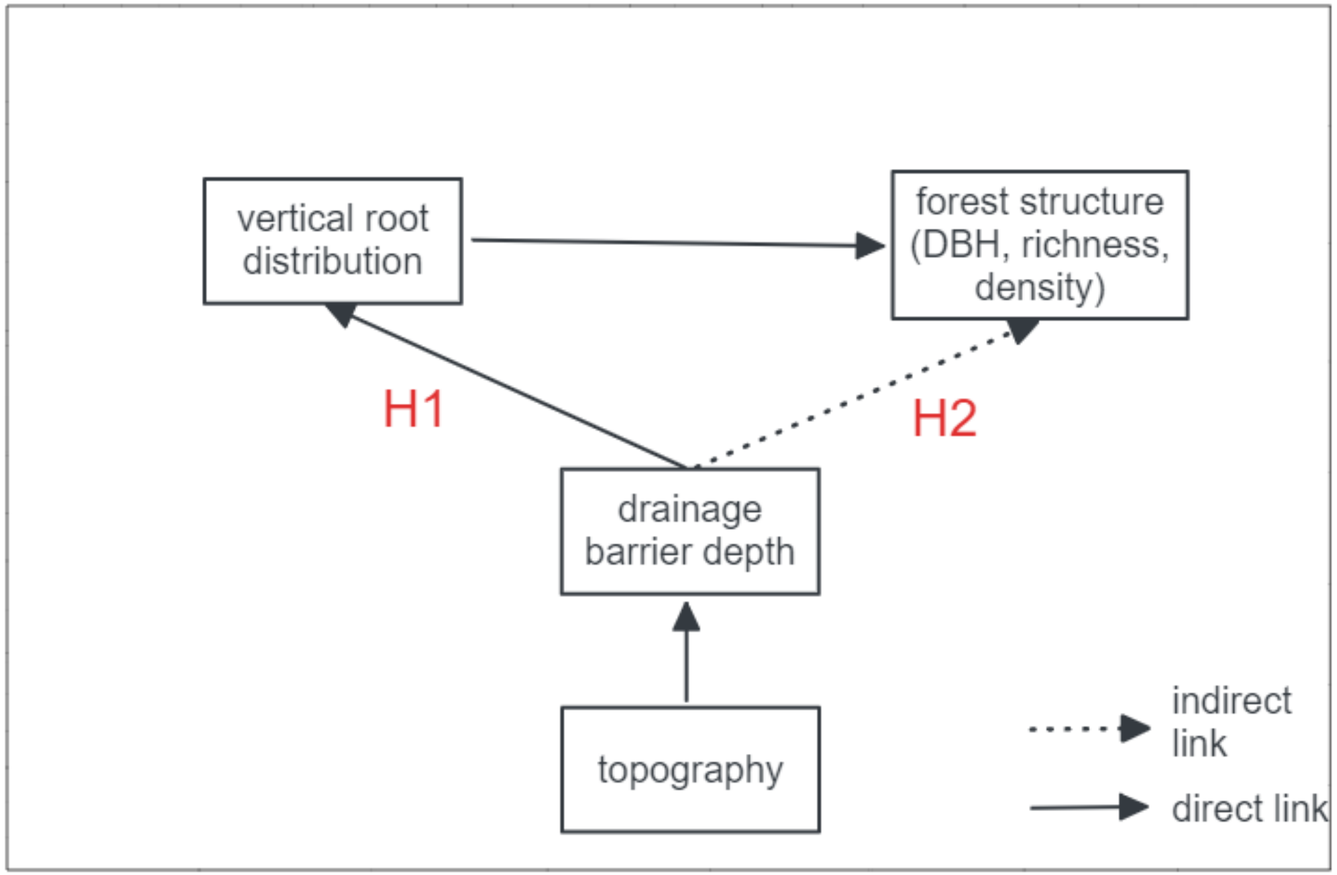
Acrisols and the drainage barrier



Impact on trees



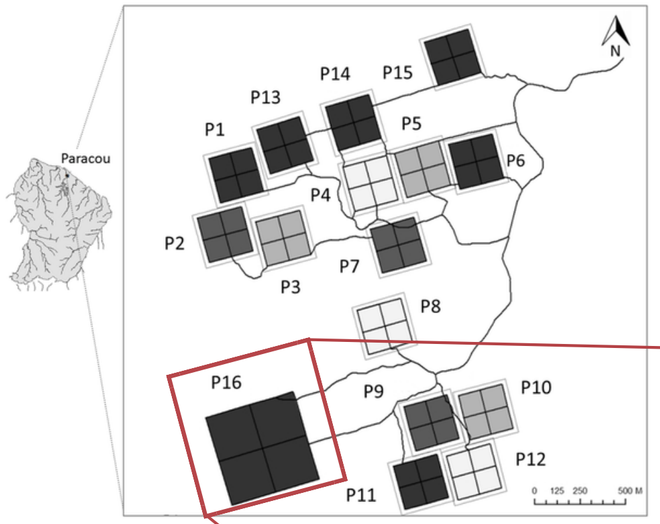
Our study


vertical root distribution
forest structure (DBH, richness, density)
H1
H2
drainage barrier depth
topography
indirect link
direct link

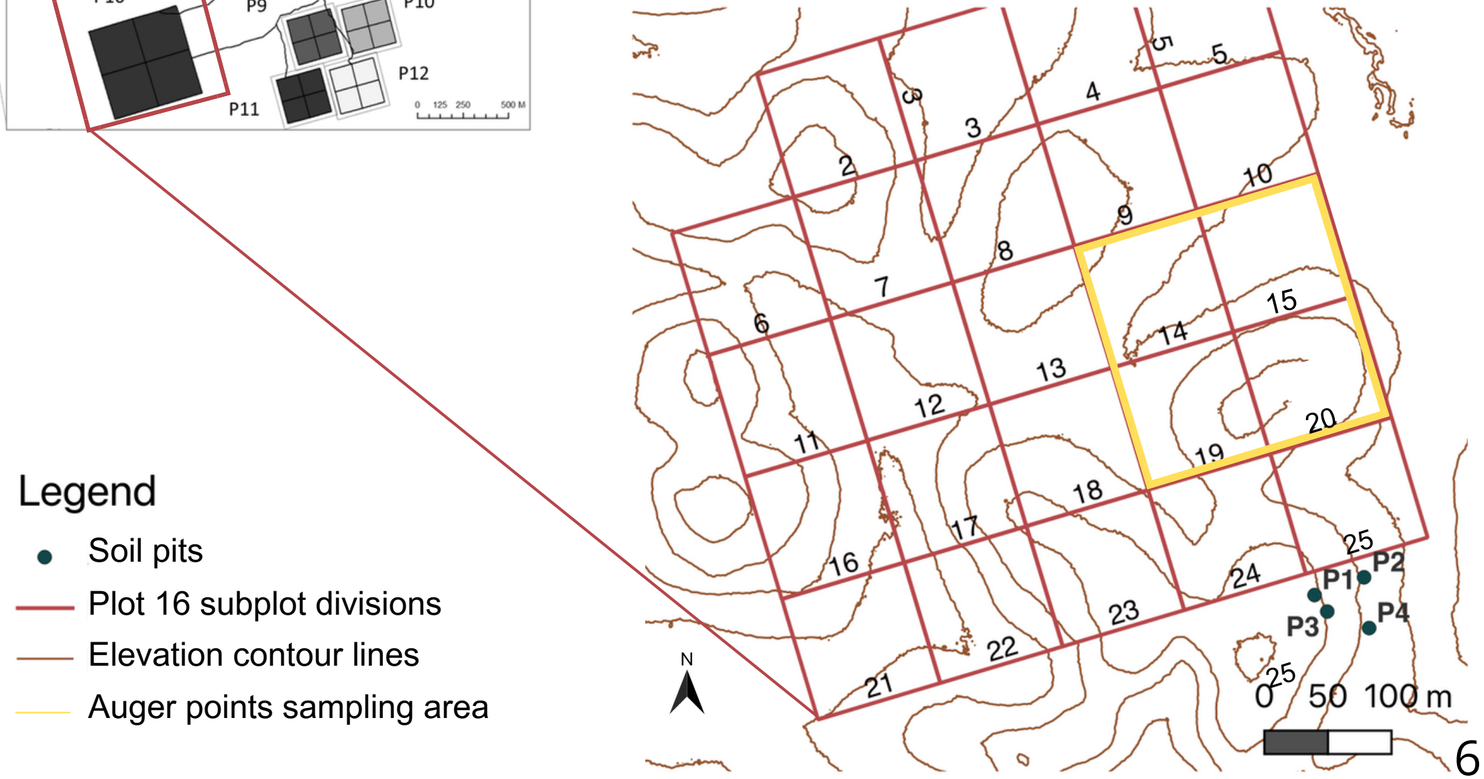
Study site

- Paracou Research Station
- Plot 16 (P16)
- Hills & valleys
- Soil type: Acrisol

