Before/after disturbance: Silvicultural Methods for Managing Cork Oak in Fire-Prone Landscapes

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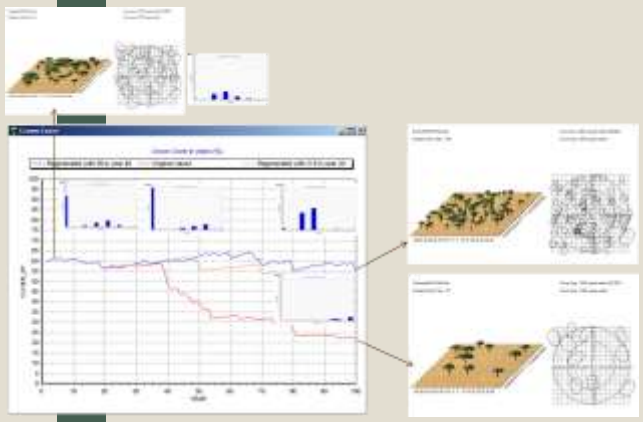
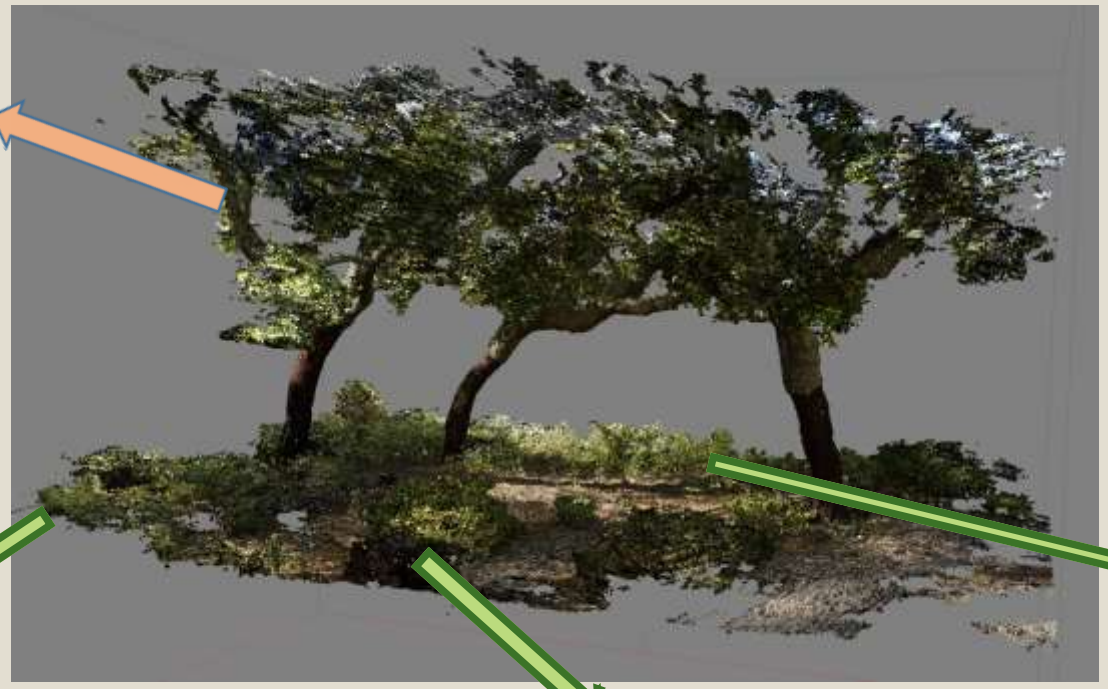
Forest and woodland ecosystems

Structure and function





Management options

Management options:

- Natural and artificial regeneration
- Stem formation pruning (young stages)
- Thinning
- Sanitary thinning-mortality
- Crown pruning
- Debark-cork (minimum 9-year period)
- Shrub control:
  - Grazing
  - Disking
  - Shrub cutter
  - Permanent or temporary pasture crops

Site quality: soil and root distribution

Soil type, mineral and organic matter components are the drivers to:

- Fertility
- Water storage capacity
- Biological porosity and microbiome
- Tree/shrub root system distribution
- Herbaceous vegetation root system distribution
- Soil cohesion and resilience
- Site quality
    - Stand structure and density in time
    - Regeneration intensity and survival
    - Tree productivity and survival

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File Data Points Data Cylinders Data Model View Selection Tools Settings Help

Connection: USB RS232 Close

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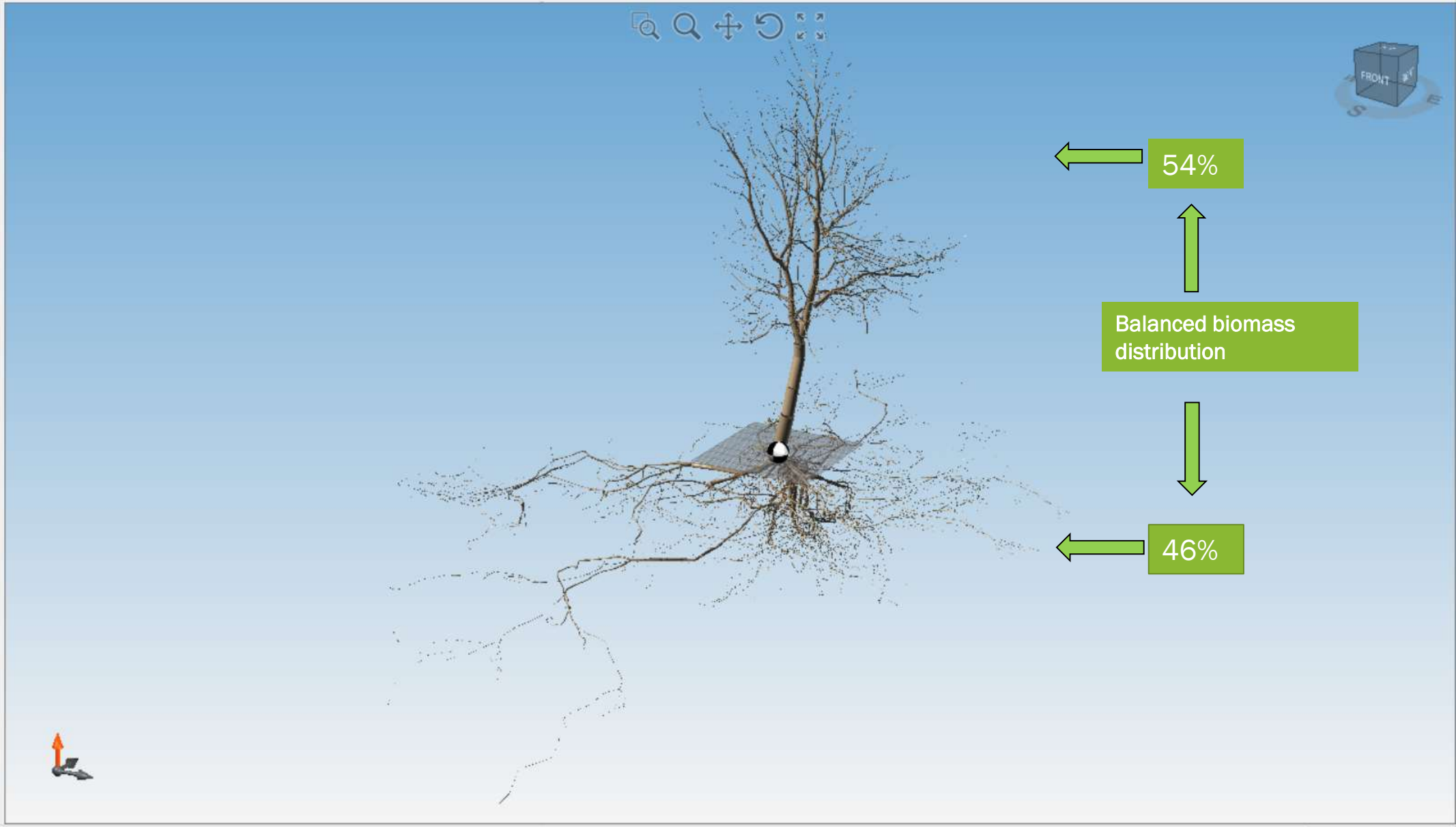

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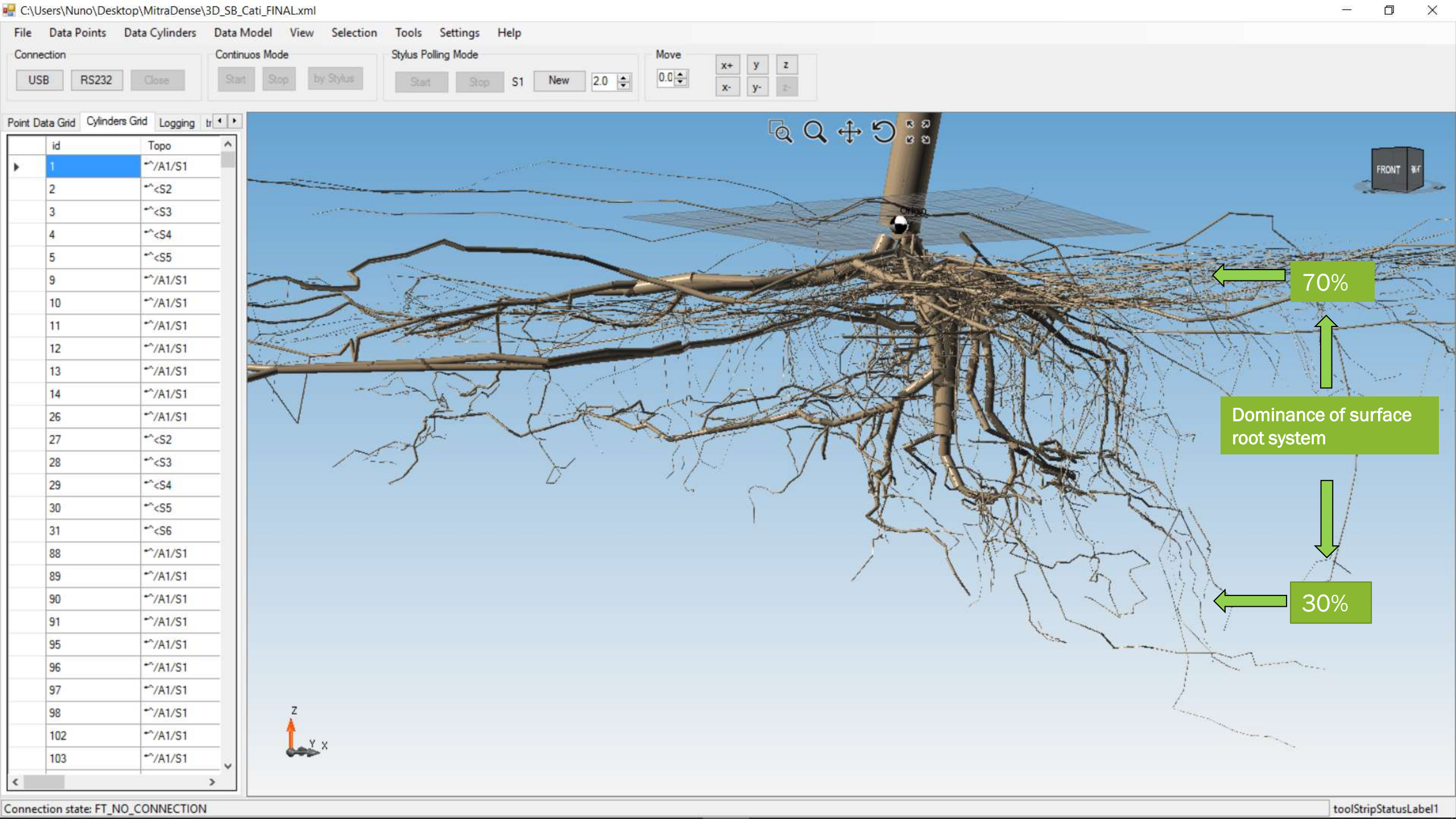
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102 */A1/S1
103 */A1/S1
FRONT
70%
Dominance of surface root system
30%
Z
Y
X
Connection state: FT_NO_CONNECTION
toolStripStatusLabel1

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File Data Points Data Cylinders Data Model View Selection Tools Settings Help

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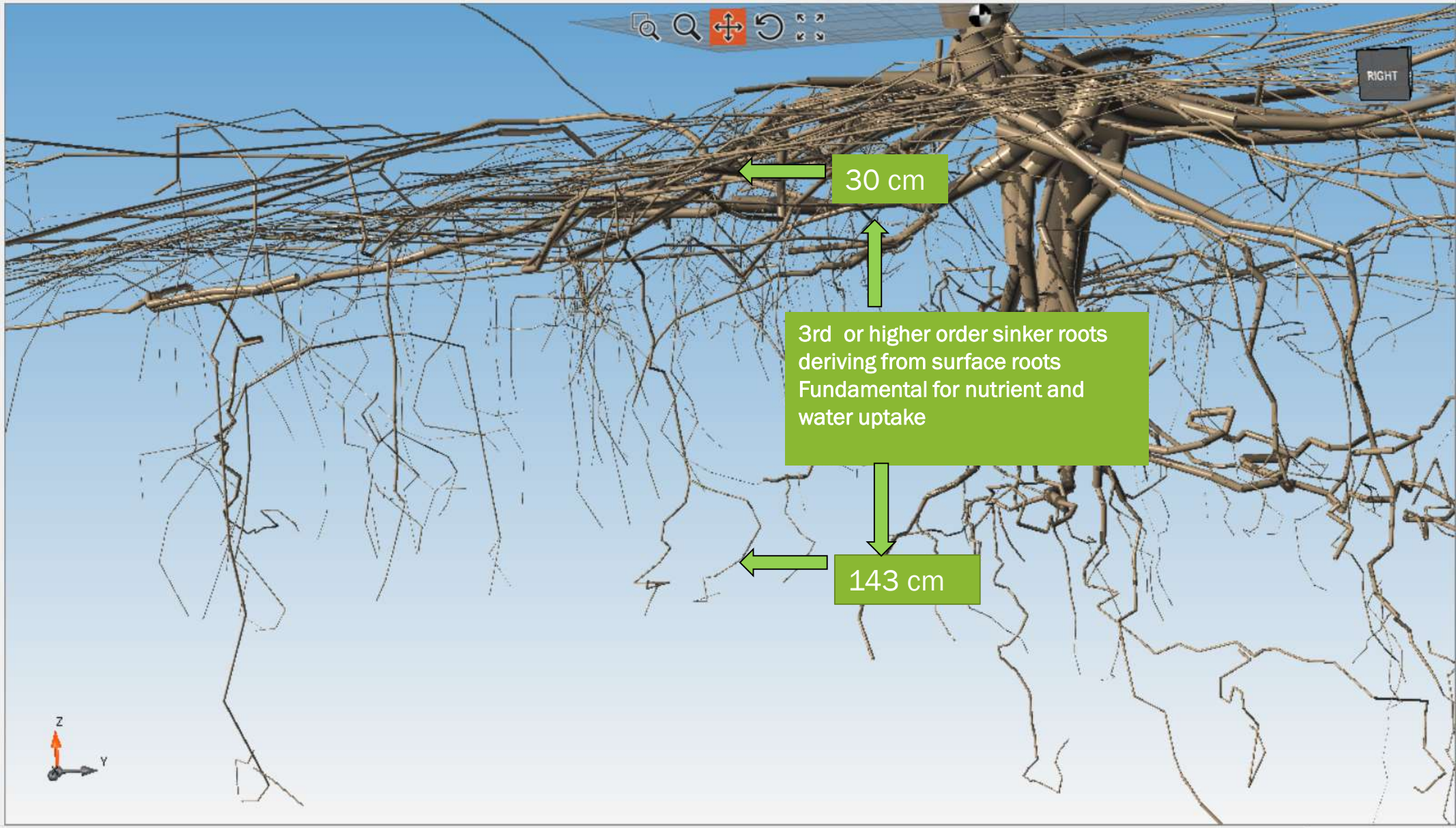

