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Sensitivity of cork growth to drought events along the production cycle

Vanda Oliveira
Alexandra Lauw
Helena Pereira

cef Centro de Estudos Florestais 40 years

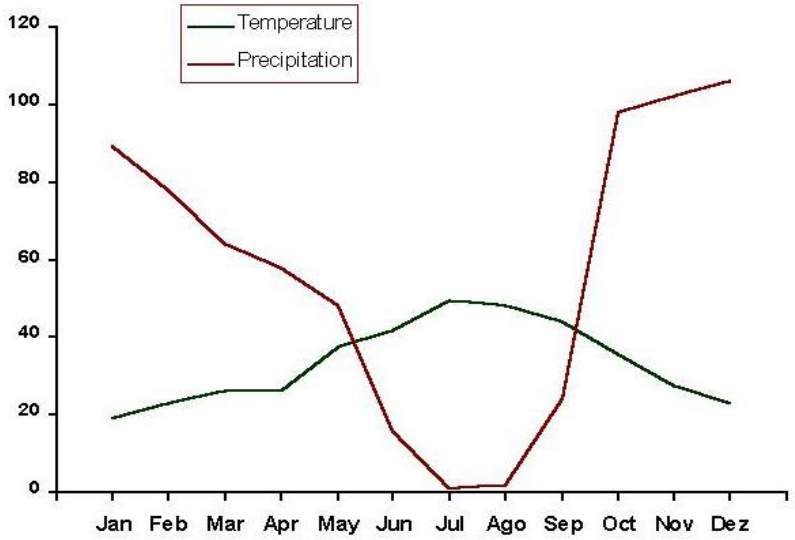
U LISBOA UNIVERSIDADE DE LISBOA

INSTITUTO SUPERIOR DE AGRONOMIA
Hinc Patriam Sustinet

- The soil water availability is a limiting factor for plant growth in Mediterranean climates. Therefore scenarios of increasing frequency and intensity of drought periods in a near future may particularly impact these regions

- It is well known that drought negatively impacts tree growth (even survival in extreme cases)

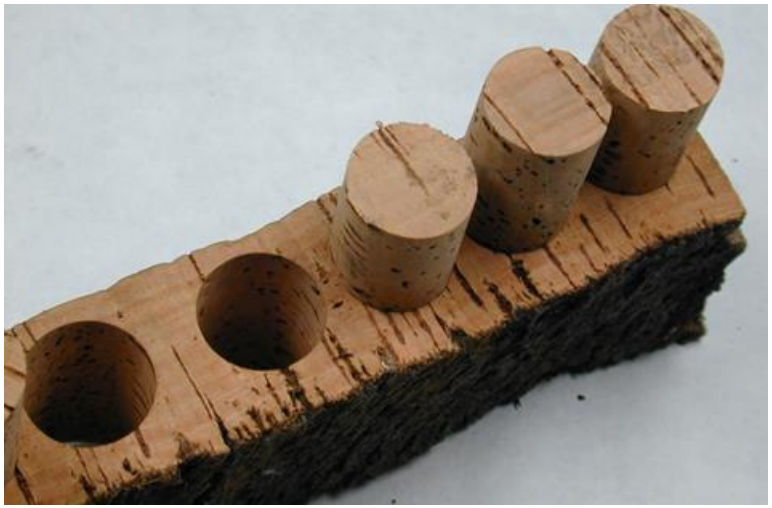
- The cork oak is considered well adapted to the Mediterranean climate, coping well with the hot and dry summer months with a root architecture adapted to the search for ground water