- Pit data collected close to subplot 25
- Auger data from sub plots 14-20



Plot 16 and sampling locations in Paracou Research Station, French Guiana



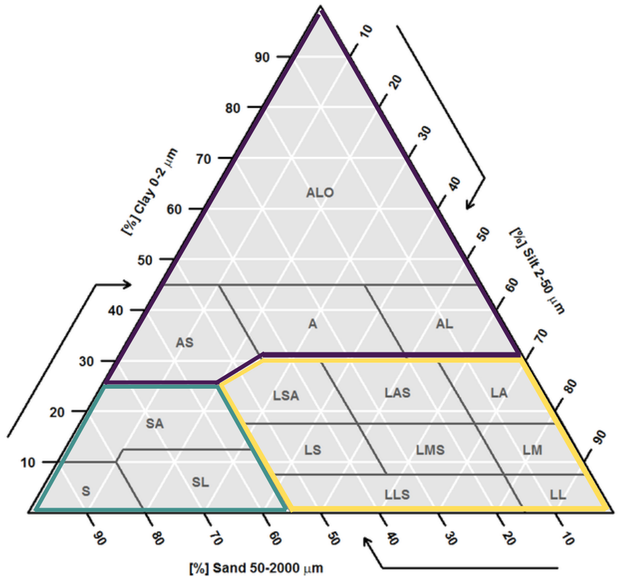
1

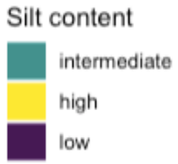
Pit data

Root vertical distribution

Pit data

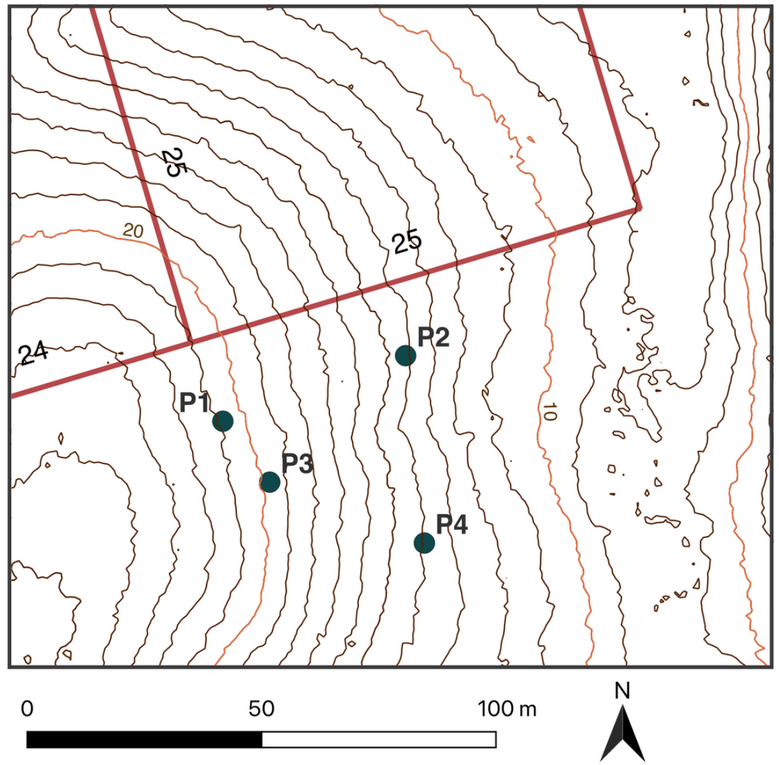
- 4 pits on mid-slope position (17-18%)
- soil horizon identification
- texture class (Jamagne, 1977)
- HSD (High Silt Depth)

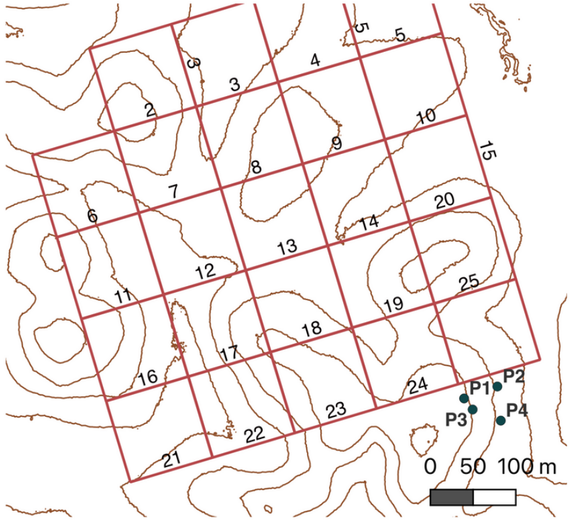




High Silt content

Soil pit locations excavated in September 2023 close to Plot 16 (Subplot 25) in Paracou, French Guiana





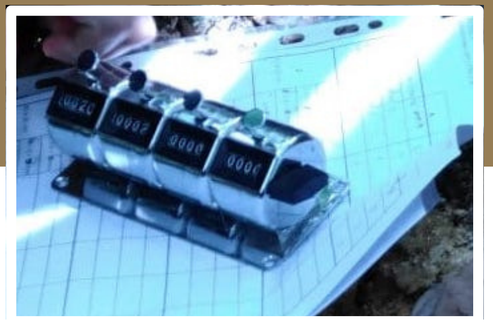
Legend

- Soil pits (depth 100 cm)
- Plot 16 subplot divisions
- Elevation contour lines

Authors: Dobetsberger Greta, Sanvito Emilie,Thion Clément

Date: 04.12.2023
EPSG:32622 - WGS 84 / UTM zone 22N
Universal Transverse Mercator (UTM)
04.12.2023

Pit data



- root count with 100x50 cm grid, 10x10 cm squares
- classified by diameter (< 2 mm, 2-5 mm, 5-10 mm and 10 mm)
- root index calculated

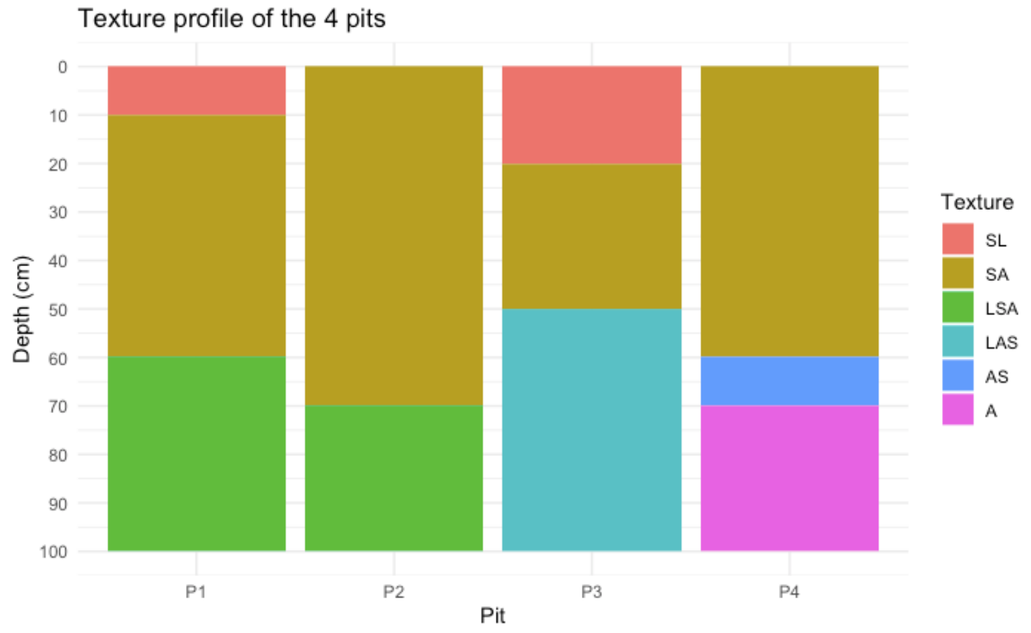
$$RI_d = \sum_{i=1}^{4} r_i n_i$$

d layer depth

i index of diameter class

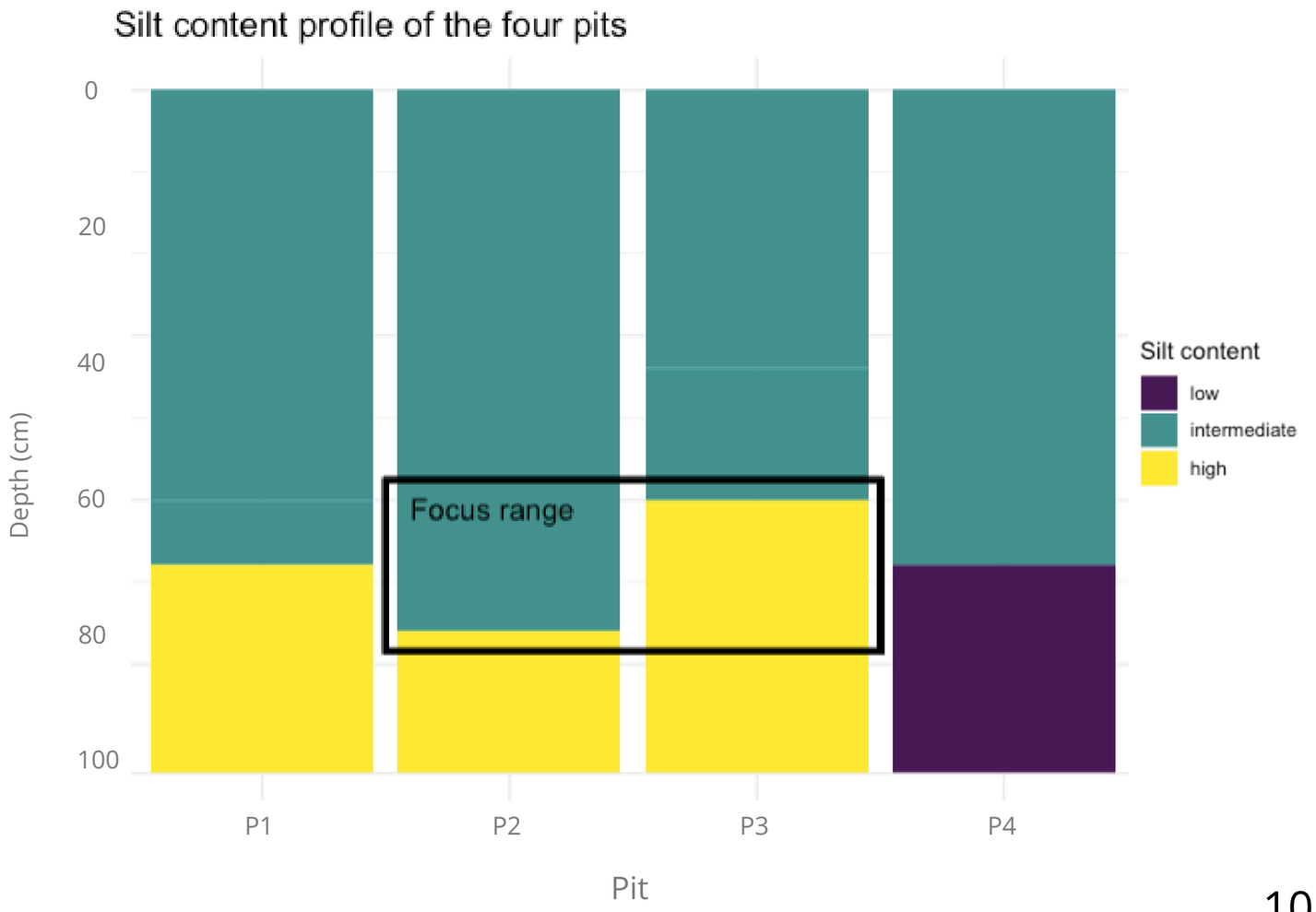
$r_i \in [1, 2, 5, 10]$ minimum root diameter

n_i count of root diameter class i



Pit data

- Similar root index across pits
- Comparison of P2 and P3 (60-80 cm)
- Root index decreasing with depth
- Sample size!