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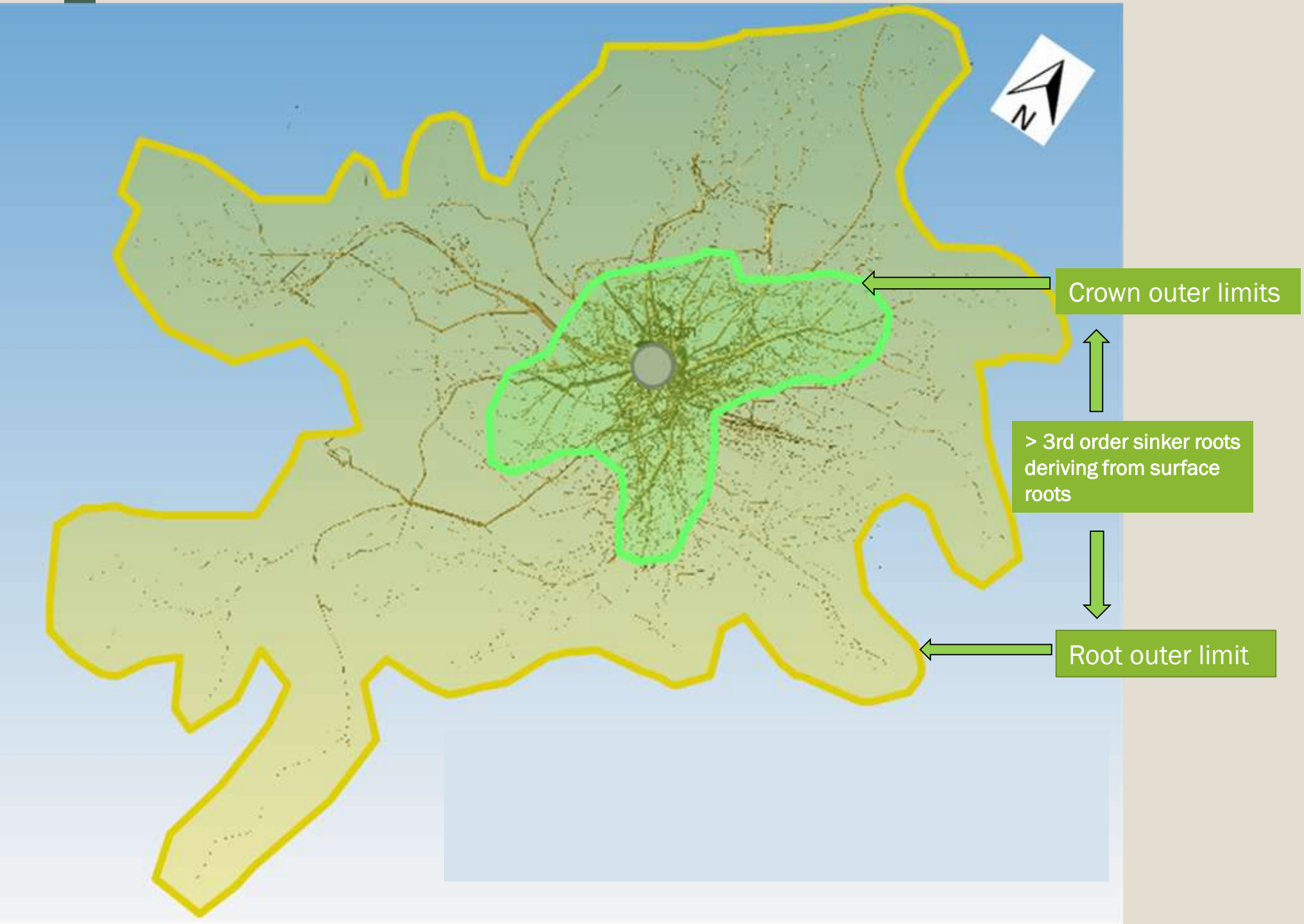
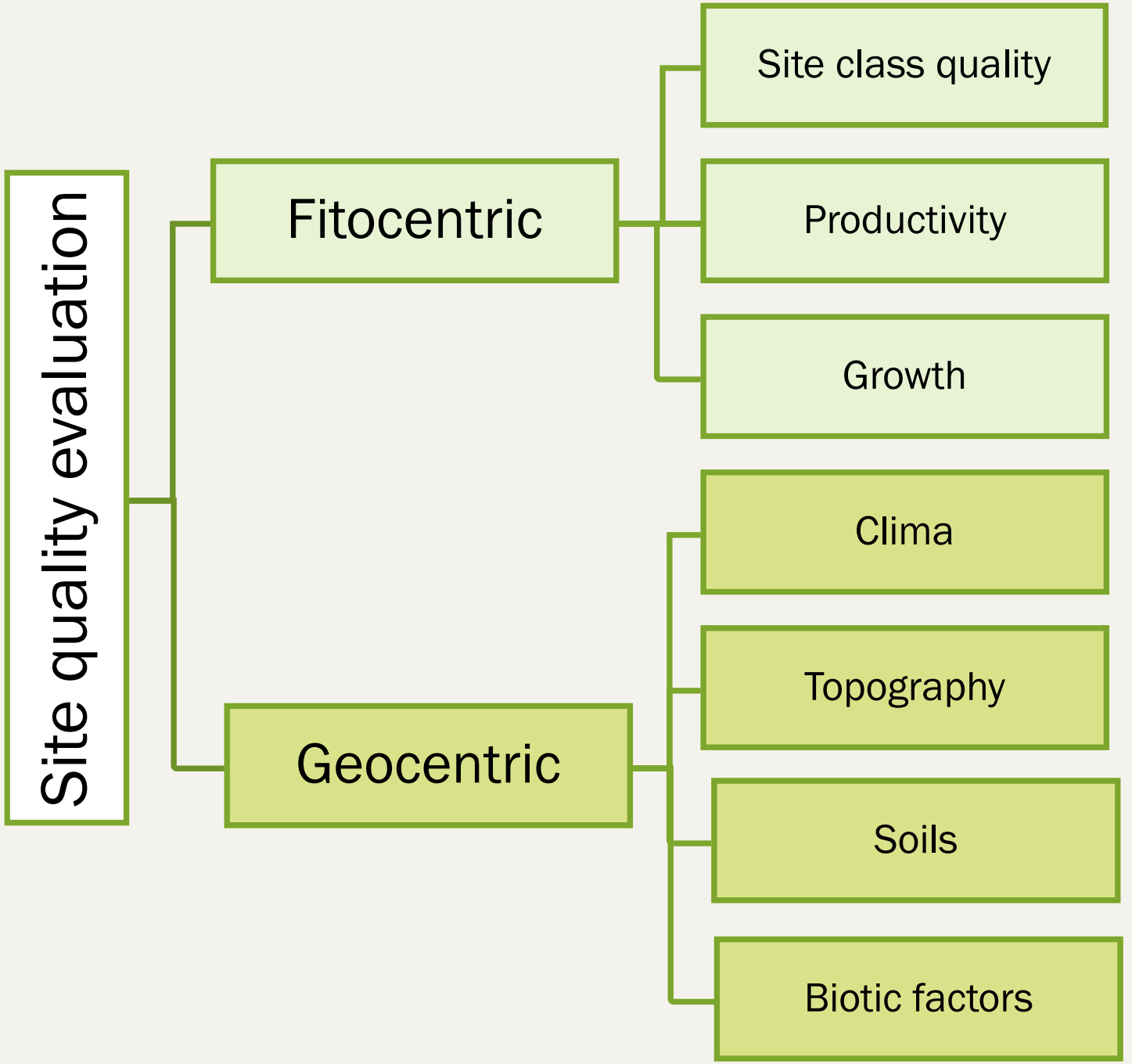

N
Crown outer limits
> 3rd order sinker roots deriving from surface roots
Root outer limit

Vegetation Control

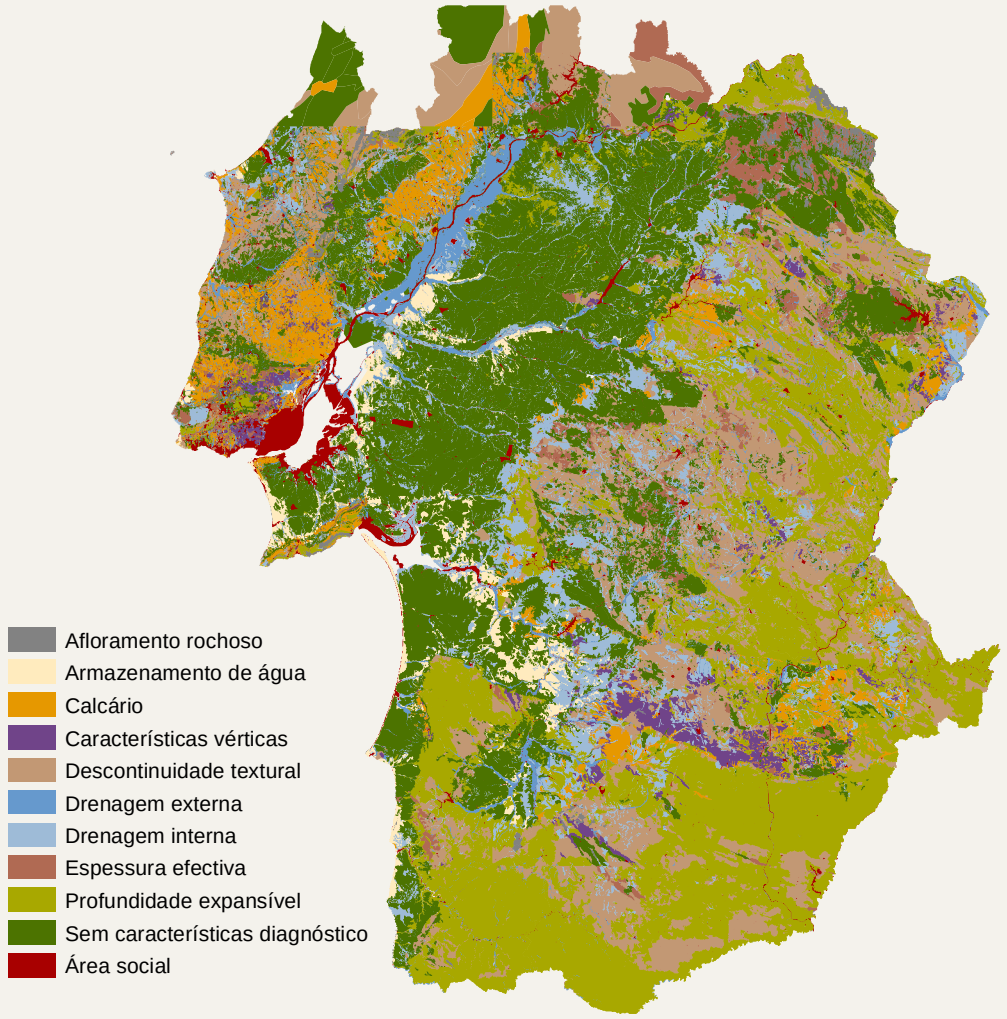
Very harmful

Alternative


Site quality evaluation
Fitocentric
Site class quality
Productivity
Growth
Geocentric
Clima
Topography
Soils
Biotic factors

SOIL

Soil diagnostic characteristics



Soil diagnostic characteristics	Soil conditioning factor for growth
No limitation	No conditioning
Expandable depth	Depth limited by fragile rock layer, possible to alter soil depth with machinery.
Active chalk	Presence of active chalk
Textural discontinuity	Argic B horizon (with or without compaction), possible to alter soil depth with machinery.
Vertic characteristics	Shrink-swell processes that can affect root devellopment
Salinity	Excessive salt concentrations in soil profile.
External drainage	Potential accumulation of water at the soil surface, (stagnic properties)
Internal drainage	Presence of shallow water tables (gleyic properties).
Water storage	Low water storage capacity
Permanent depth	Depth limited by strong rock layer.
Surface rock layer	Non productive soil.
Social area	Non usable soil due to construction.

SOIL

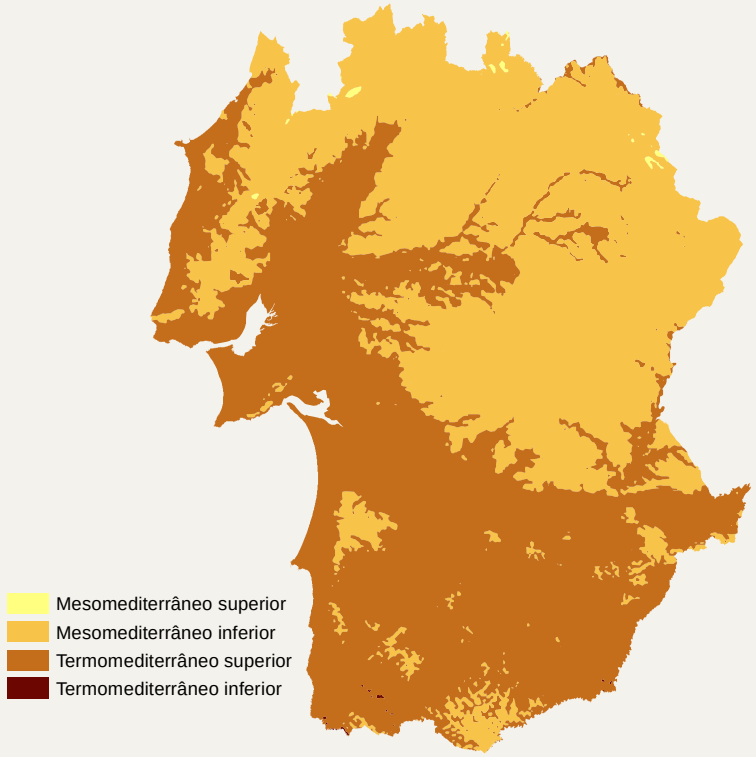
EDAPHIC POTENTIAL

Holm oak (Quercus rotundifolia Lam.)	Cork oak (*Quercus suber L.*)
Classe 3	
Active chalk Textural discontinuity Expandable depth No limitation	Expandable depth No limitation
Classe 2	
Water storage Permanent depth	Water storage Textural discontinuity Permanent depth
Classe 1	
Surface rock layer Vertic characteristics External drainage Internal drainage Salinity	Surface rock layer Active chalk Vertic characteristics External drainage Internal drainage Salinity

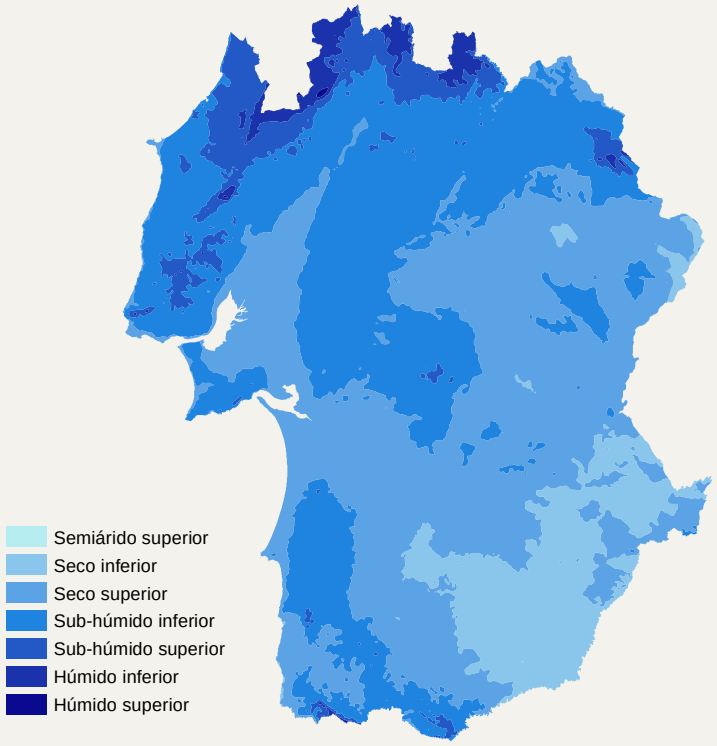
CLIMATIC POTENCIAL

Bioclimatic indices that are highly correlated with the actual vegetation distribution

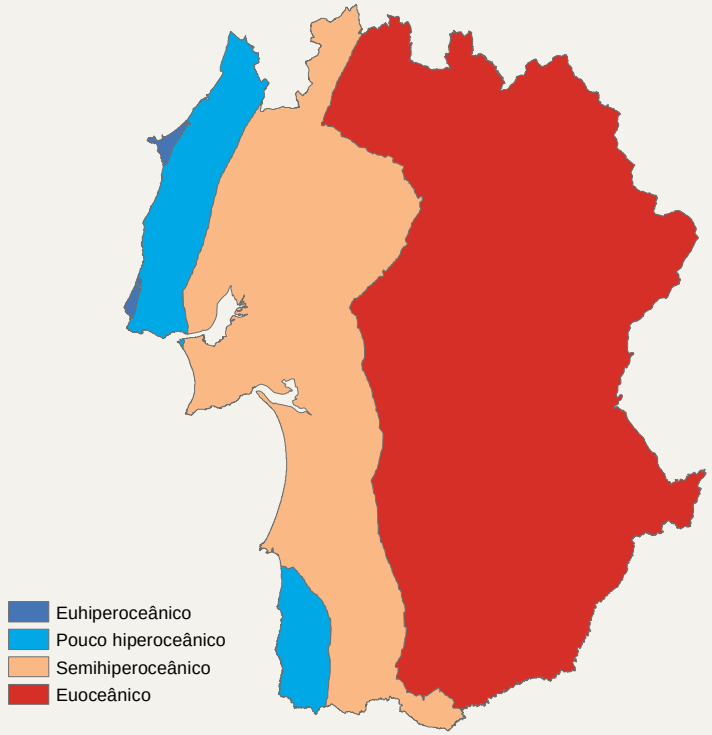
Thermicity index (It)



Ombrothermic index (Io)

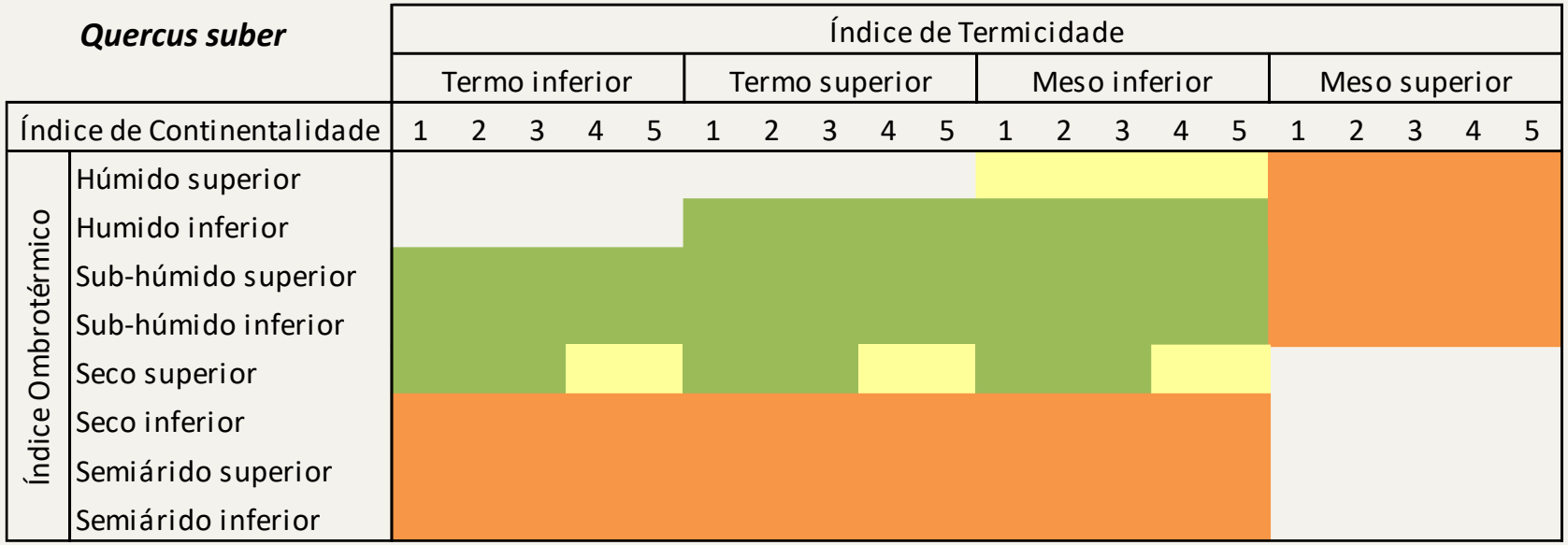


Continentally index (Ic)



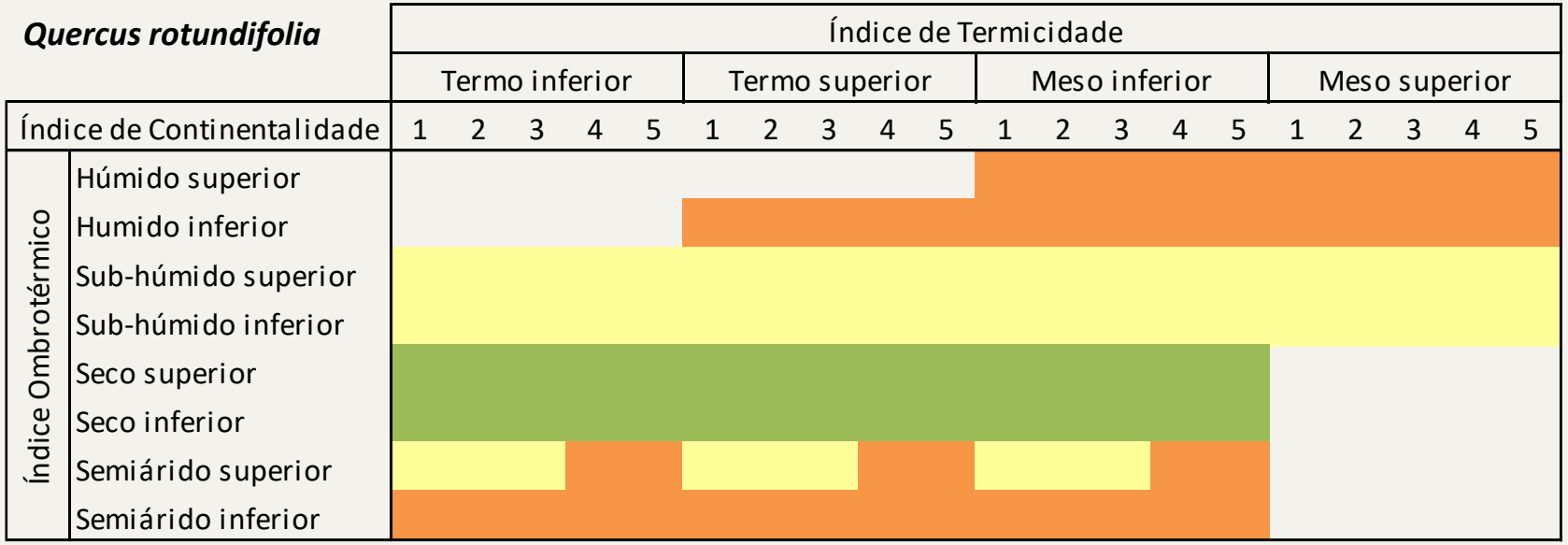
FITOCLIMATIC POTENTIAL

Quercus suber

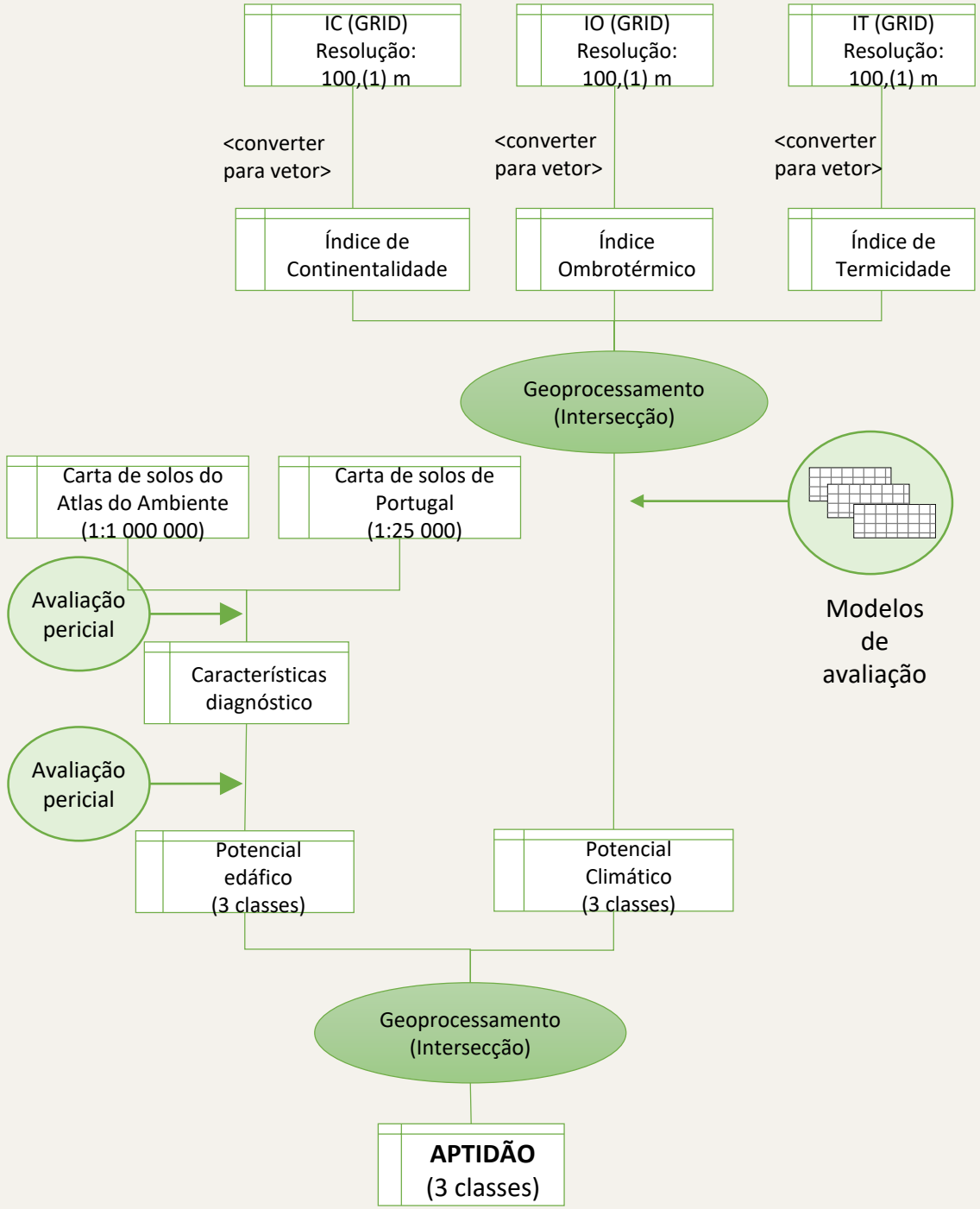


Índice de Continentalidade: 1 – Euhiperoceânico; 2 – Pouco hiperoceânico; 3 – Semihiperoceânico; 4- Euoceânico; 5 - Semicontinental