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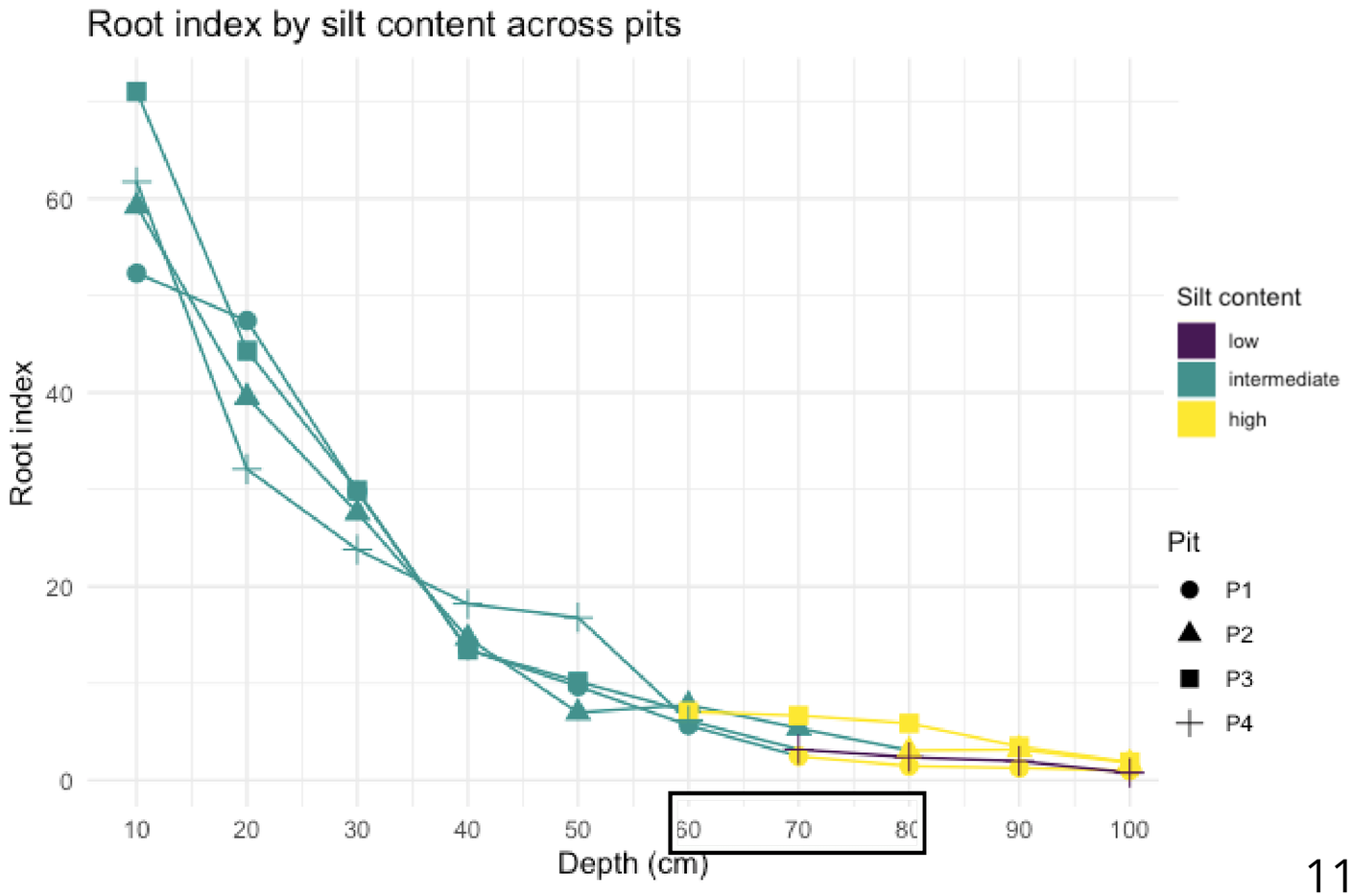


2

Auger data

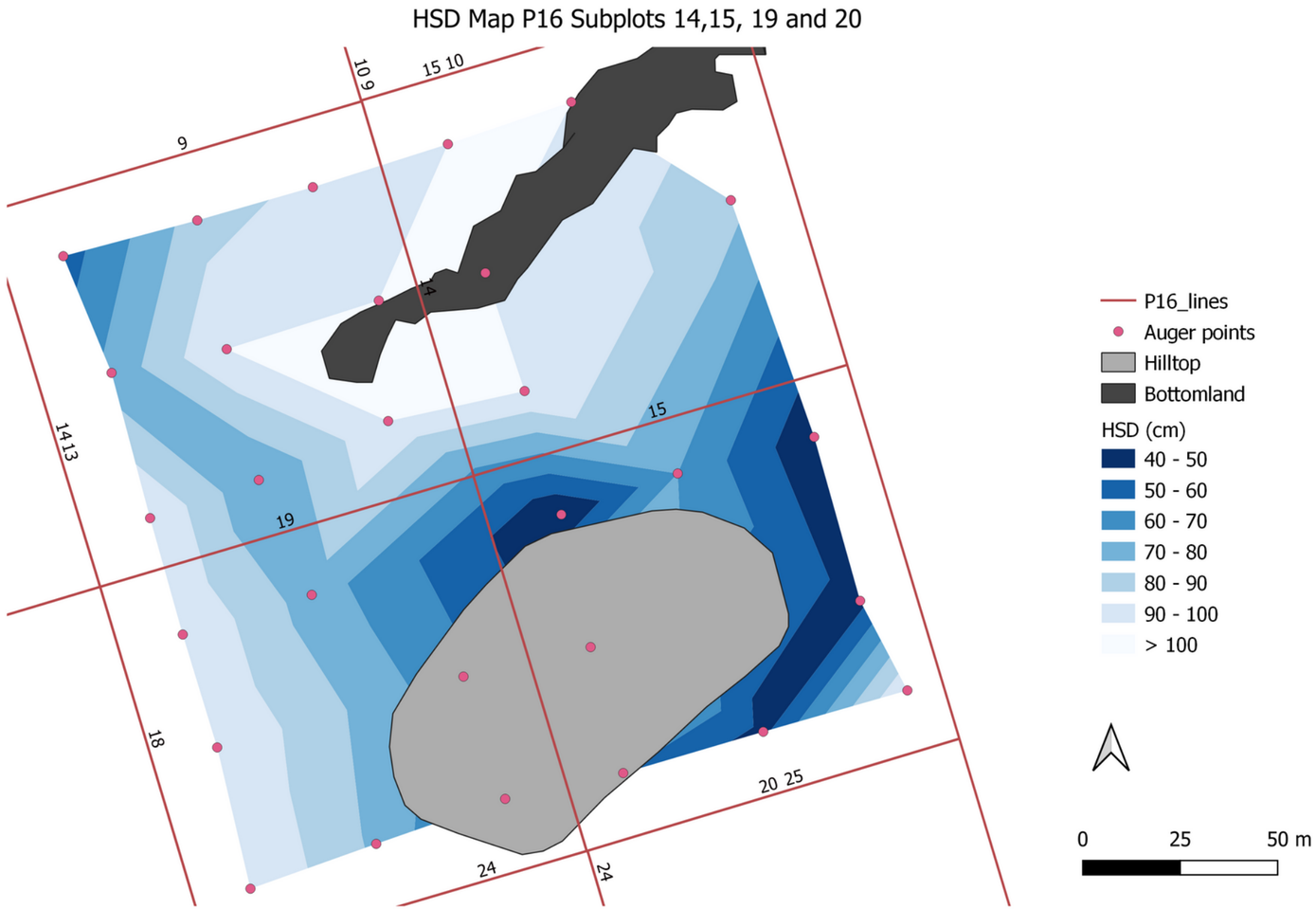
Forest community structure indicators

HSD interpolation

- Botany data < Guyafor Tree database
  + ALT project
- HSD for every auger
  No high silt -> HSD = 100 cm

- Contour Plugin in QGIS
- 10 m contour intervals

- focus on slopes
- Total area considered: 2.1 ha



Forest structure indicators

1.Per HSD class:

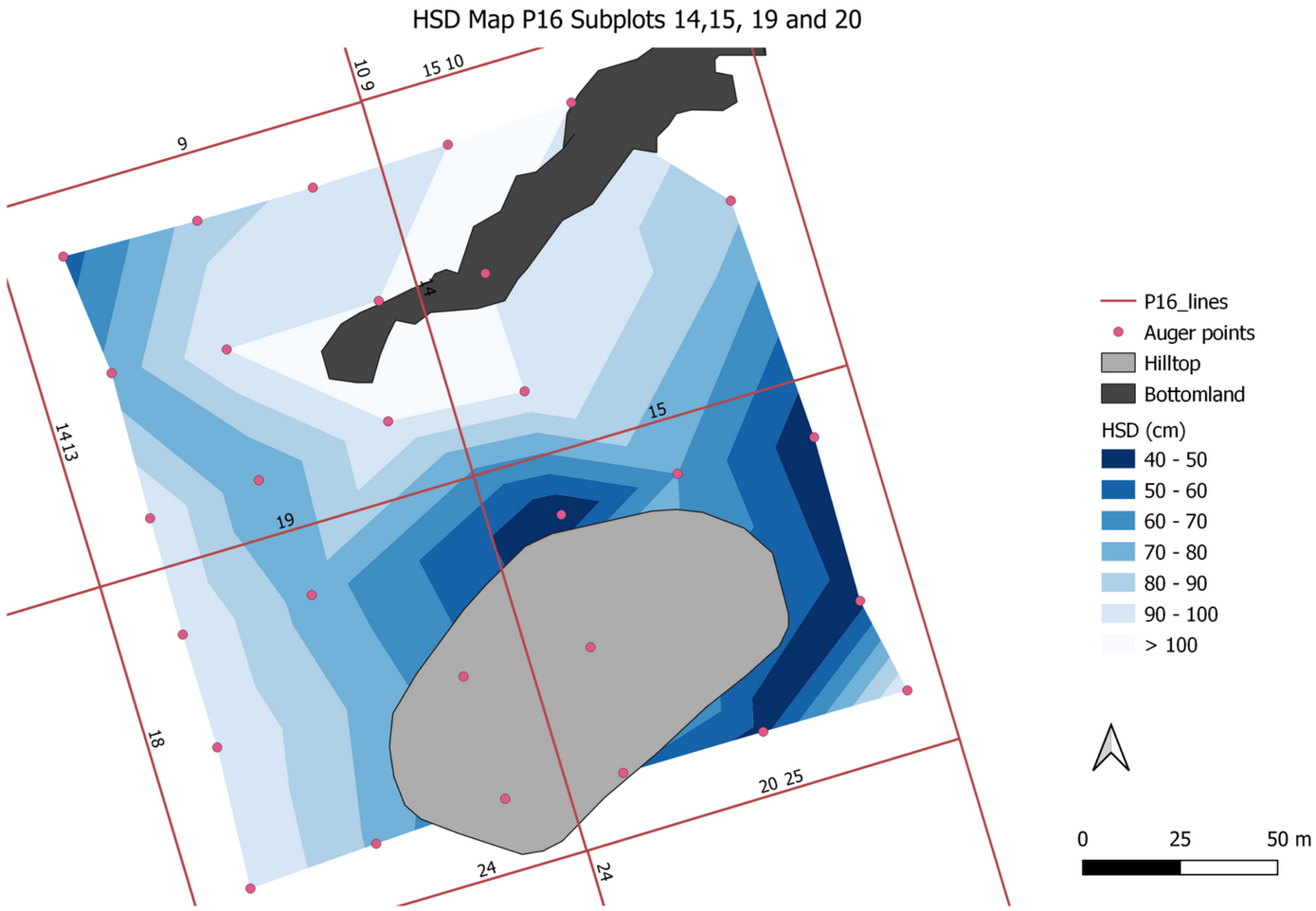
- DBH
- Species richness (count)
- Tree density (count)

2. HSD class -> intermediate value

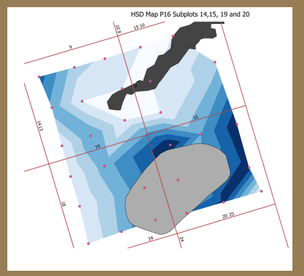
3. Poisson regression

! caution

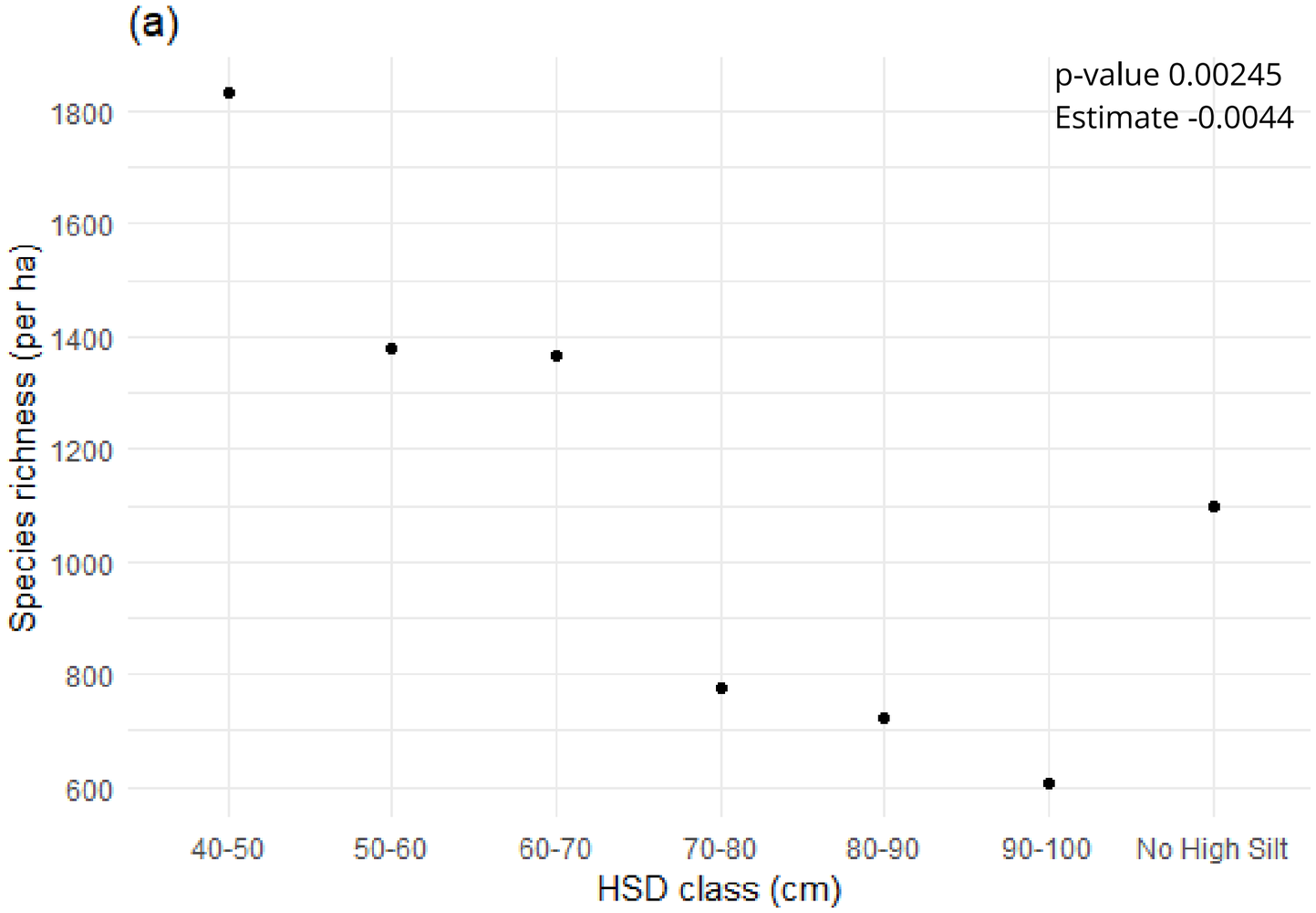
- only 7 values
- strong interpolation



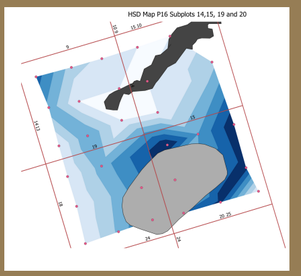
Species richness



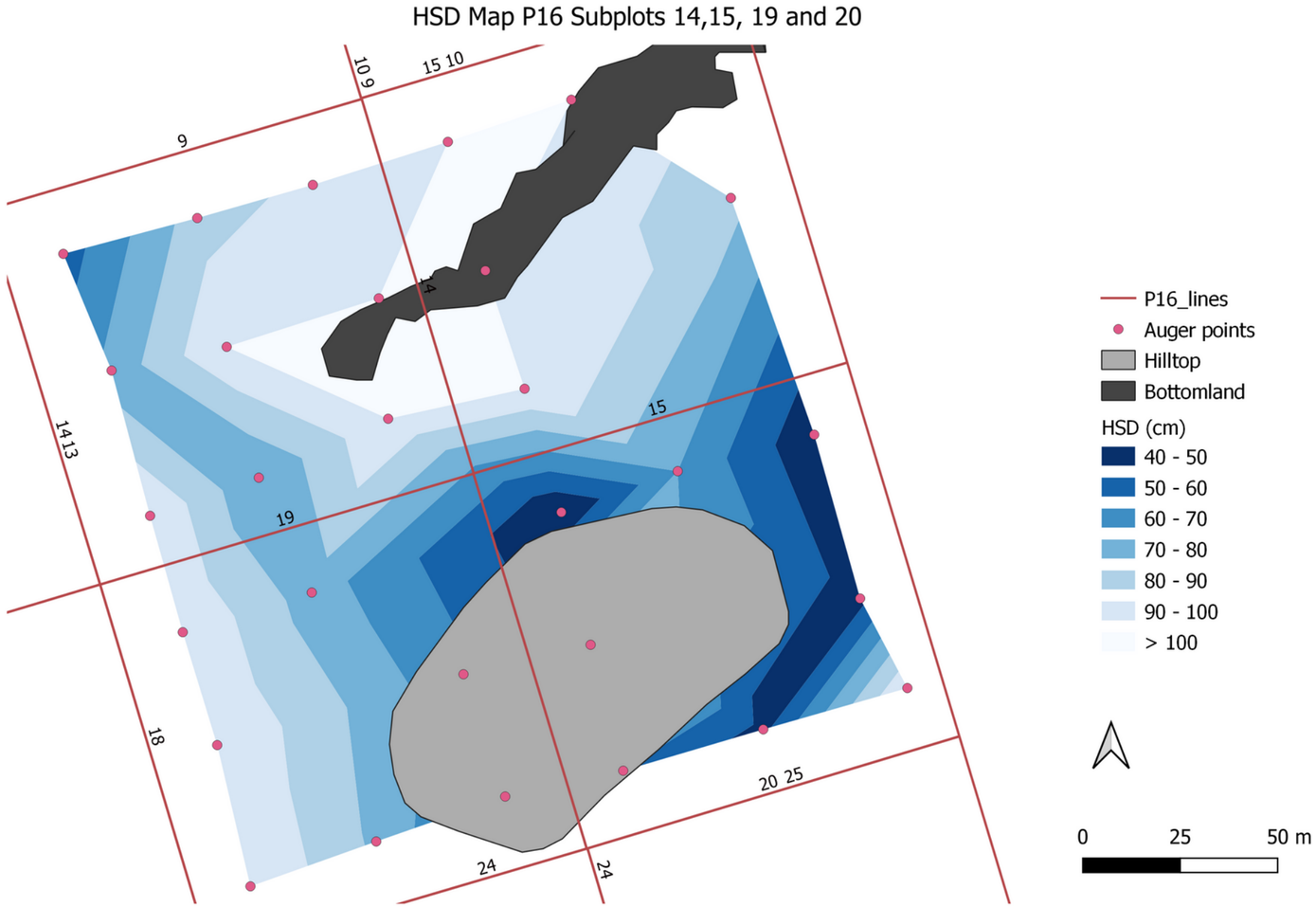
- Less drought stress in dry season
- Anoxic stress in wet season: accentuates biological diversity
- Similar to Sabatier (1997)