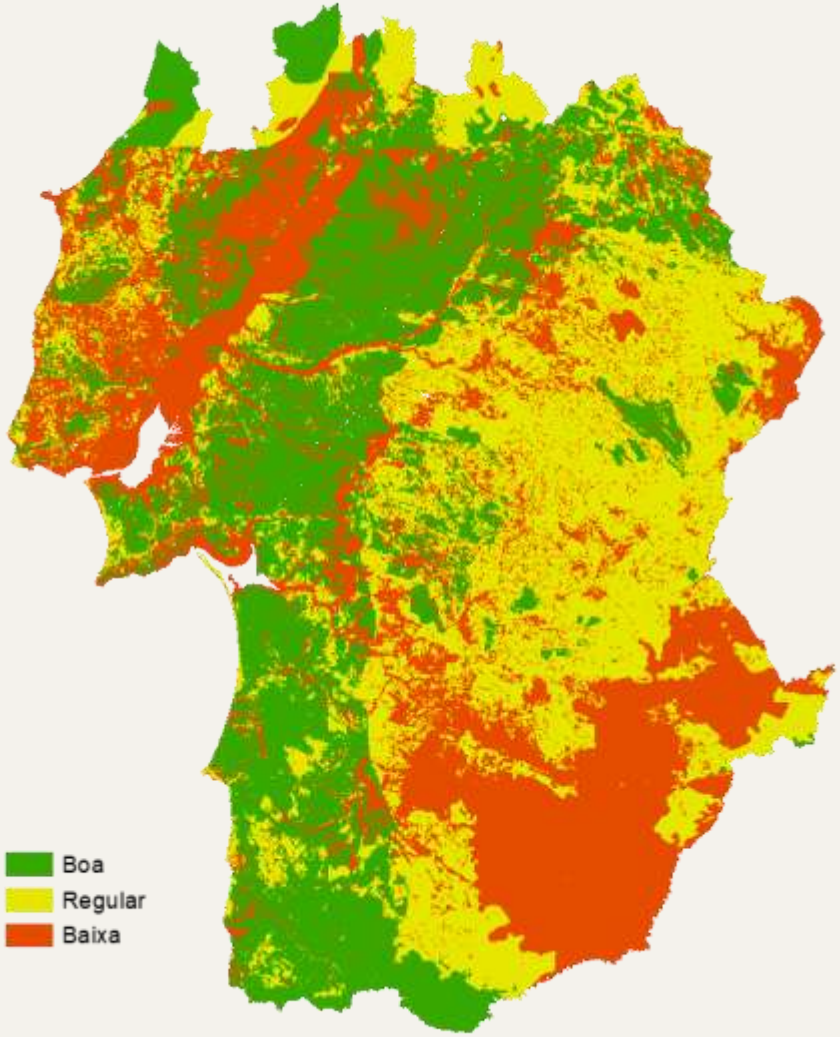
Quercus rotundifolia



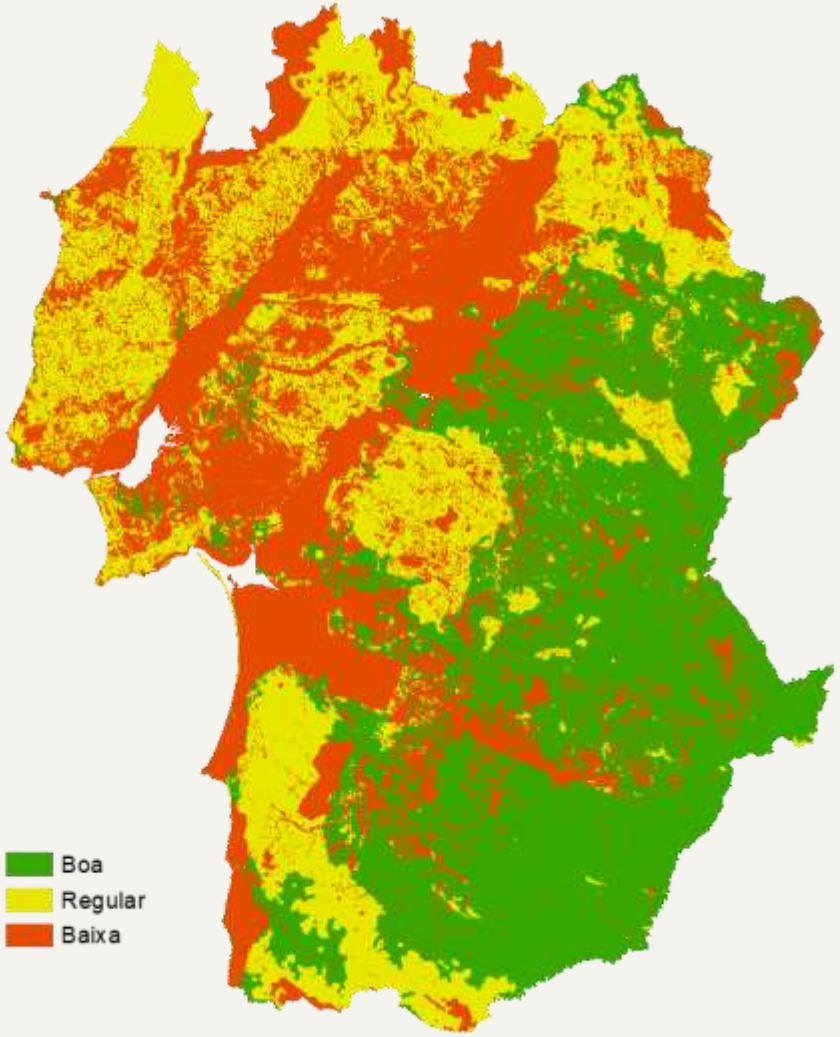
MODELO CARTOGRÁFICO



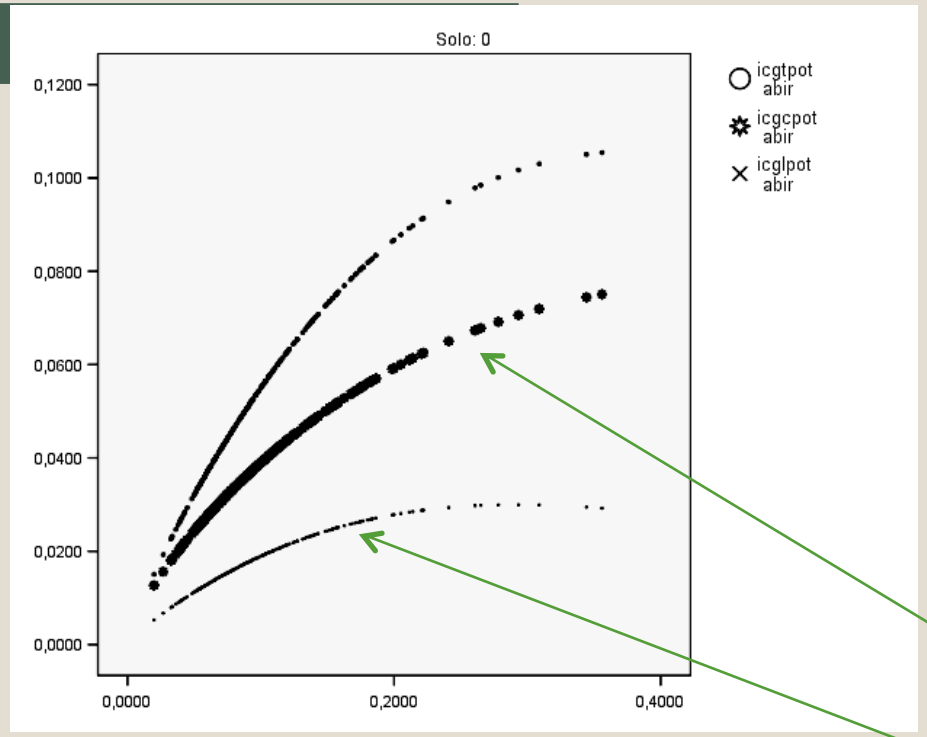
Sobreiro

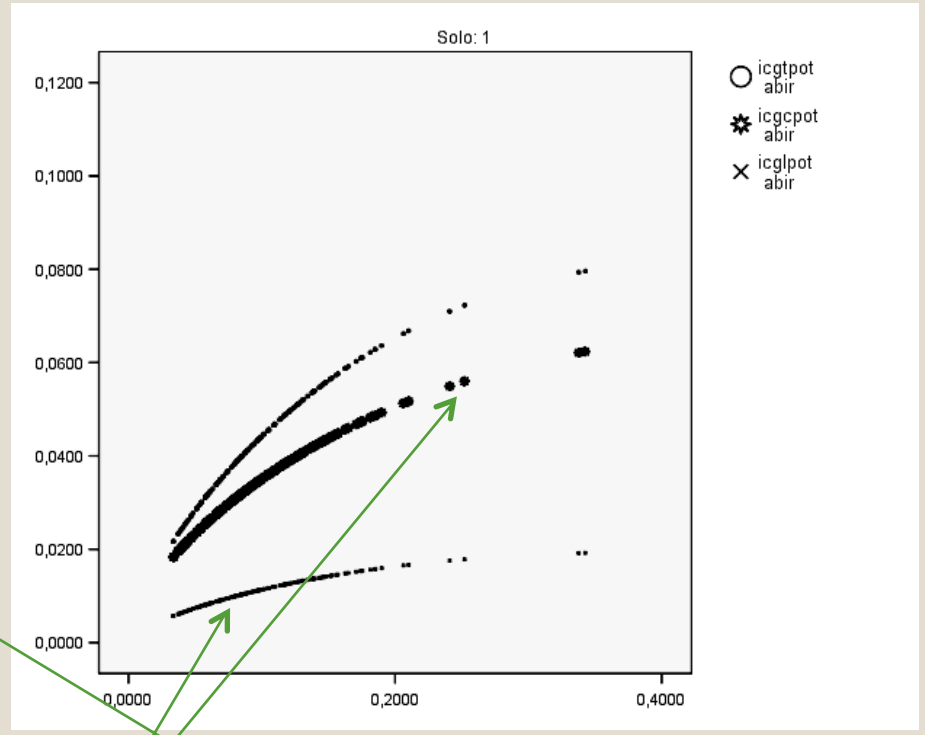


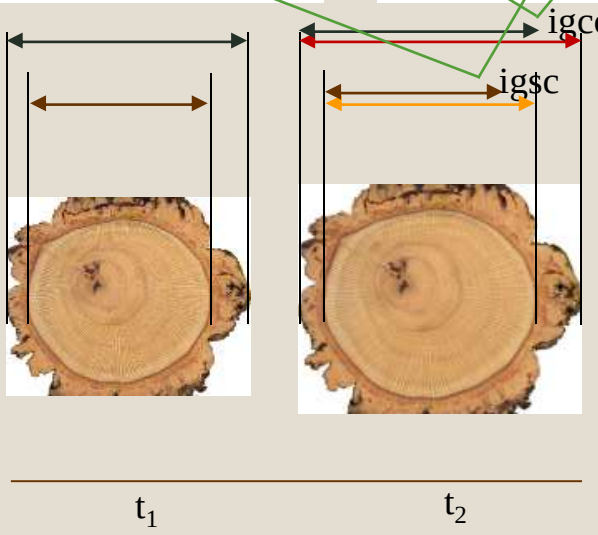
Azinheira



Potential growth function







Phases and silvicultural models

Initiation

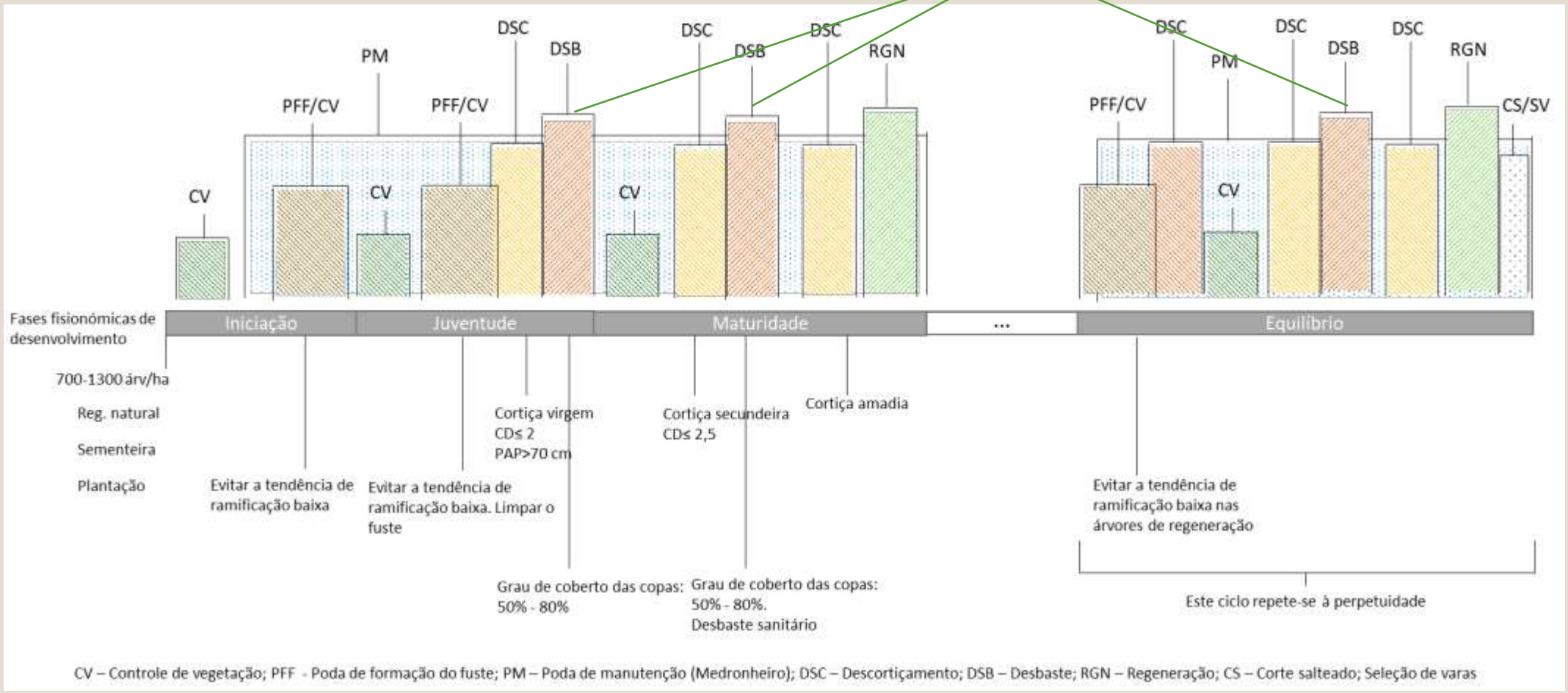
Juvenile

Maturity
Regeneration

Old growth
Regeneration

Phases and silvicultural models

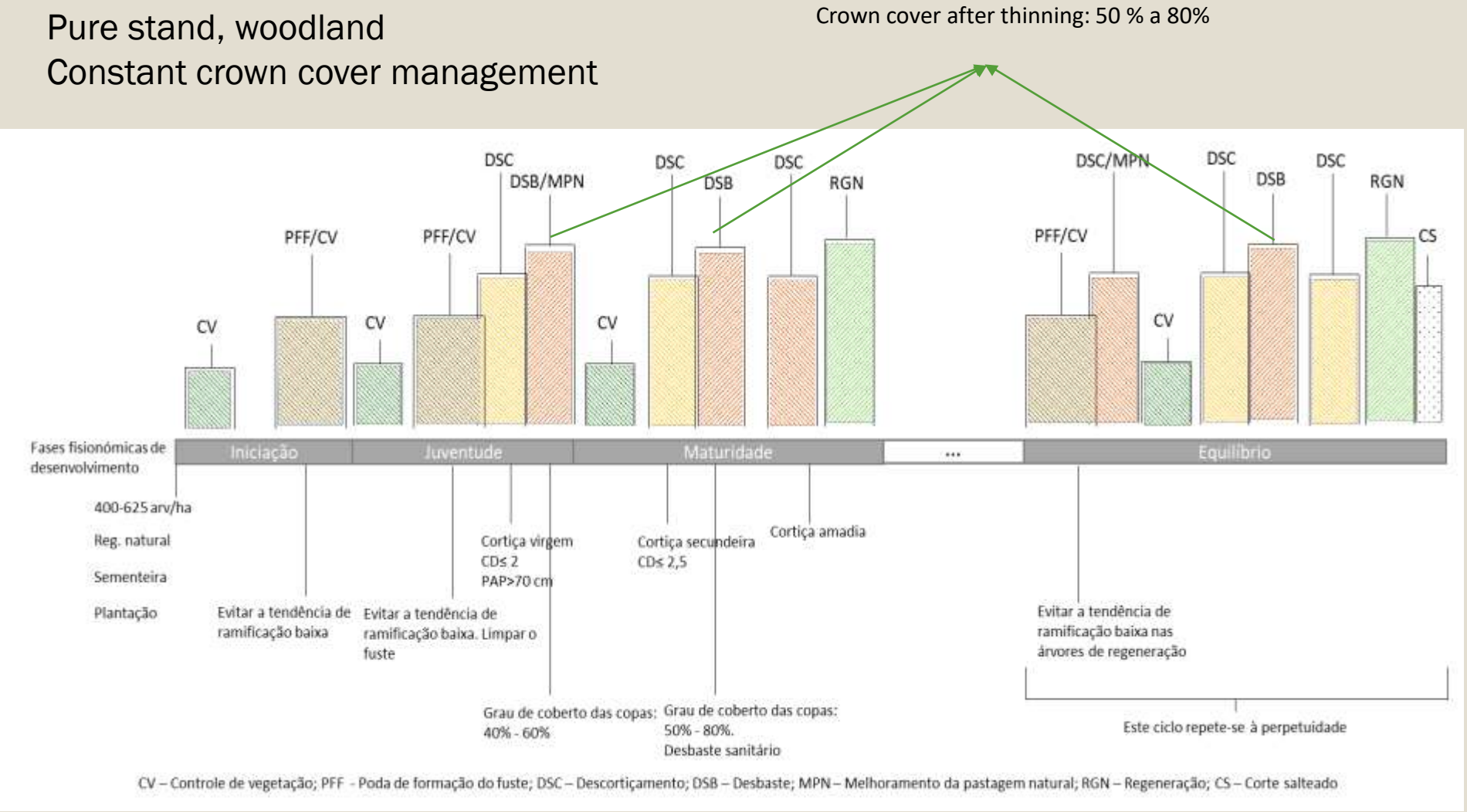
Mixed stand, forest (cork oak X strawberry tree): Constant crown cover management



Adapted Ribeiro etal. (2023)

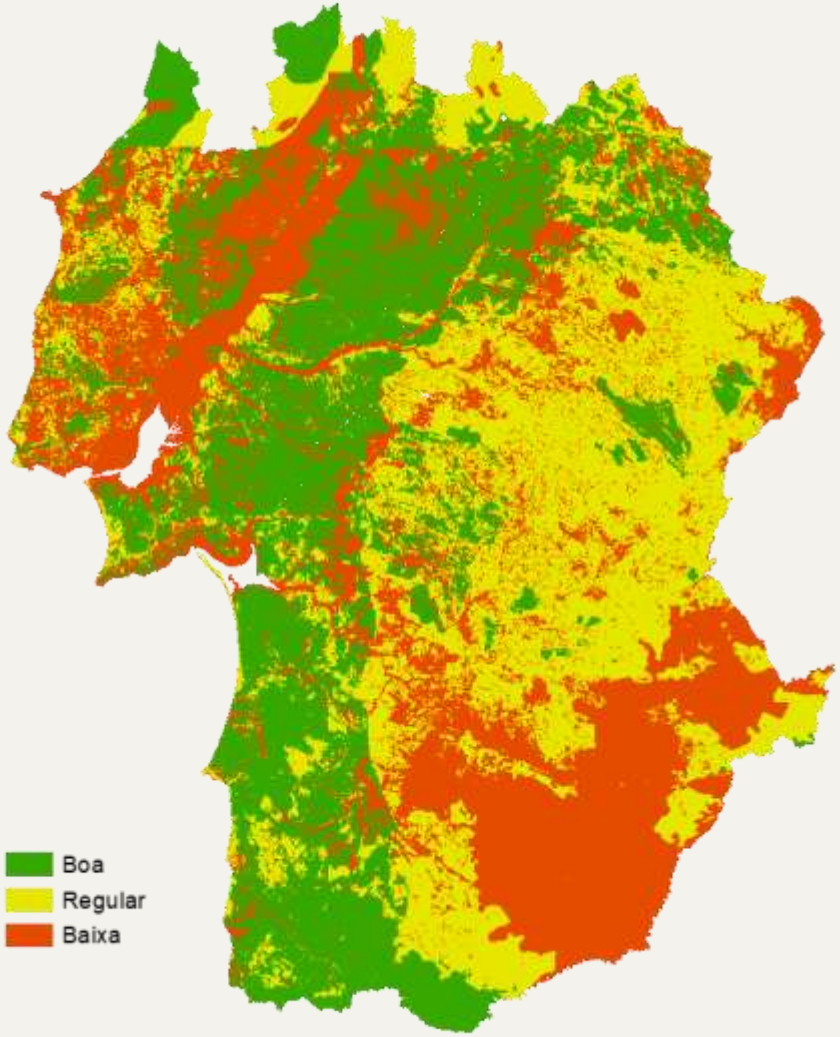
Phases and silvicultural models

Pure stand, woodland
Constant crown cover management



Adapted Ribeiro etal. (2023)

Sobreiro



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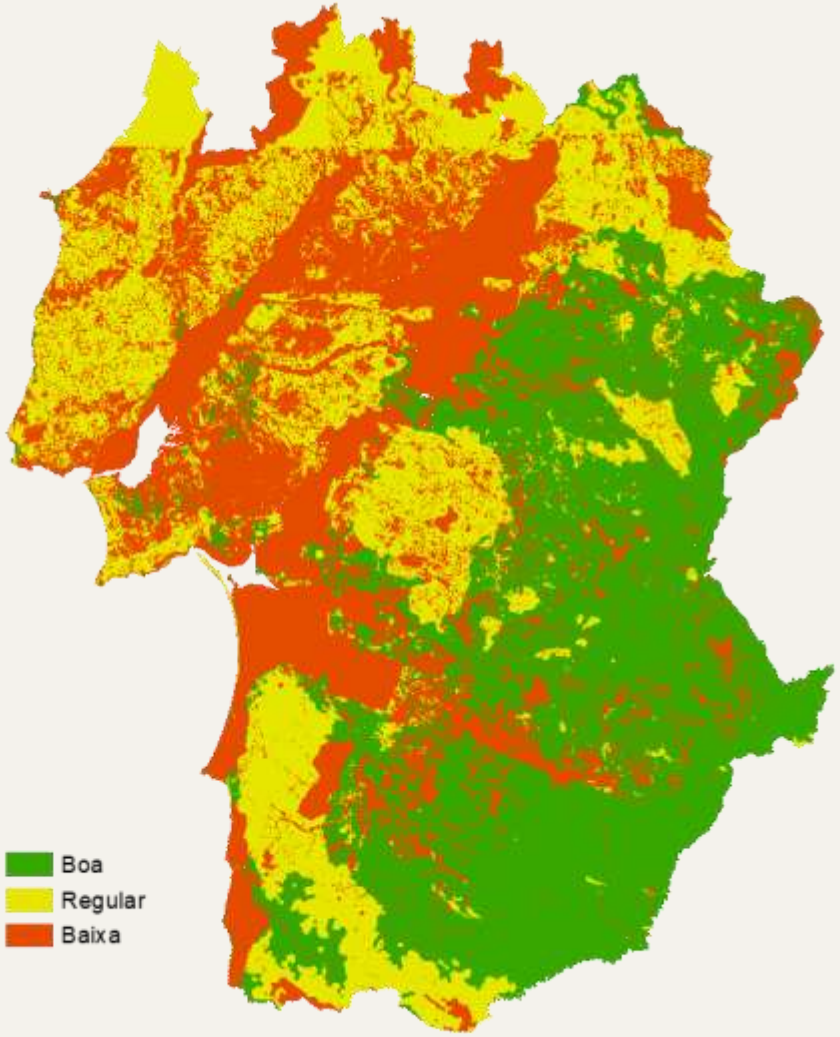
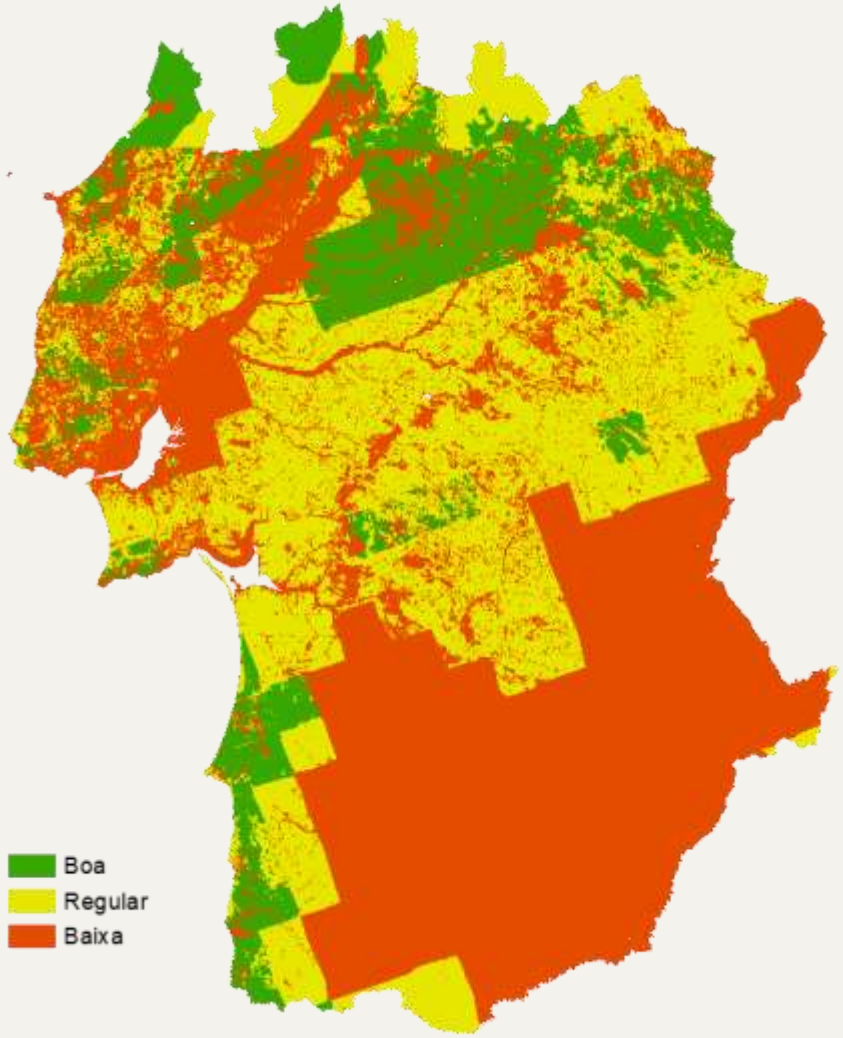
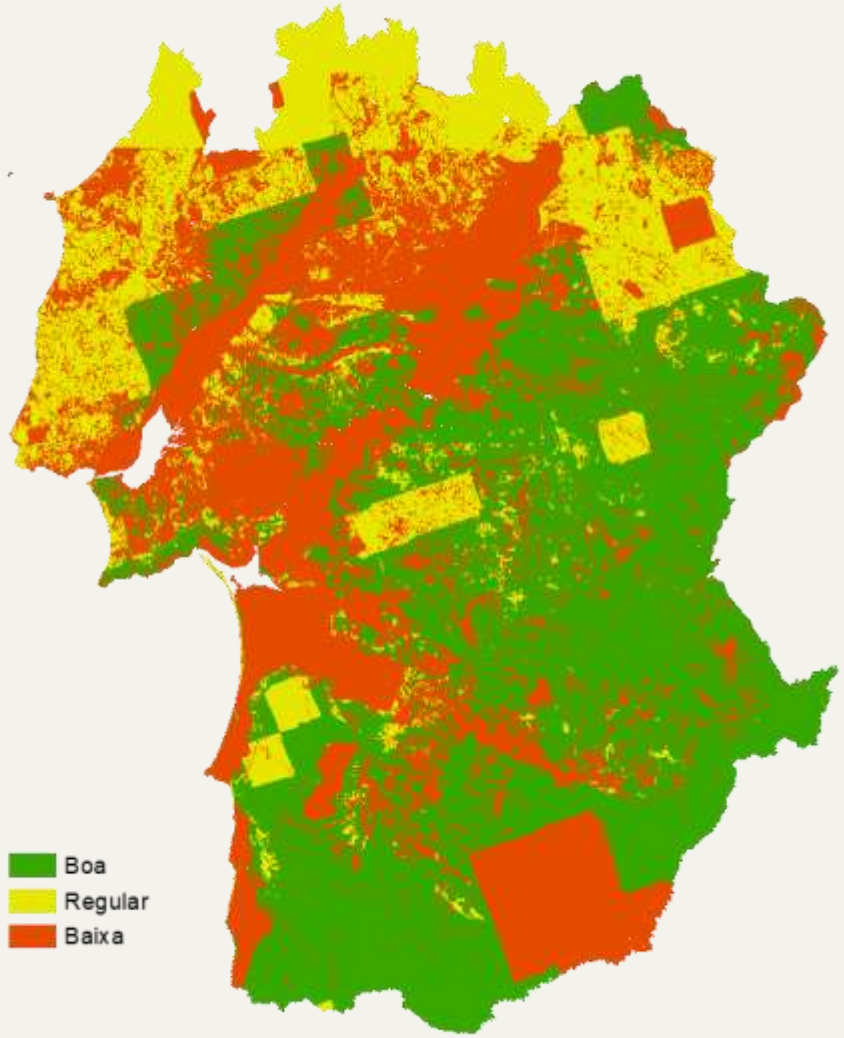


Sobreiro

RCP 45 (2050)