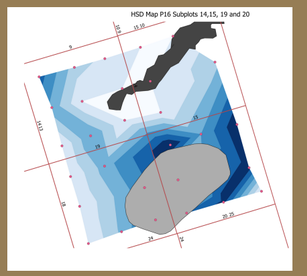
Species richness



shifts in species communities with drainage type (Allié et al. 2015)

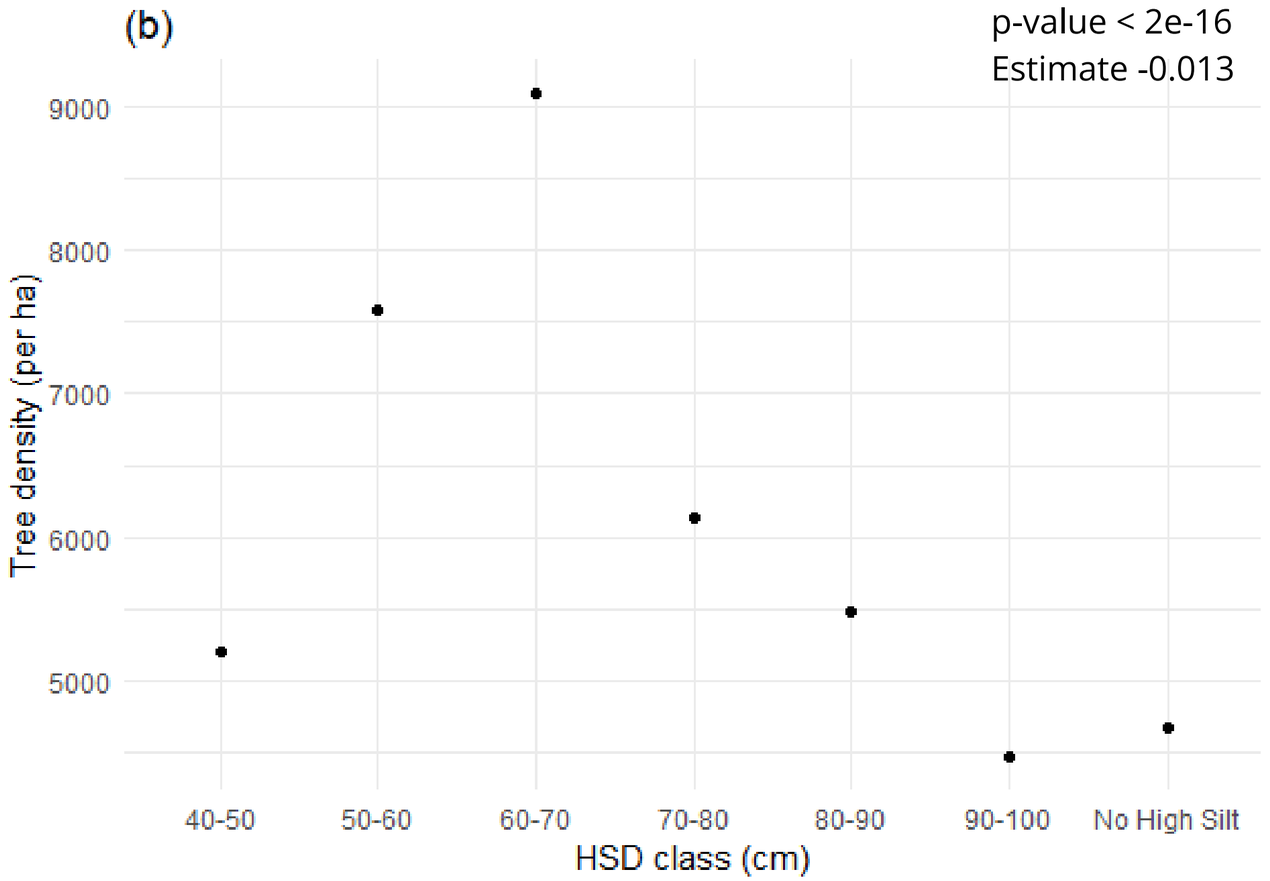


Tree density

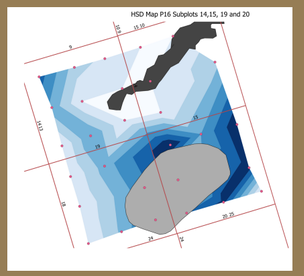


- DBH > 1 cm

Drainage barrier close to surface
-> water closer to surface
-> anoxic stress

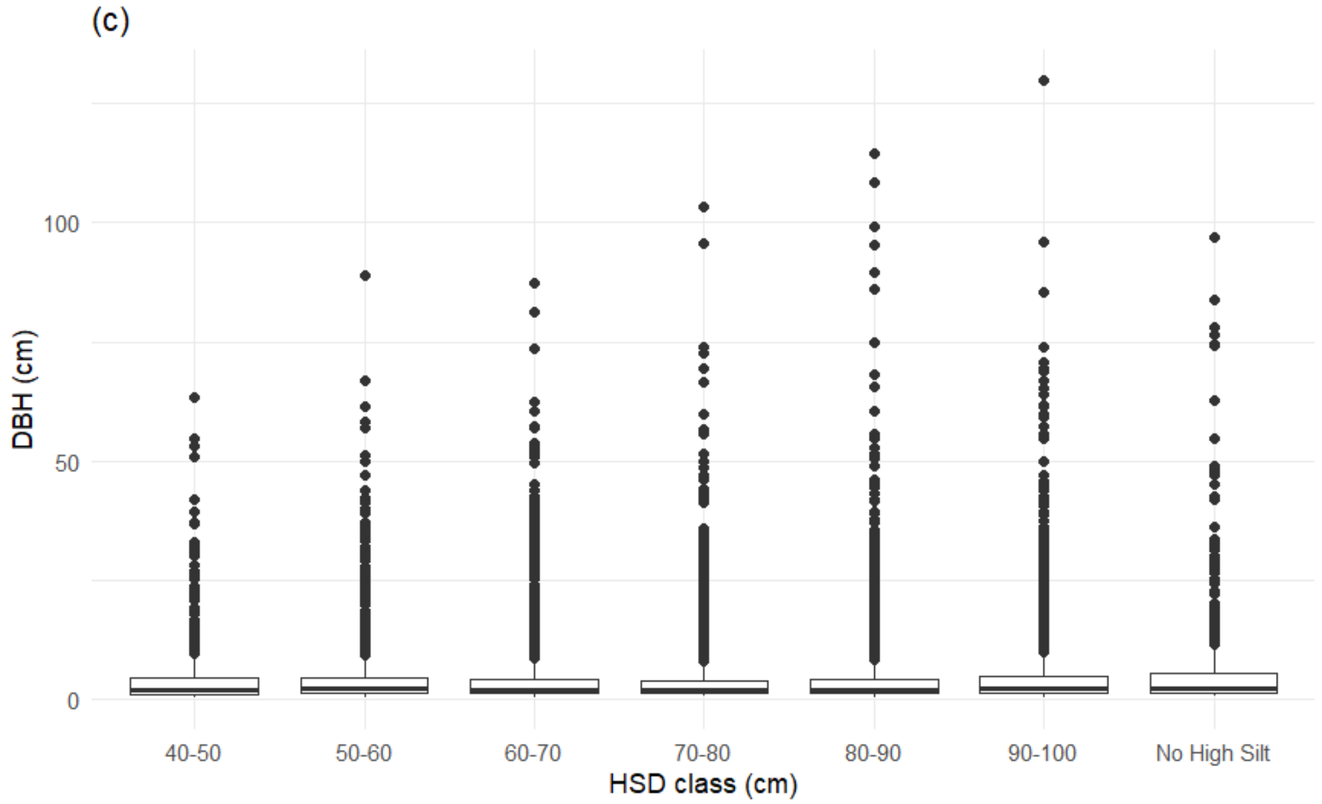


DBH

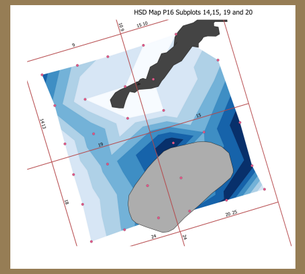


- no linear dependency
- trend in outliers

=> higher maximum DBH in less constraining situations



DBH



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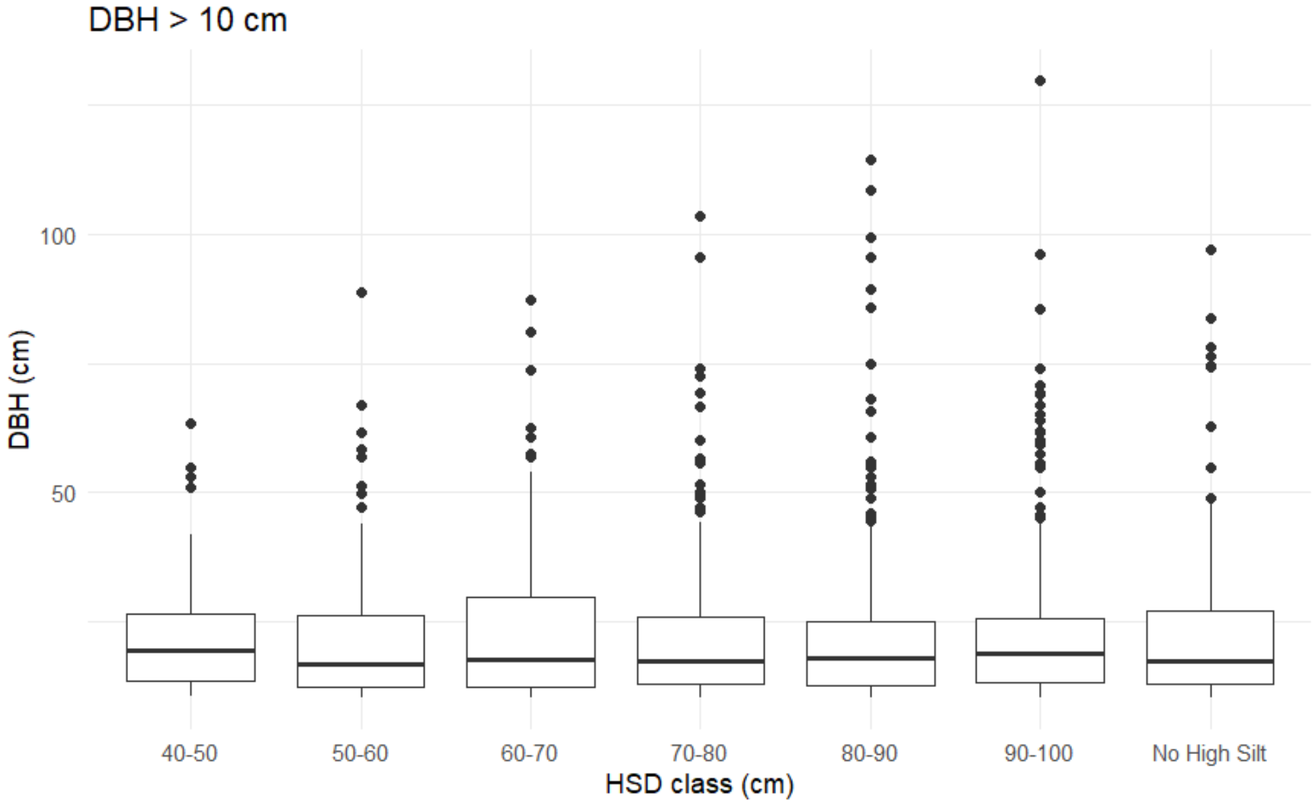
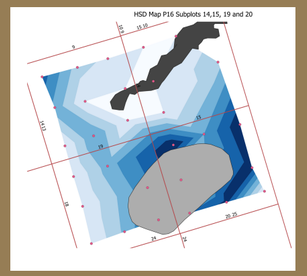


DBH



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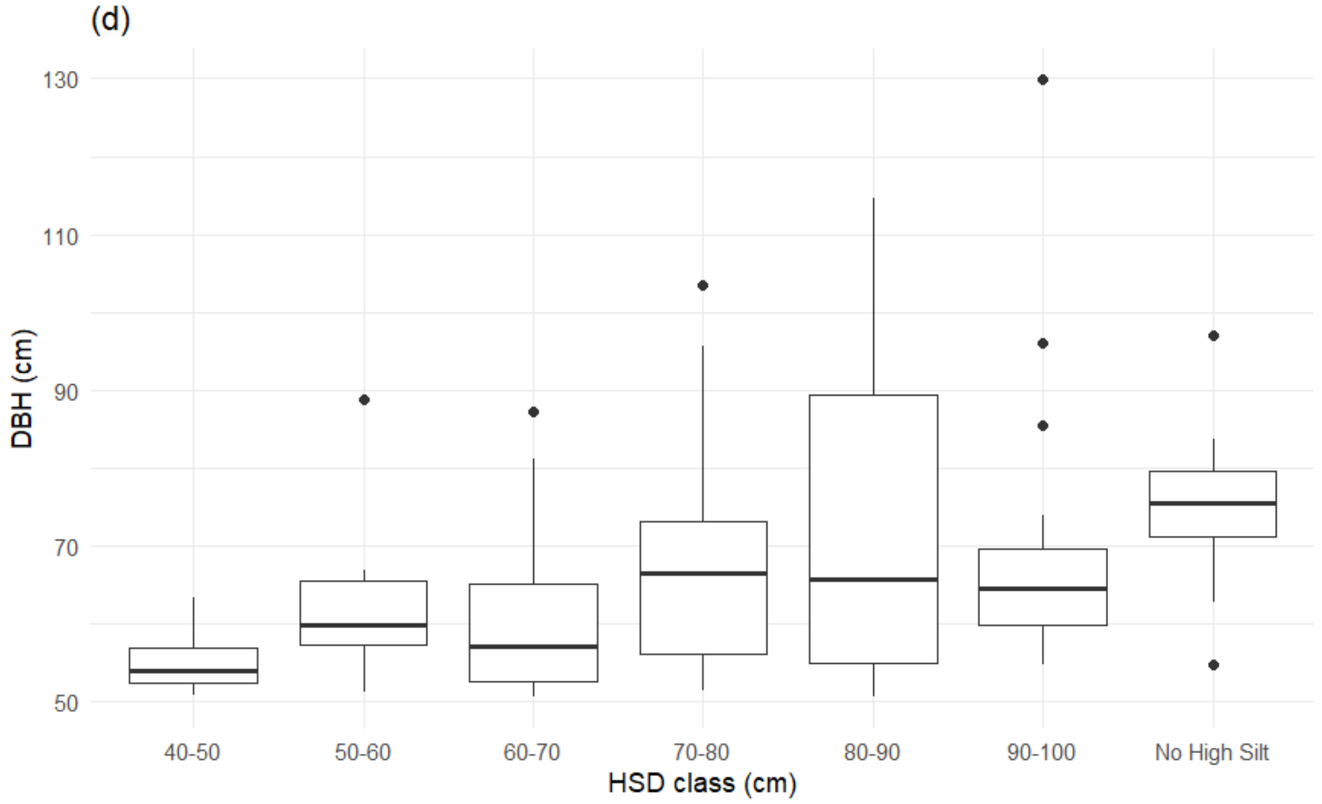


Conclusion

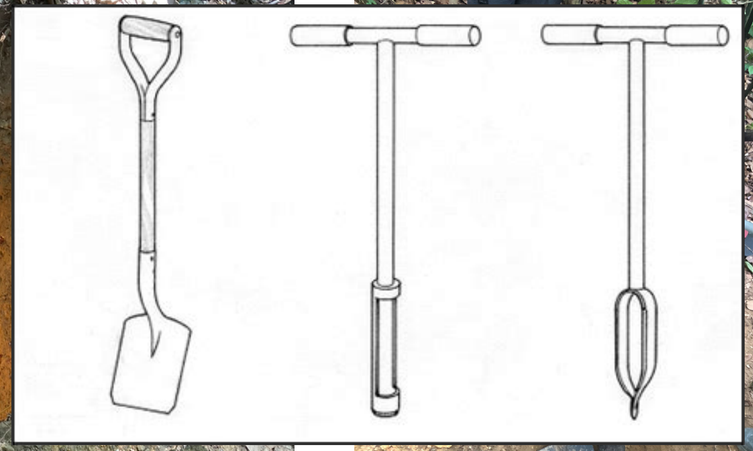
- No effect of drainage barrier on RVD in pit data (sample size?)
- Effect on forest community structure indicators (saplings)
- Drainage barrier and texture correlated with other environmental variables
- Further studies needed to study the impact of drainage barrier on roots -> direct effect on roots vs. indirect for forest structure indicators

Thank you!

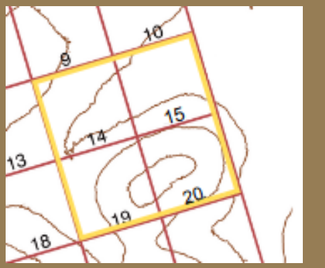
Literature?

Allié et al. 2019

Photos to pick from



Mica-silt relationship

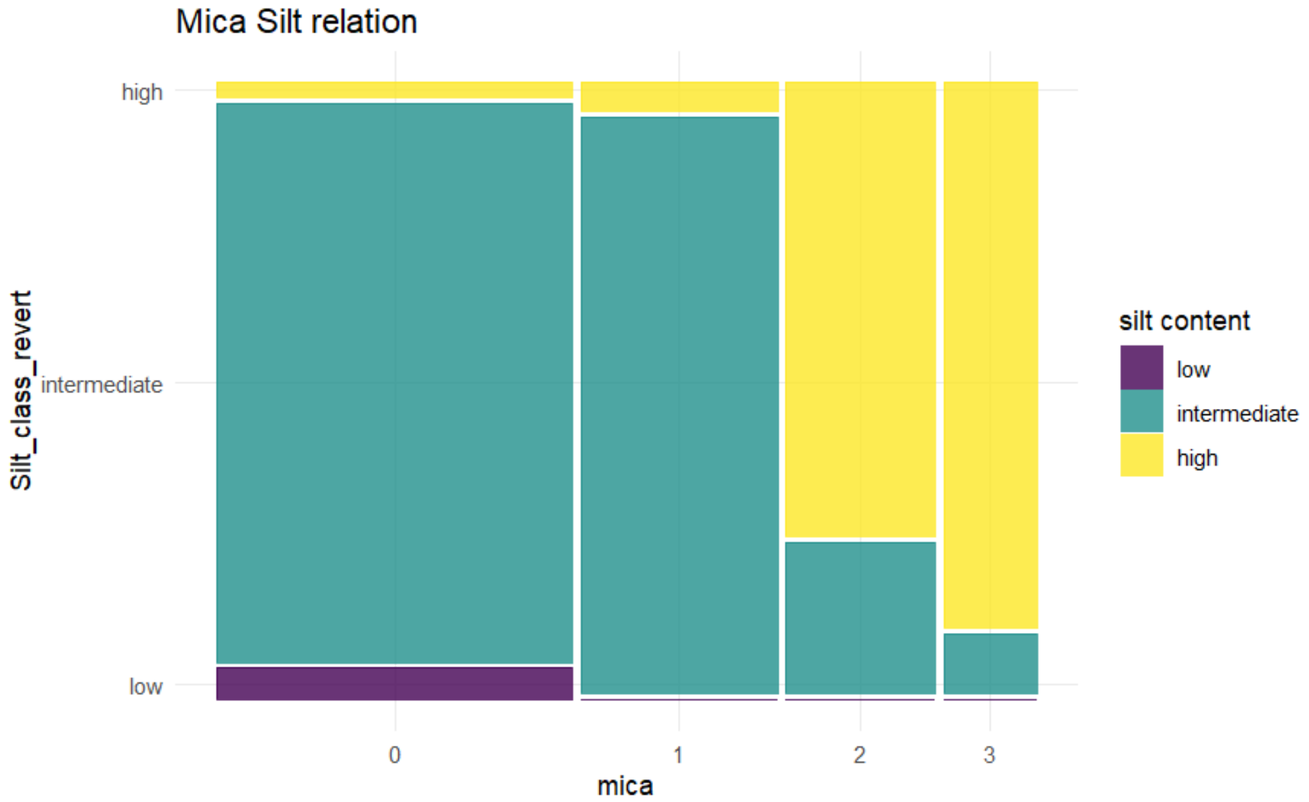


- Muscovite -> kaolinite (< silt particle size)