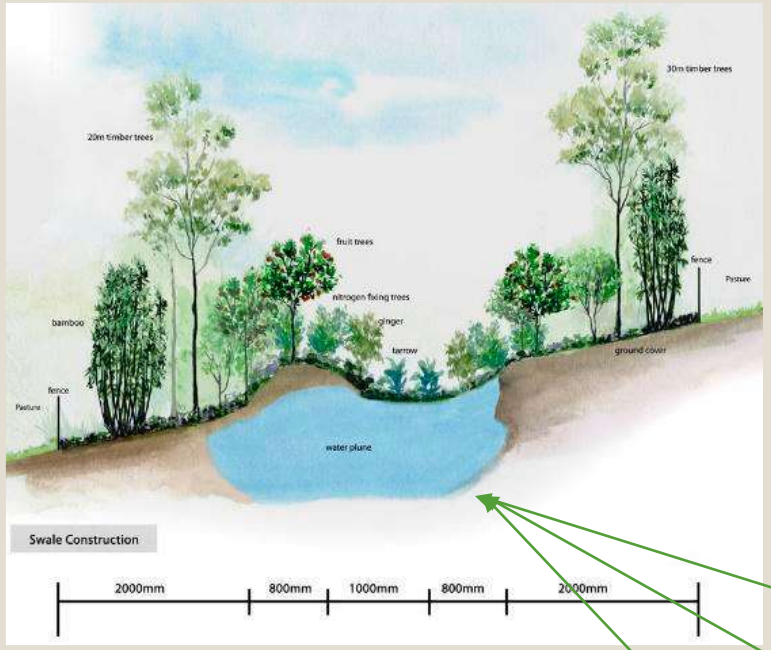
Azinheira

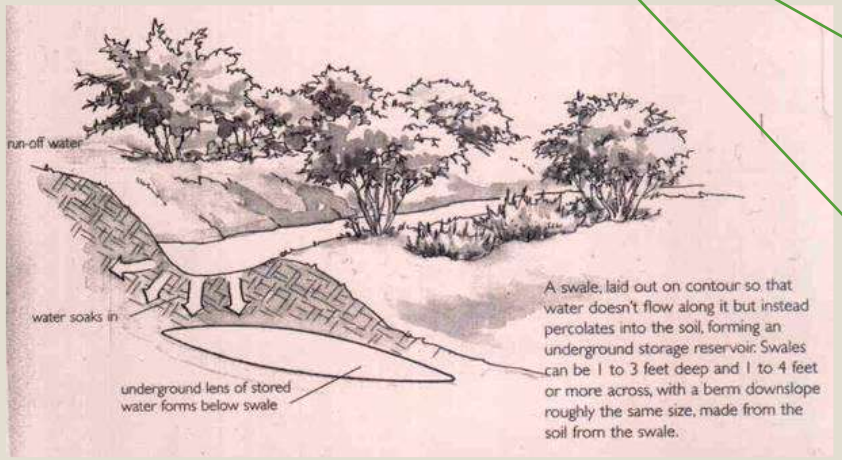




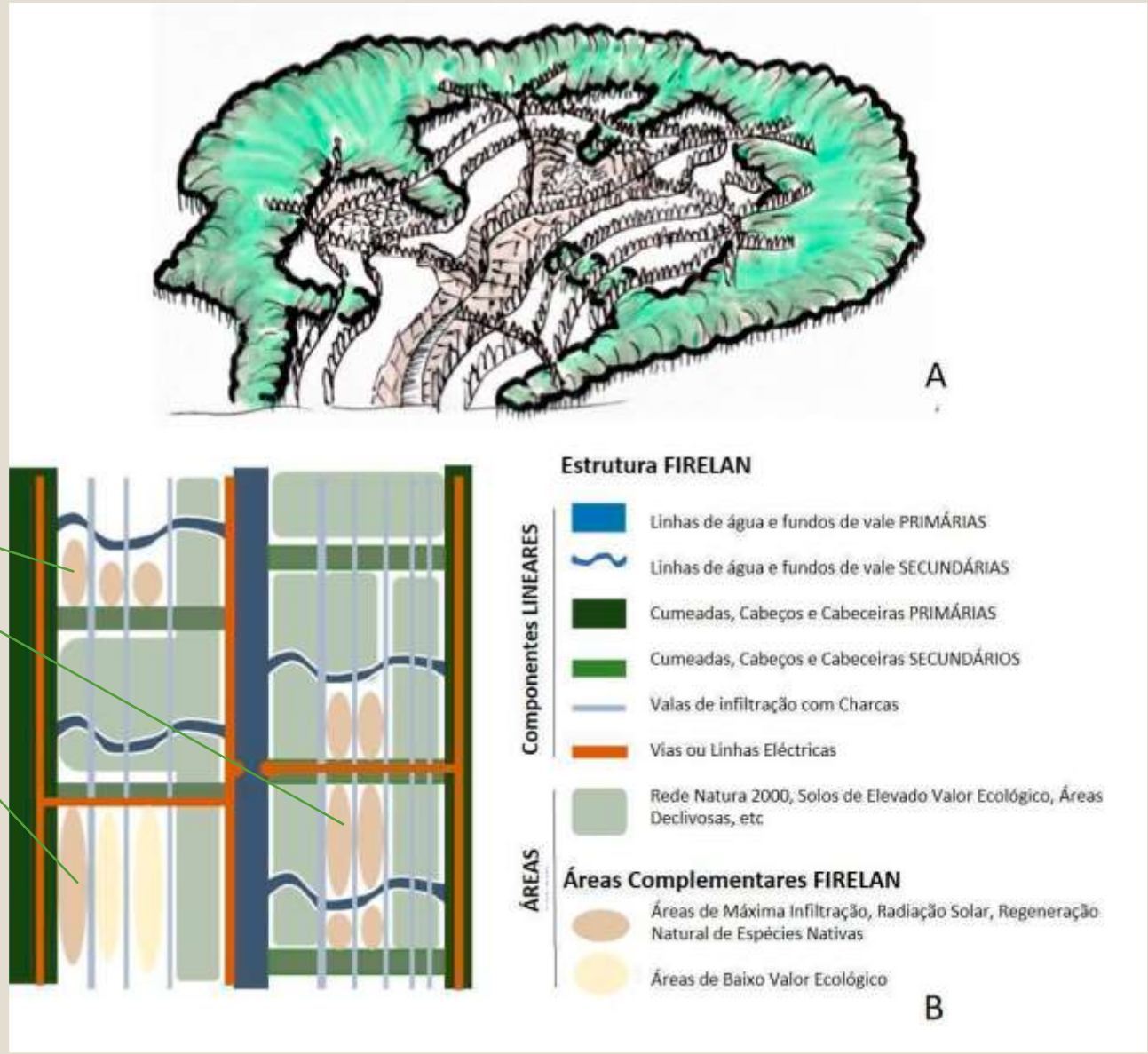
Before disturbance

Before disturbance: Landscape planning





Magalhães etal., (2023)