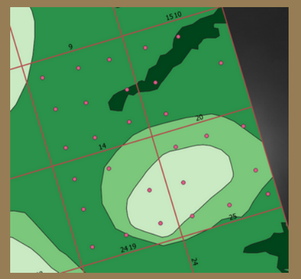
=> Chi-squared test between silt and mica content

- Strong positive relationship

chi-square = 57.154
p-value < 0.001



Correlation with topography



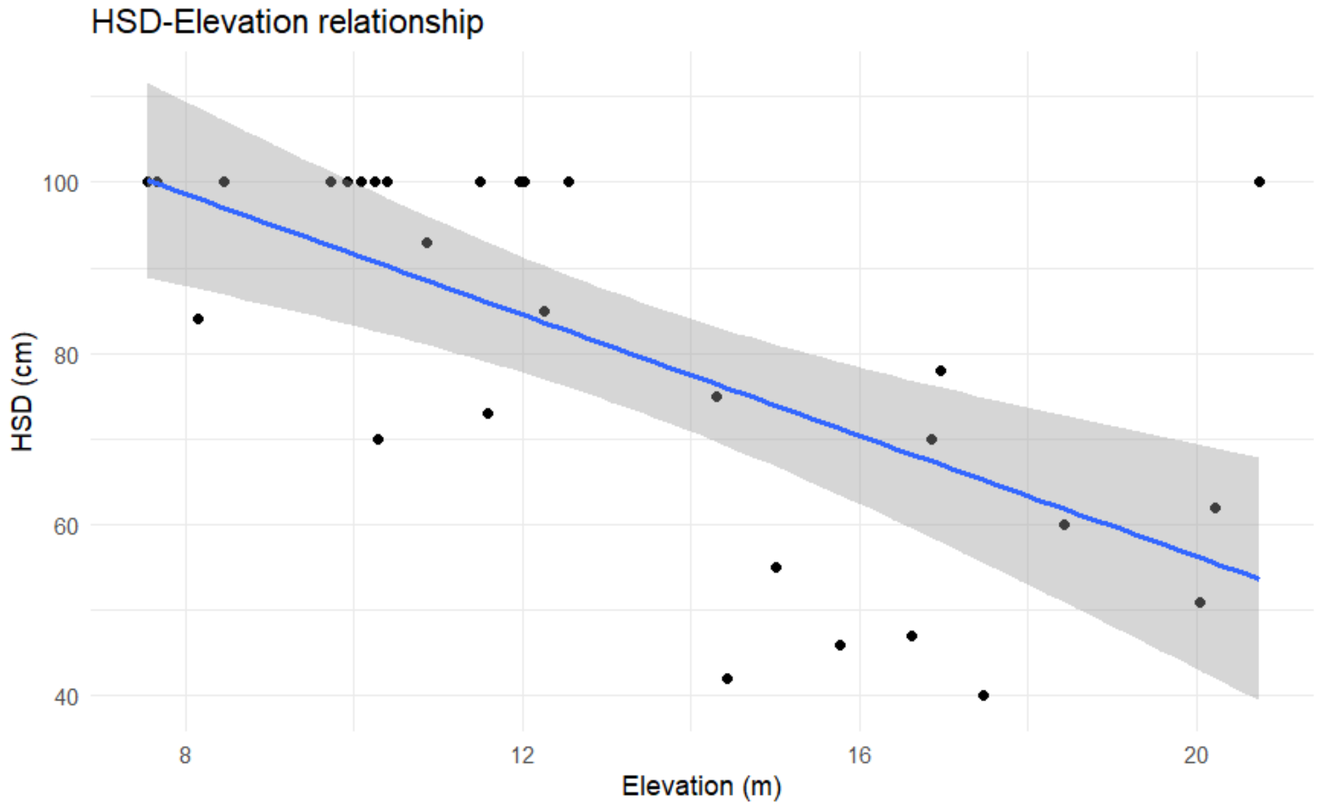
- Robust negative correlation

(rho = -0.634; p-value = 0.0002246)

<=> Epron (2007)

Why?

- Auger points mostly on lower slopes



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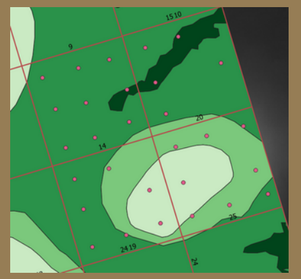
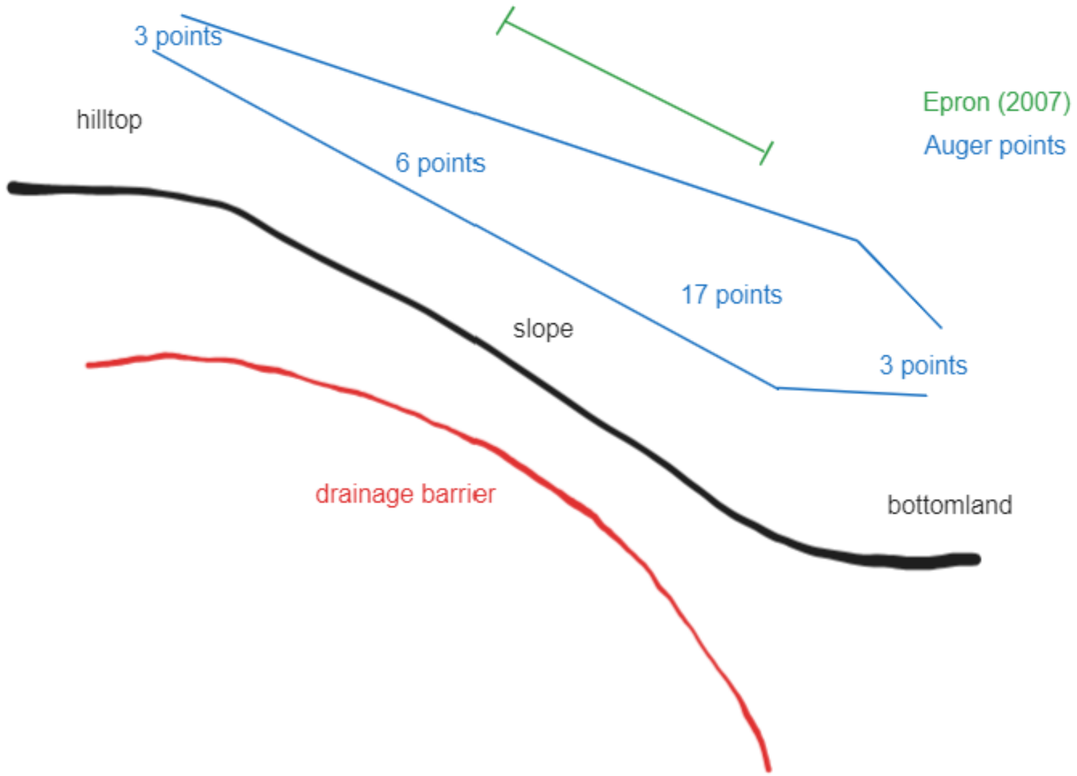
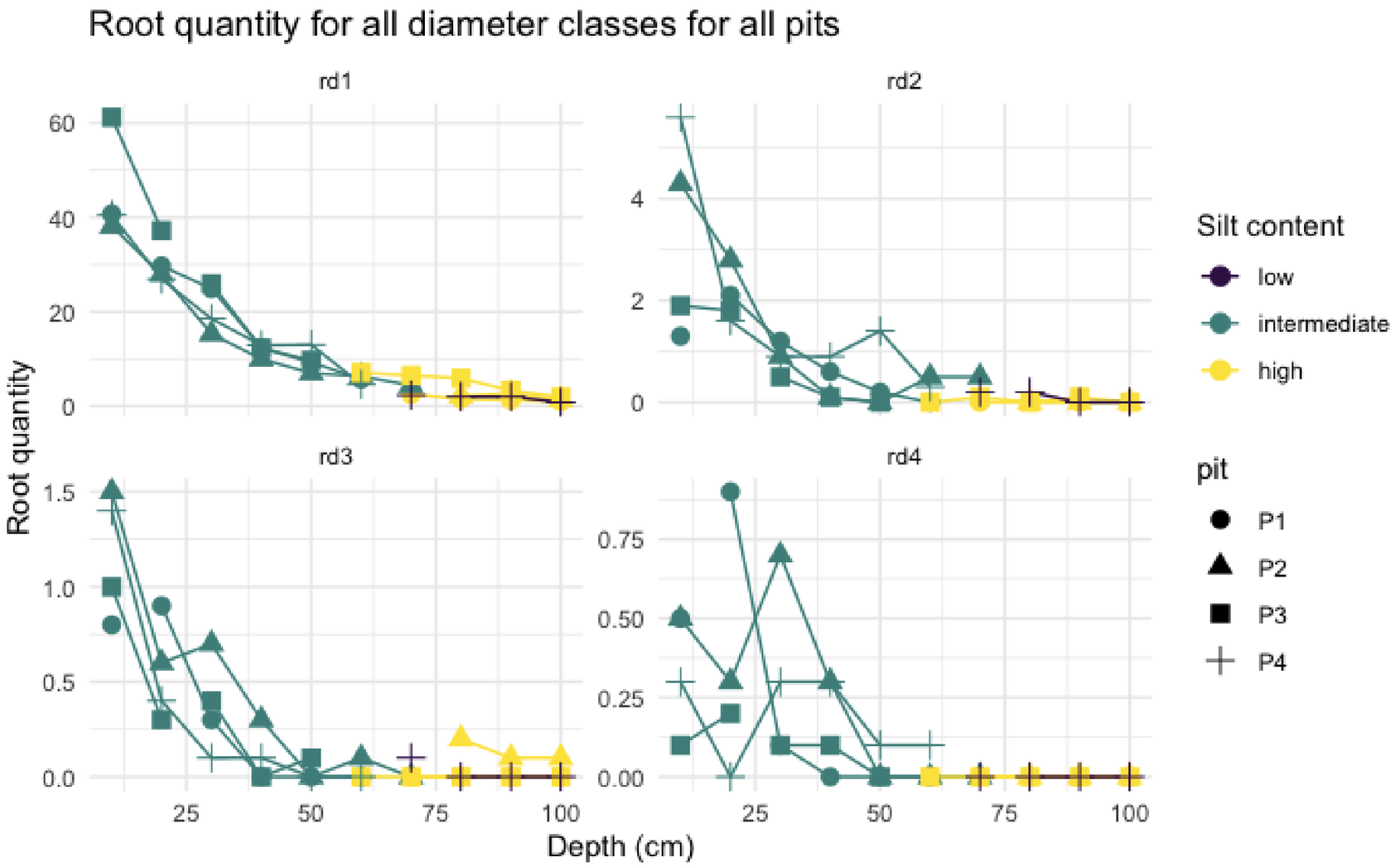


- gradual disappearance of drainage barrier
- difficult to distinguish the drainage barrier effect from other effects associated with topography

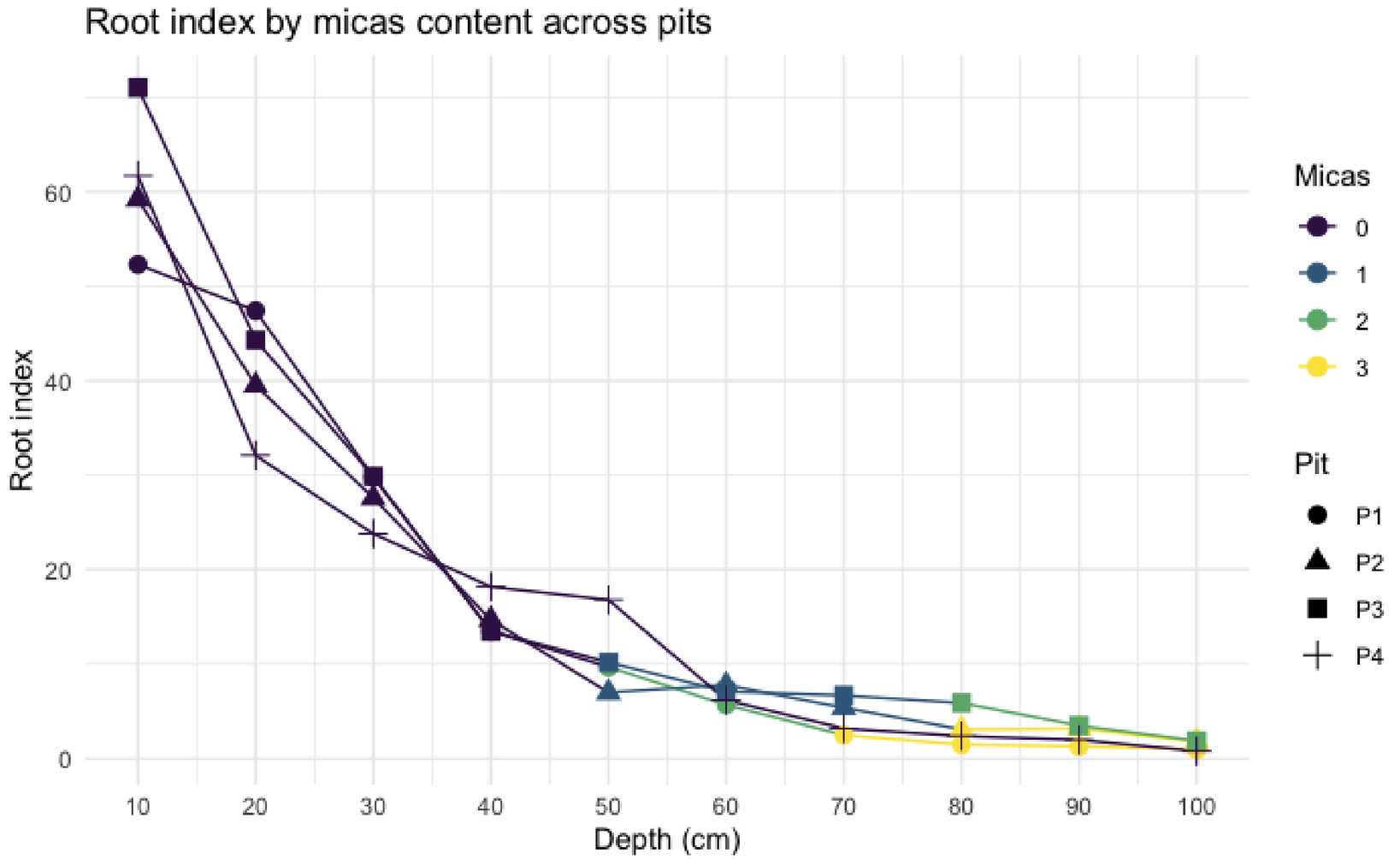


Notes: do we talk about the infiltration rate test? i feel like this is something they might ask but we can also keep it for eventual questions

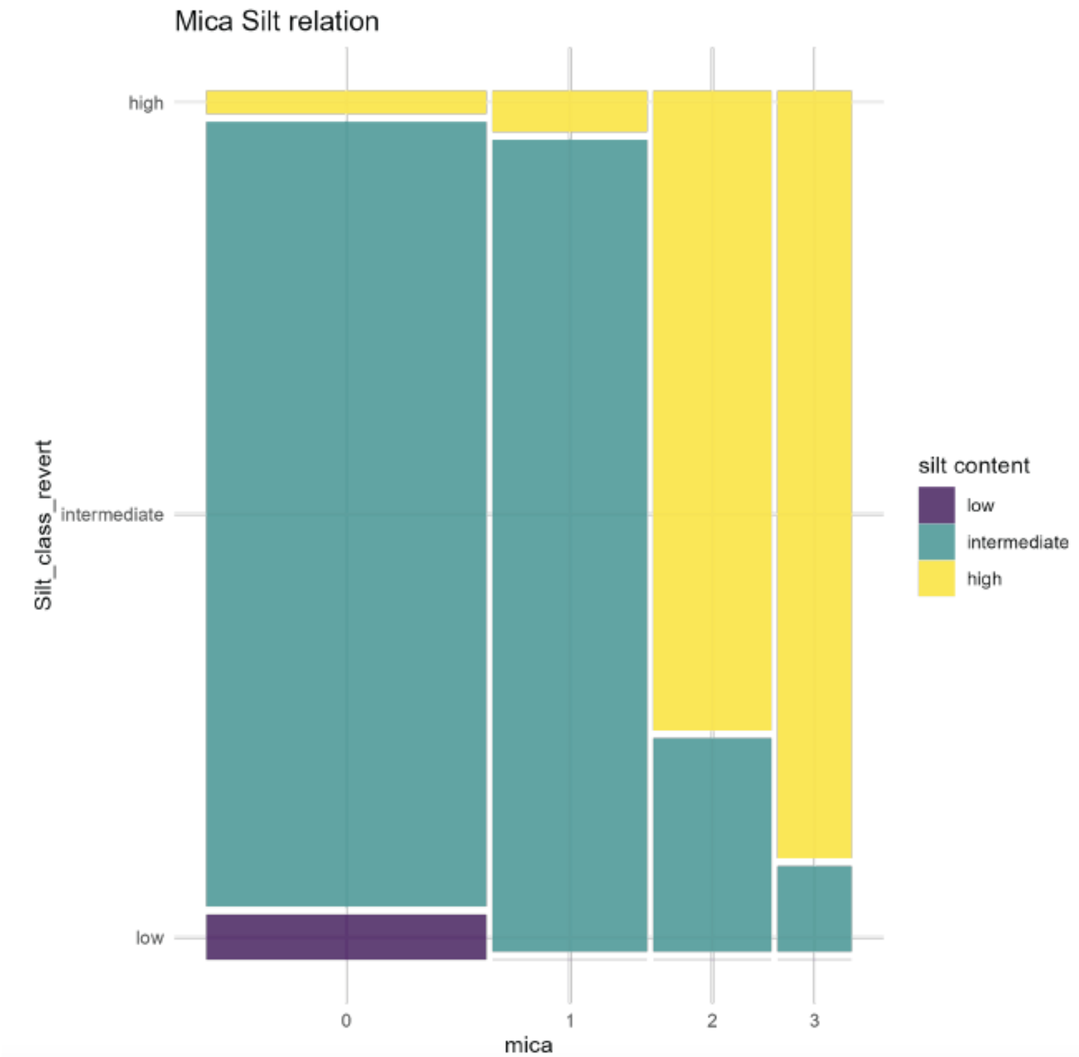
Appendix 6


Root quantity for all diameter classes for all pits
rd1
rd2
rd3
rd4
Root quantity
Depth (cm)
Silt content
low
intermediate
high
pit
P1
P2
P3
P4

Appendix 7


Root index by micas content across pits
Root index
60
40
20
0
10
20
30
40
50
60
70
80
90
100
Depth (cm)
Micas
0
1
2
3
Pit
P1
P2
P3
P4

Appendix 7


Mica Silt relation
high
intermediate
low
Silt_class_revert
0
1
2
3
mica
silt content
low
intermediate
high