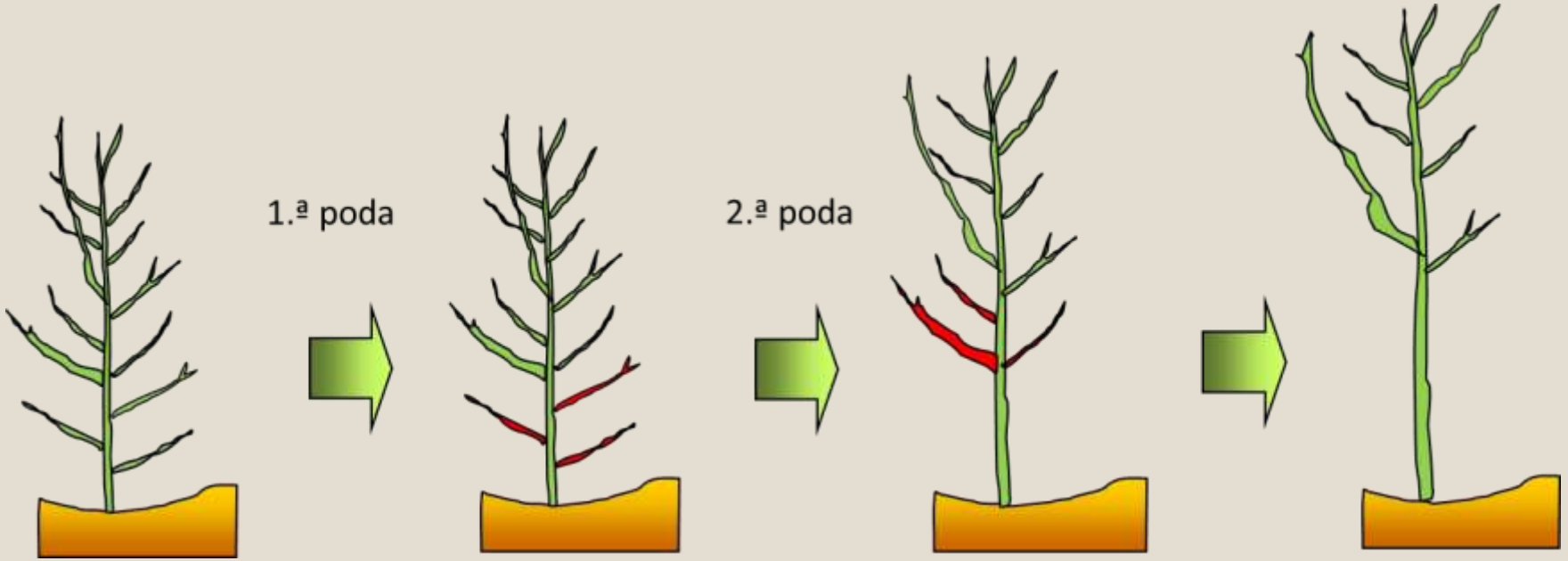


BEFORE DISTURBANCE: VEGETATION CONTROL

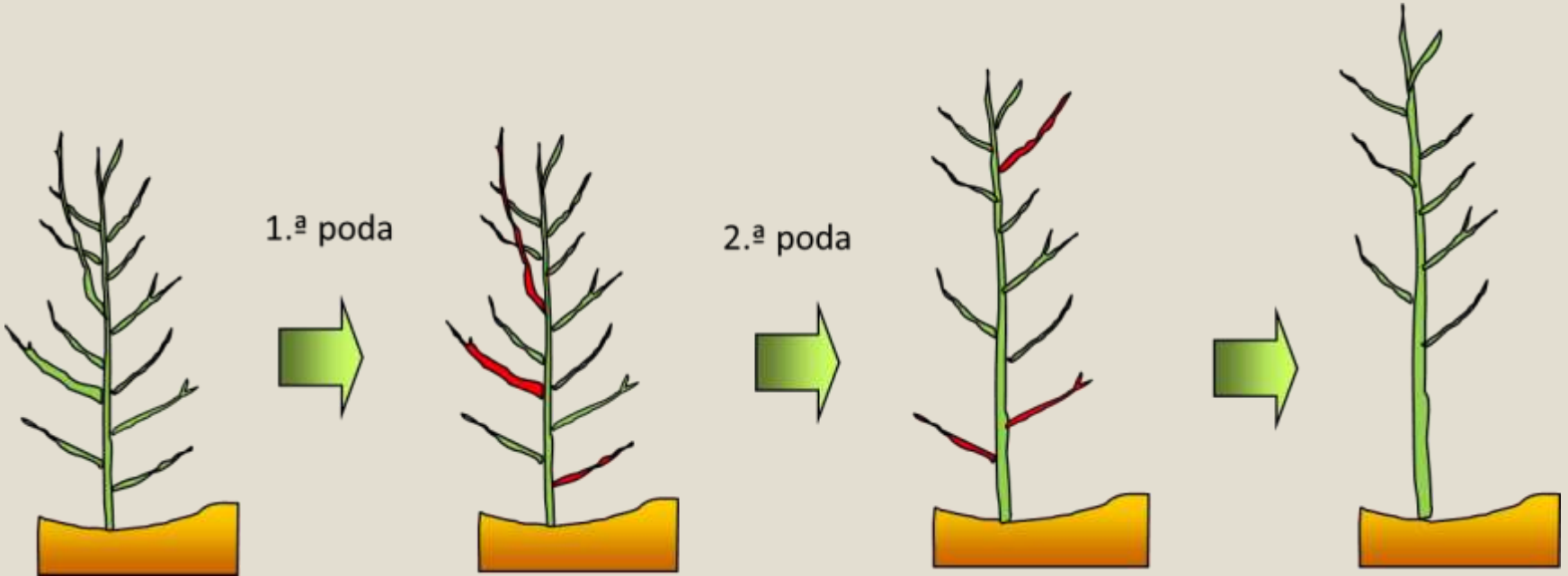
BEFORE DISTURBANCE: VEGETATION CONTROL

After disturbance

After disturbance: Tree management

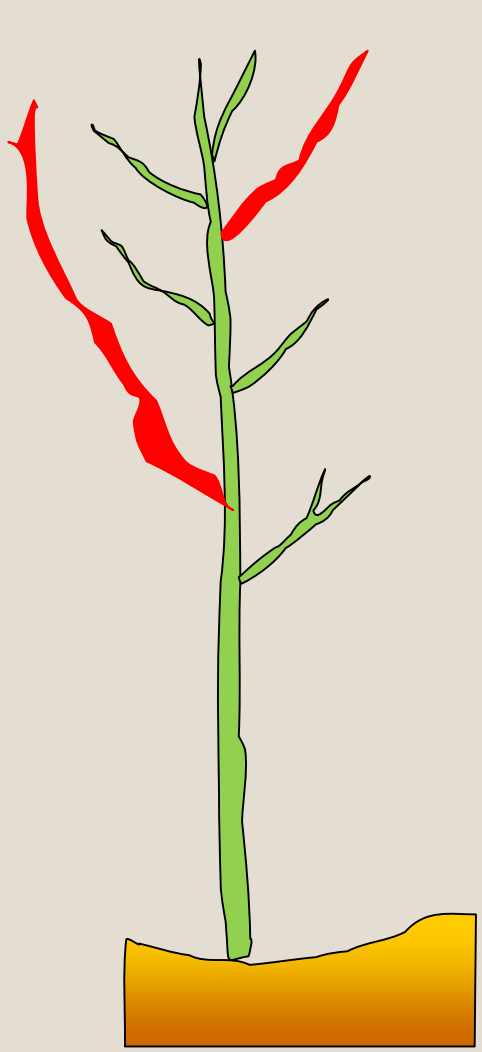


Wrong

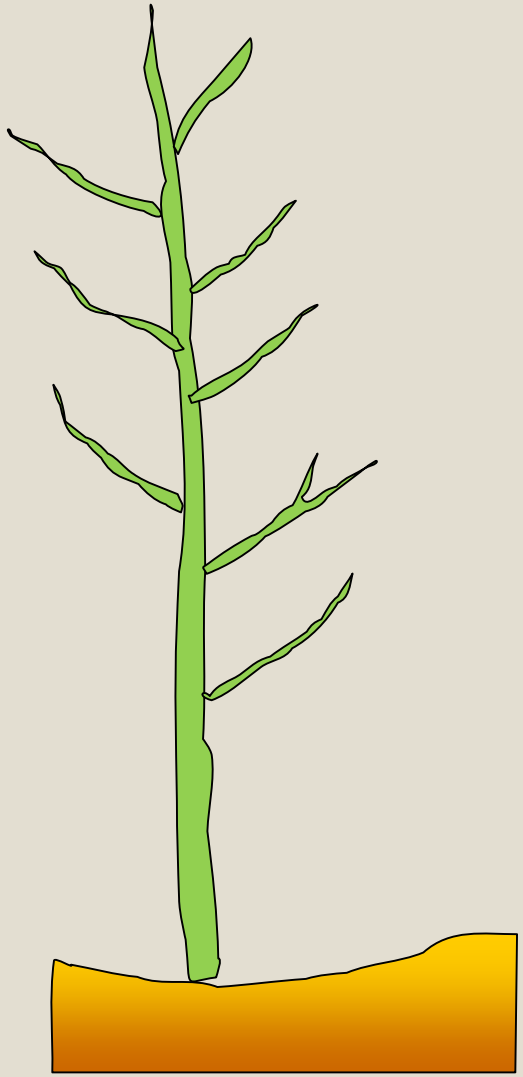


Correct

After disturbance: Tree management



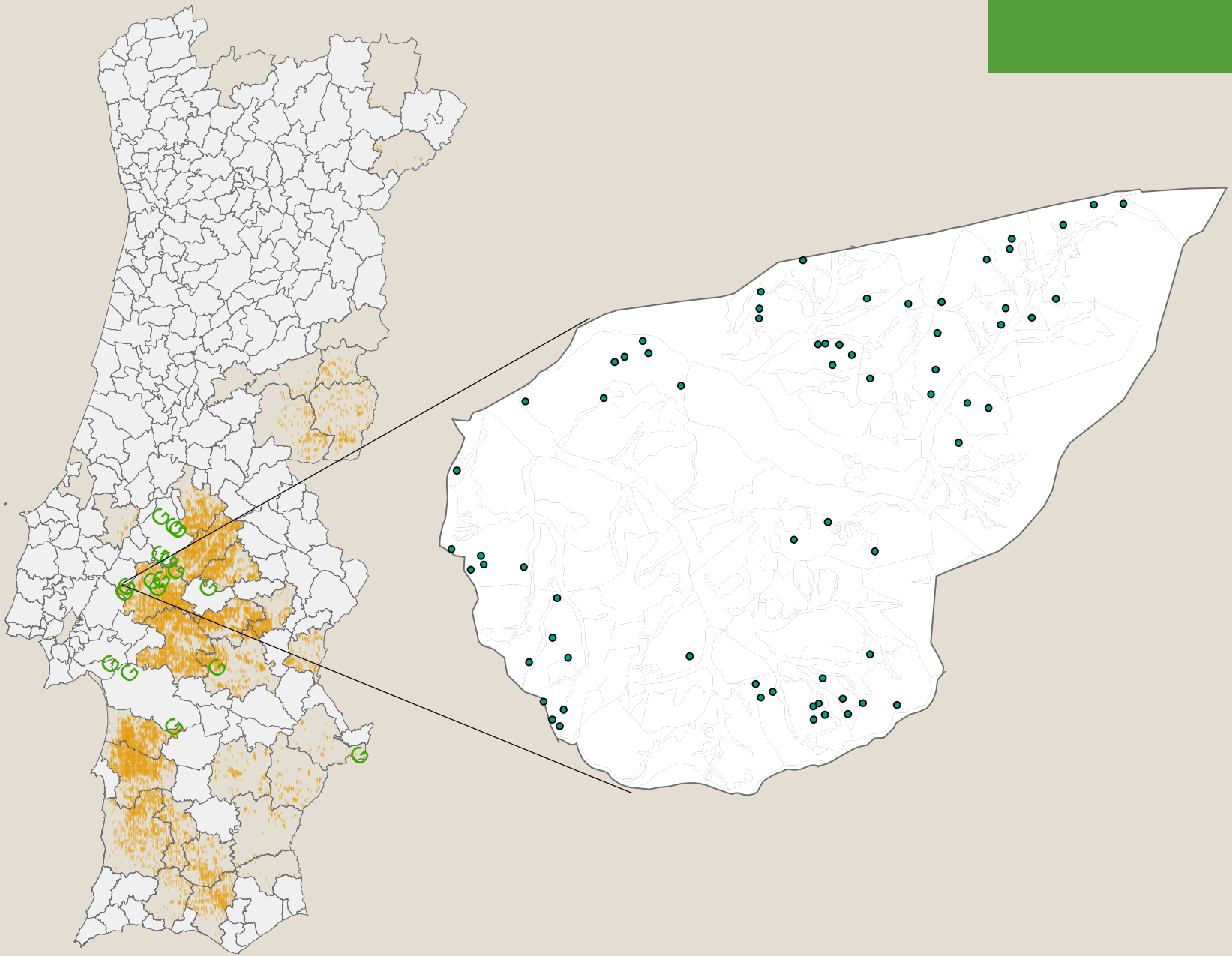
Bad result



Good result

Long term research plots results to climate change

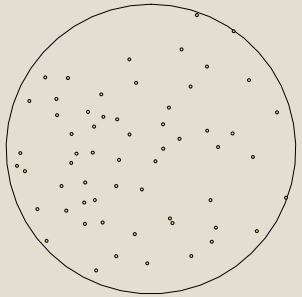
Machoqueira



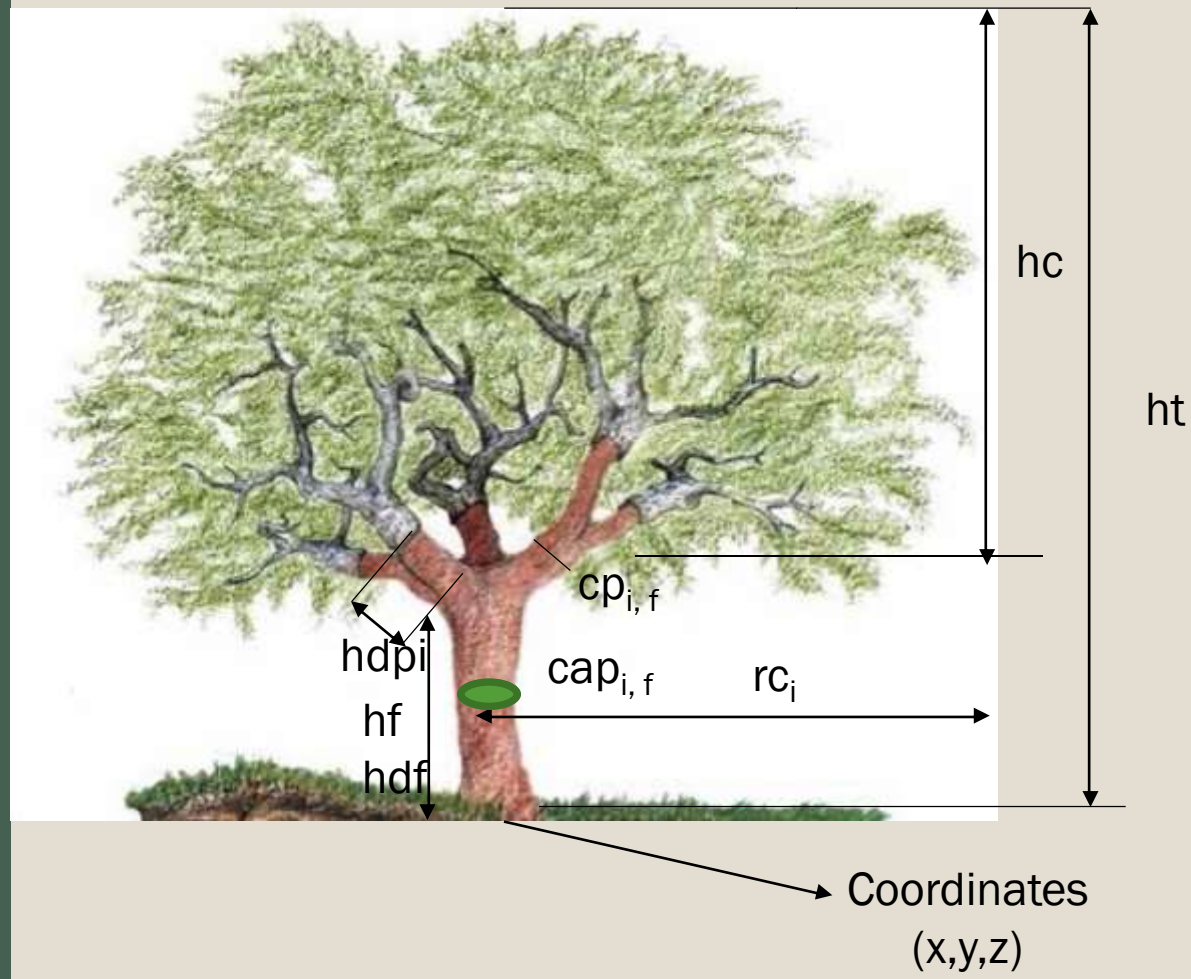
67 circular plots with 5000 m^2

Dendrometric data
Stand data

21 years
3rd measurement
3rd debarking



Tree variables

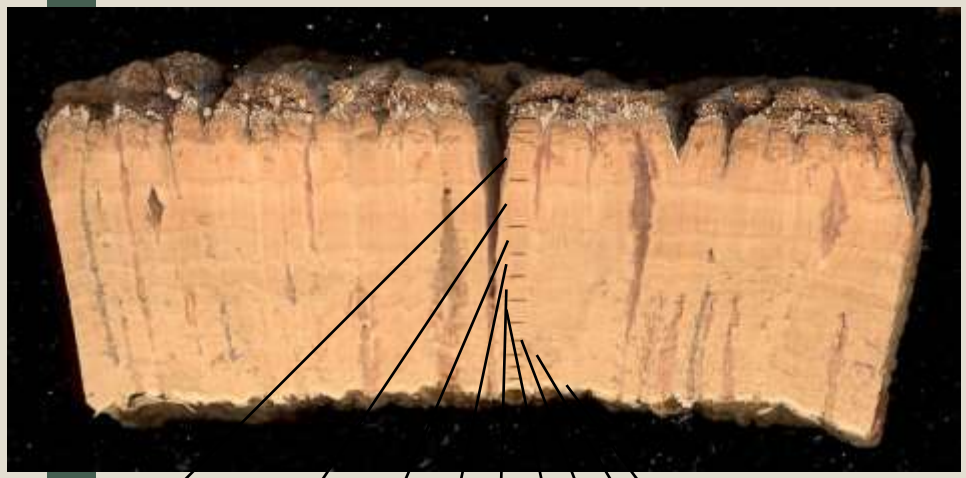


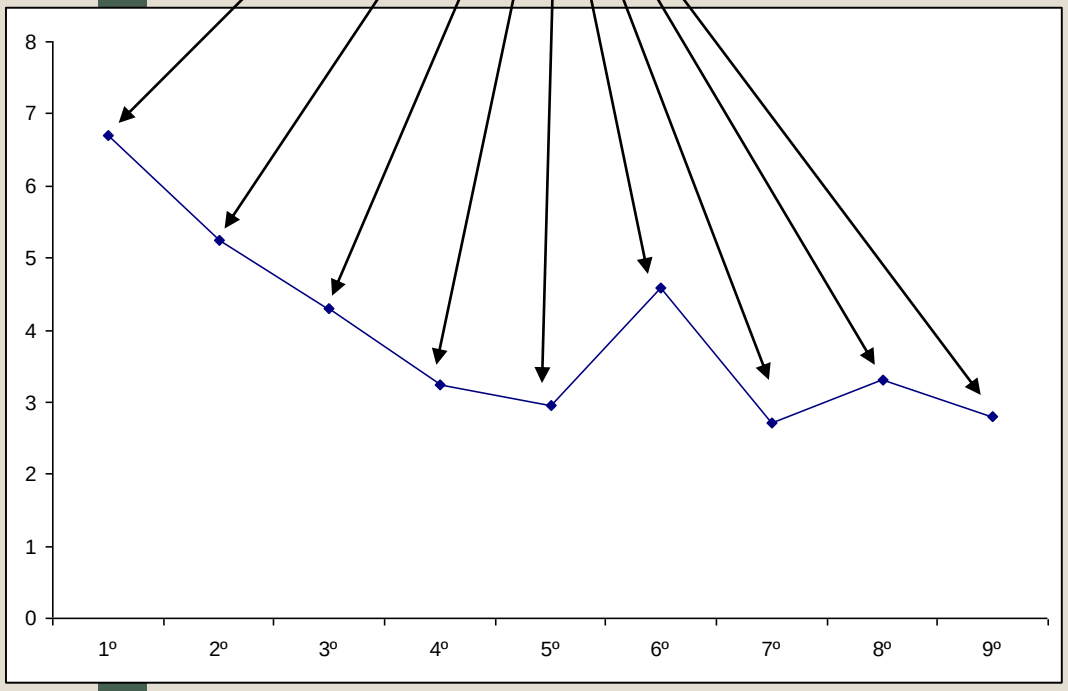
Cork

- Weight
- Moist
- Porosity
- Annual growth

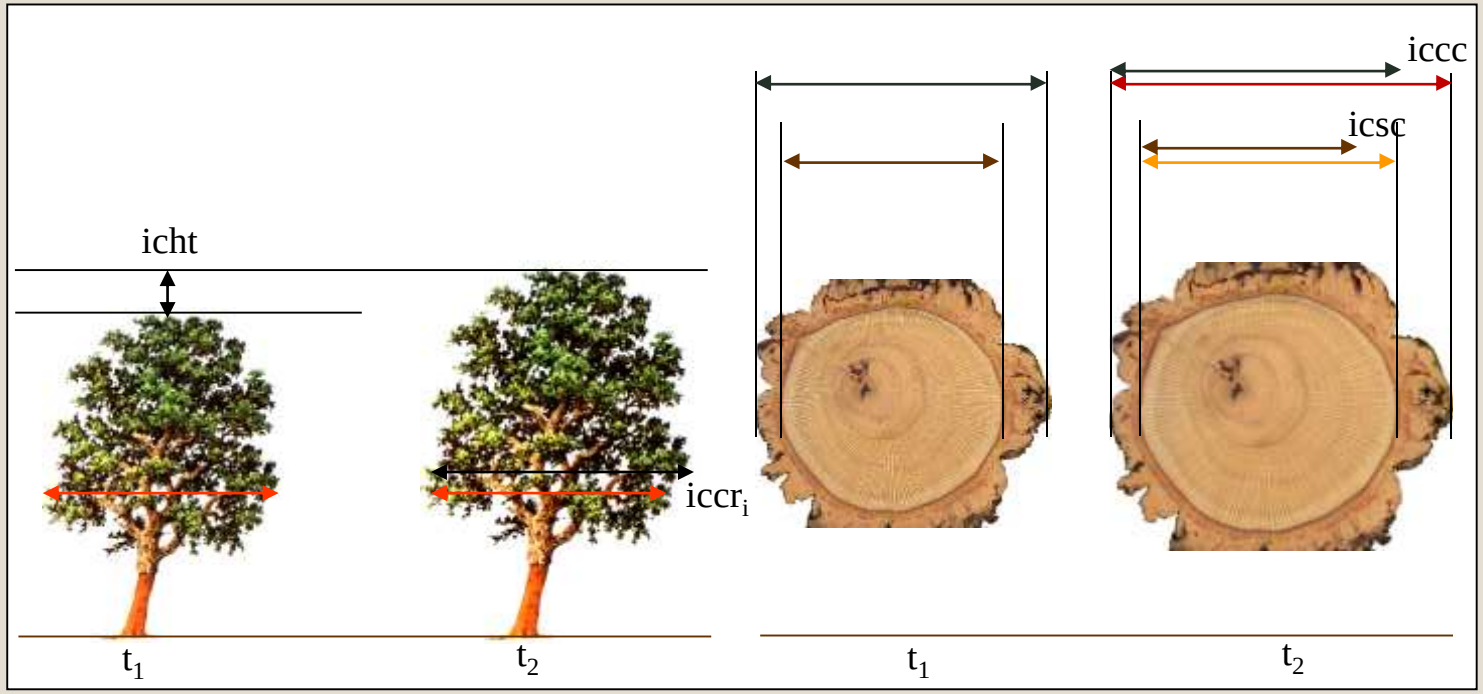
Tree growth variables: Cork

Digital image analysis of scanned cork sample in transversal cut





Increment in height, crown and stem obtained with repeated measures data:



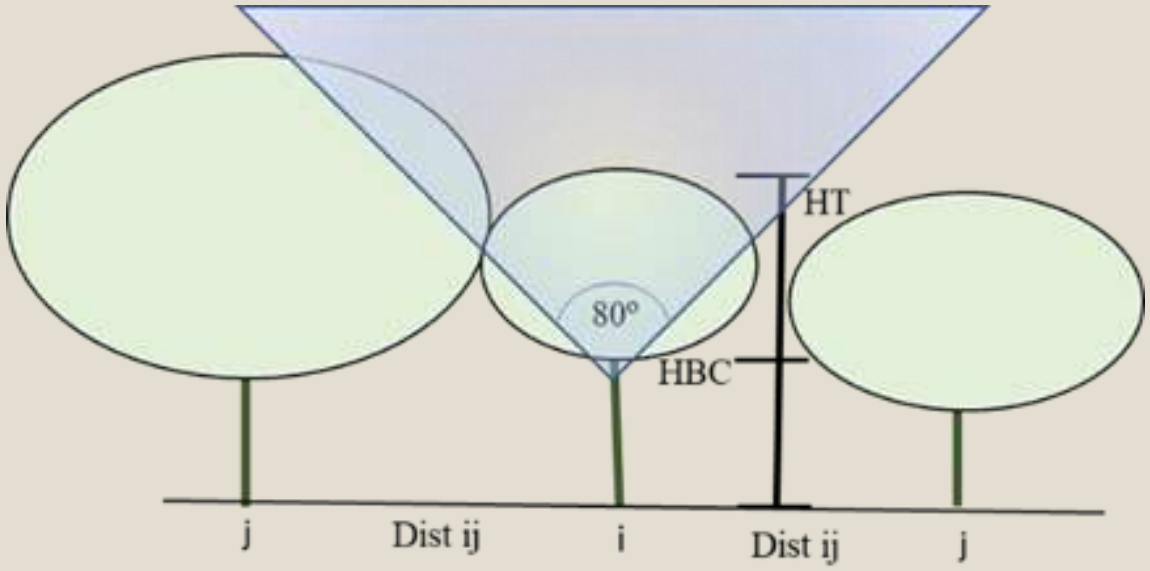
Stand variables

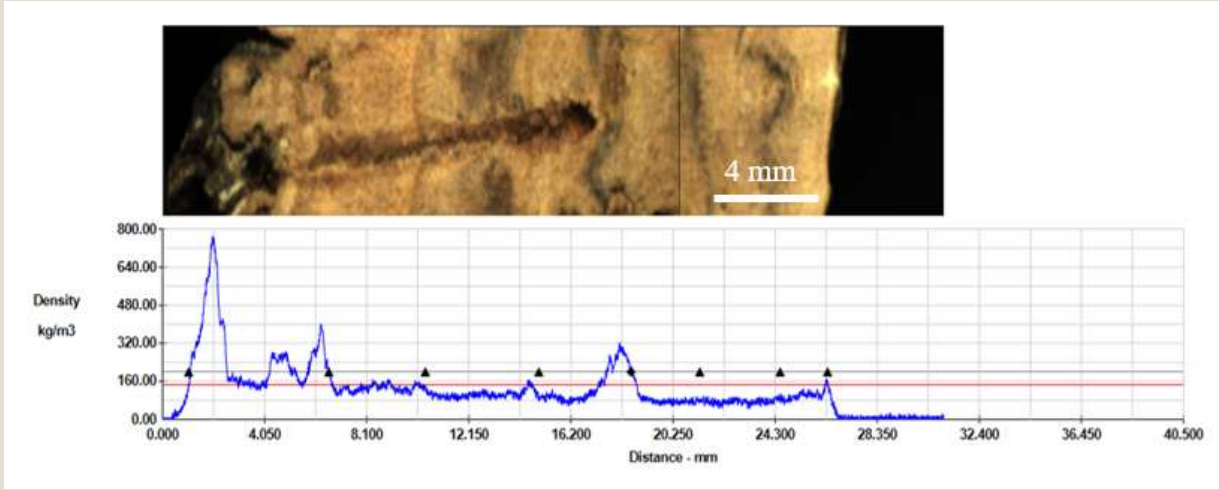
Slope
Aspect
Soil profile
Soil chemical and physical analysis
Leaves chemical and physical analysis

Silviculture: Thickness Control

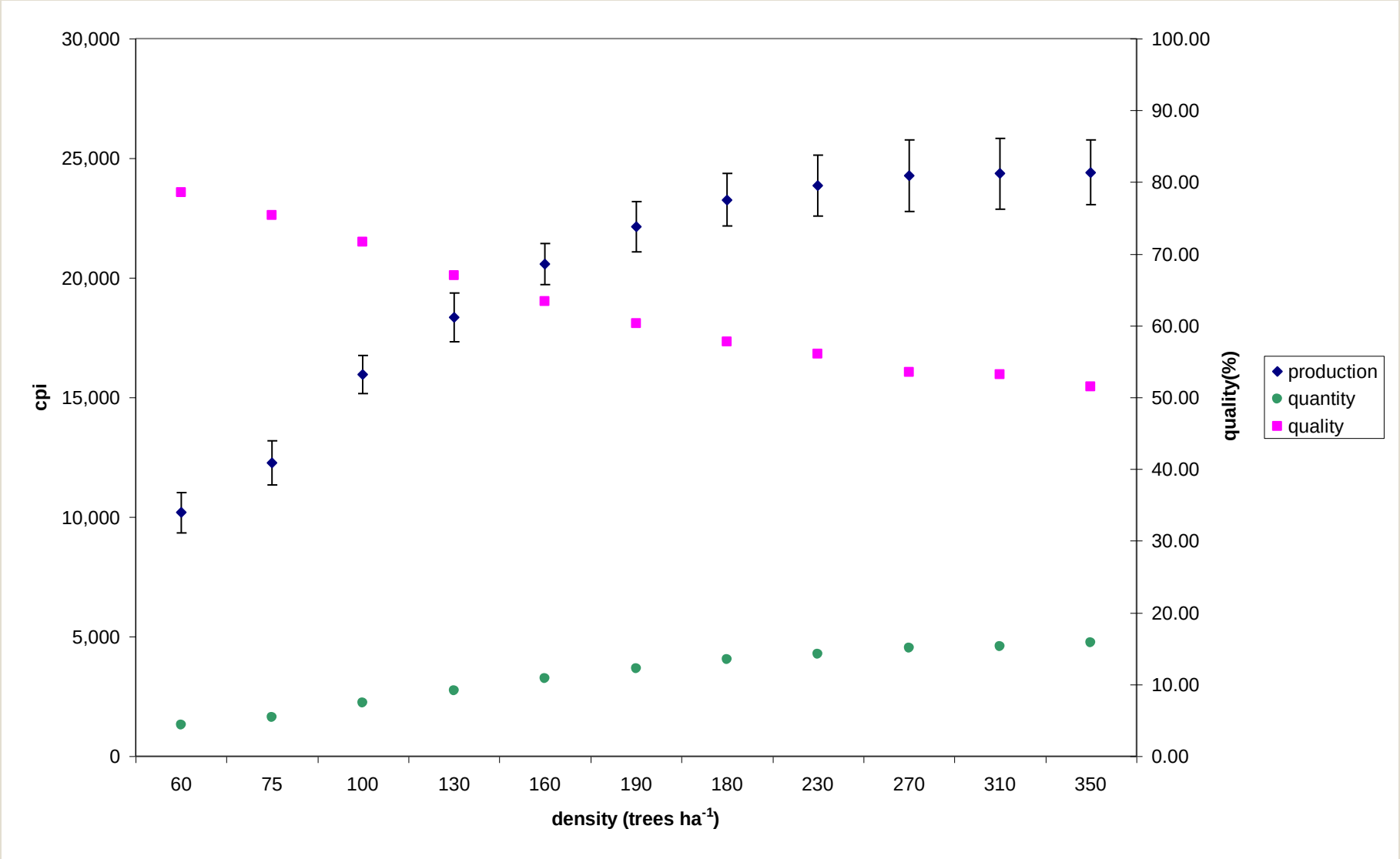
We can control cork thickness and density by optimization of tree density and hight of debark both part of the silvicultural model

Silviculture; Cork Density Control



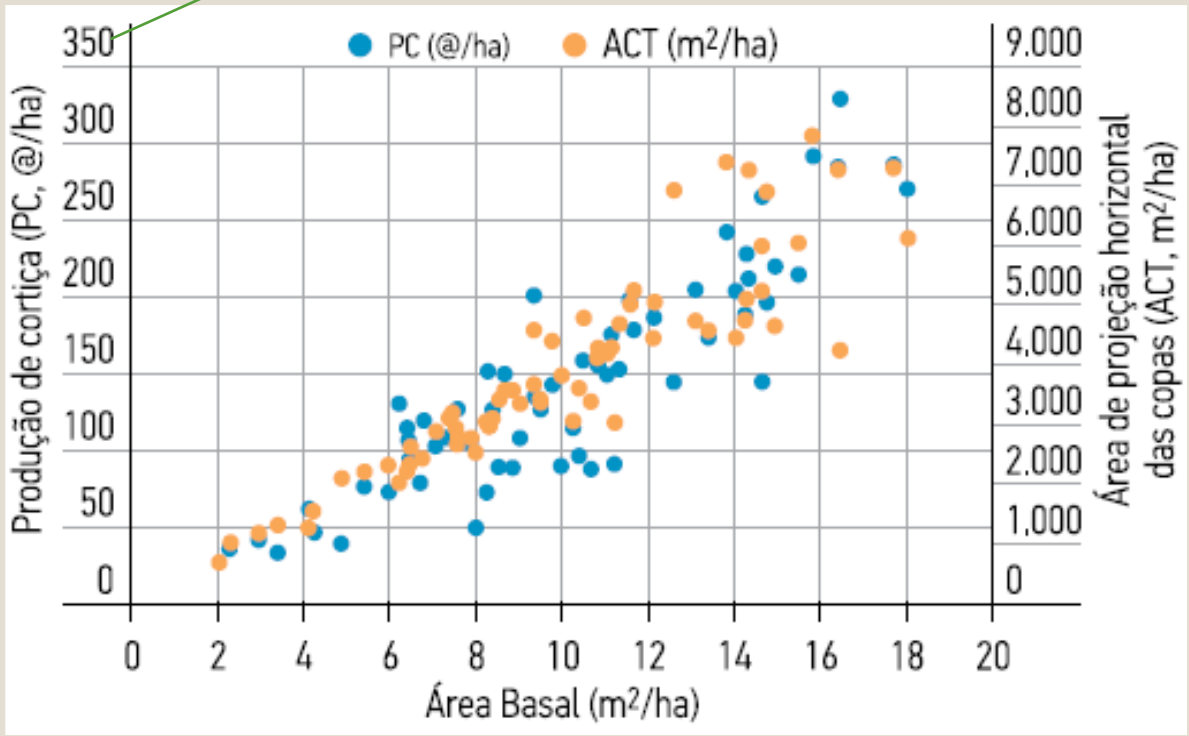


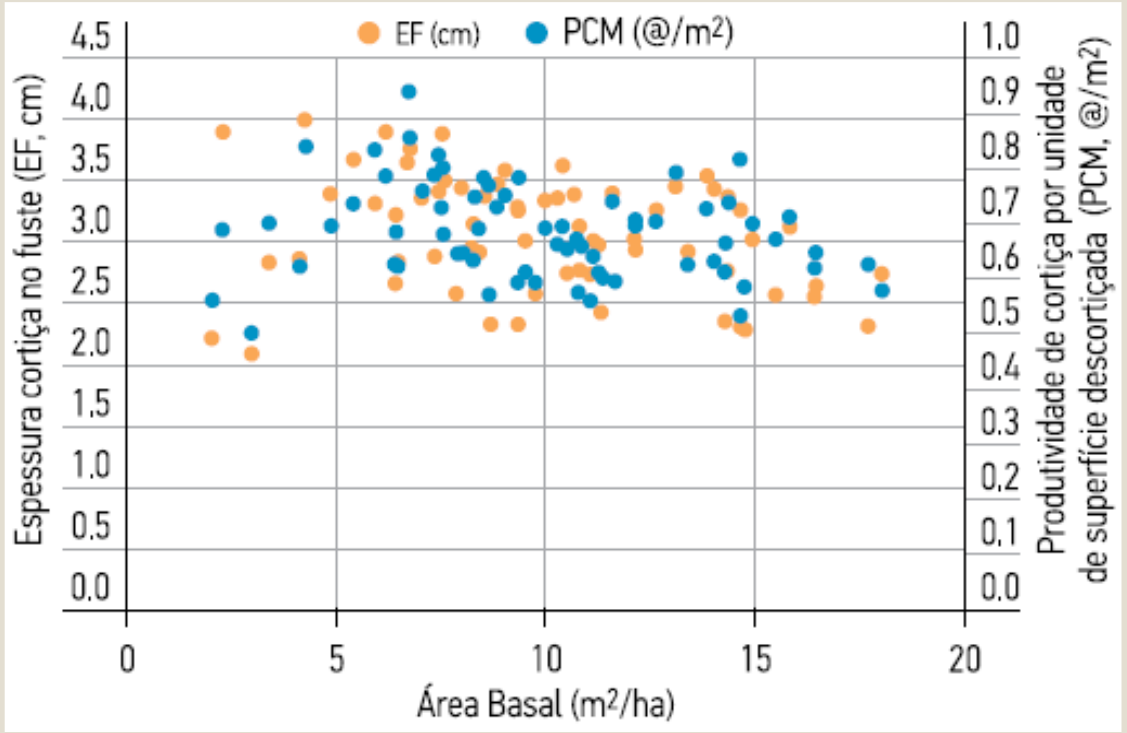
Simulation balanced uneven aged stand 100 years: Tree density



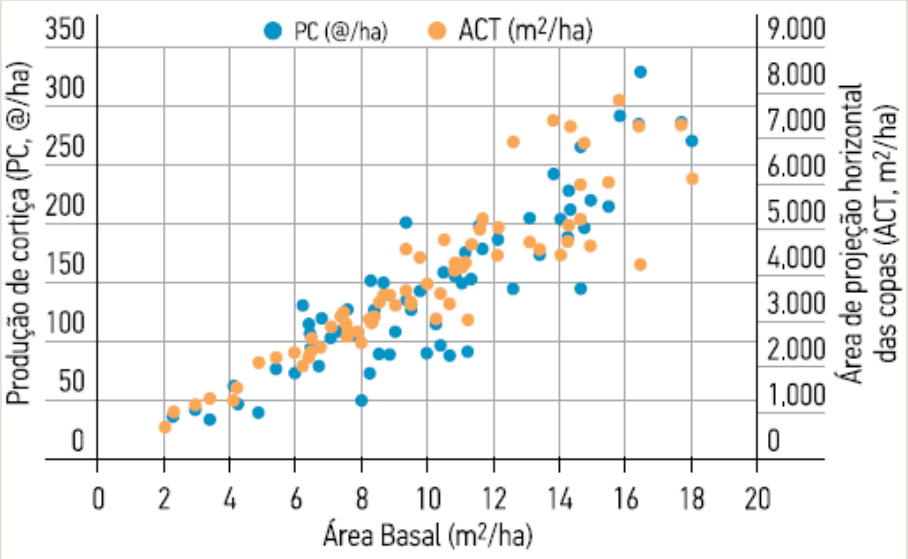
Discussion

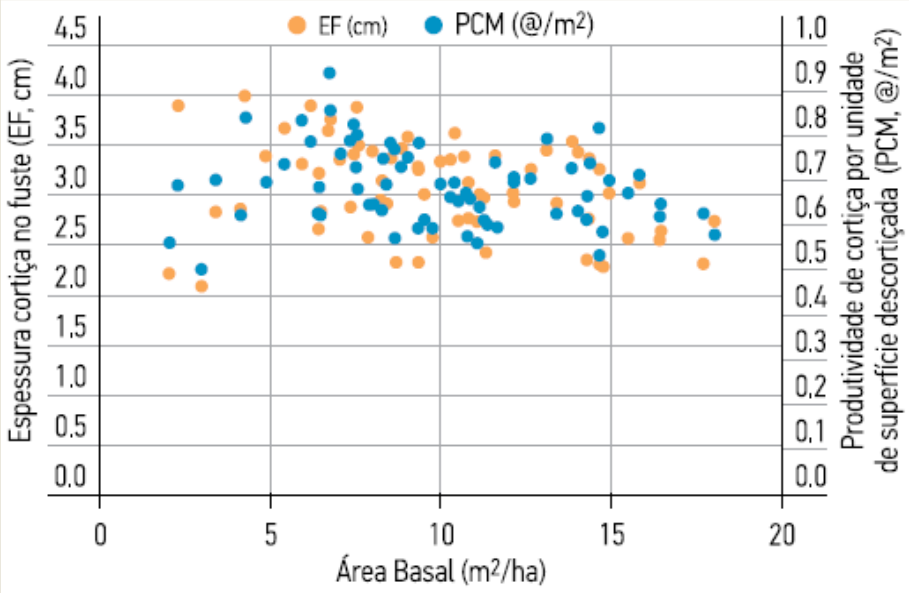
4800 kg/ha





Discussion





- Long term permanent plot with high precision data uptake are fundamental to study the effects of biotic and abiotic factors in tree / stand dynamics.
- The observed results shown the quality of the designed site index in the prediction of tree / stand growth.
- The results points that reduction of precipitation is not the main abiotic factor to affect cork oak tree growth, combination with temperature is needed to understand growth reduction.
- The results show that in terms of silviculture we can control cork growth and density with tree density (thinning), intensity of debark and interference in the light cone.
- The results explained the graphics of cork production, growth and productivity.

Thank you