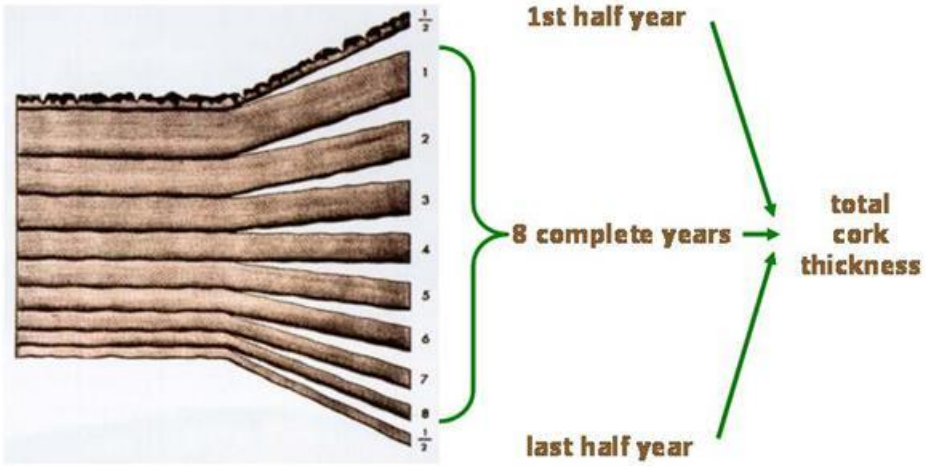
Cork growth

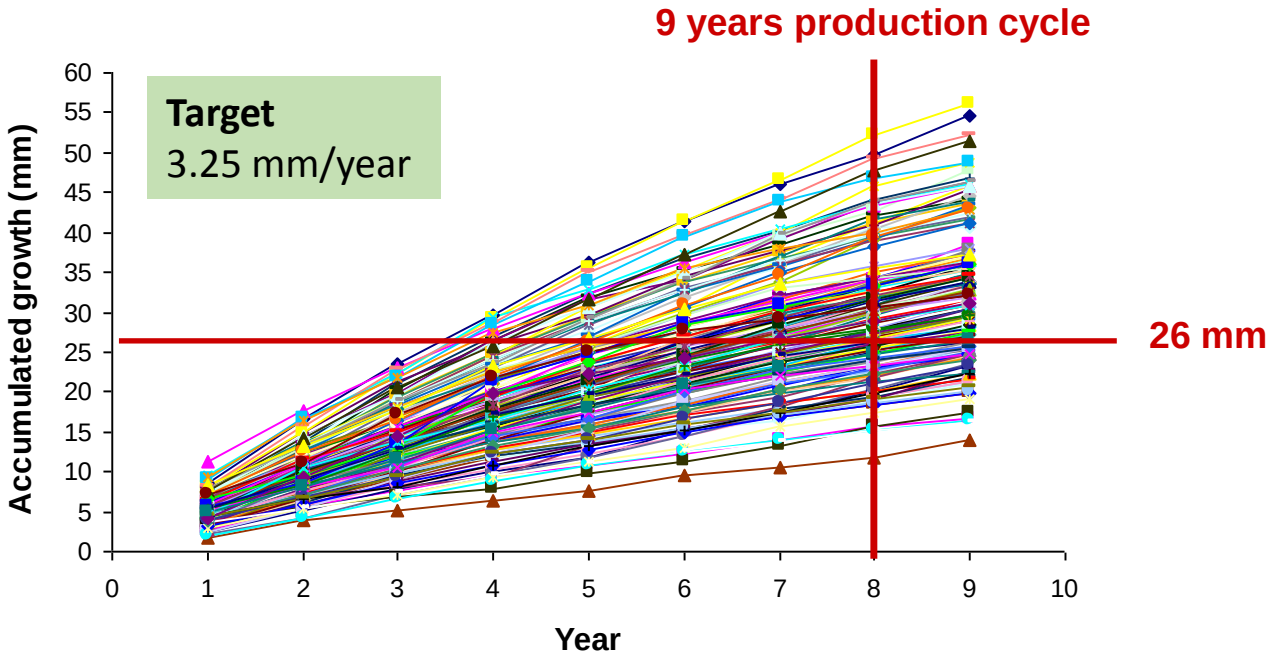
The overall economy of the cork oak relies on the production of cork with a radial thickness that is sufficient for the production of cork stoppers

Calliper classes		
delgadinha	< 22 mm	→ Discs
delgada	22-27 mm	→ Discs, technical stoppers
meia marca	27-32 mm	↕ STOPPERS
marca	32-40 mm	↕ STOPPERS
grossa	40-54 mm	↕ STOPPERS
muito grossa	>54 mm	→ Granulates



The radial thickness depends on the cork growth rate (mm/year) and the number of years of the production cycle (usually 9 years)





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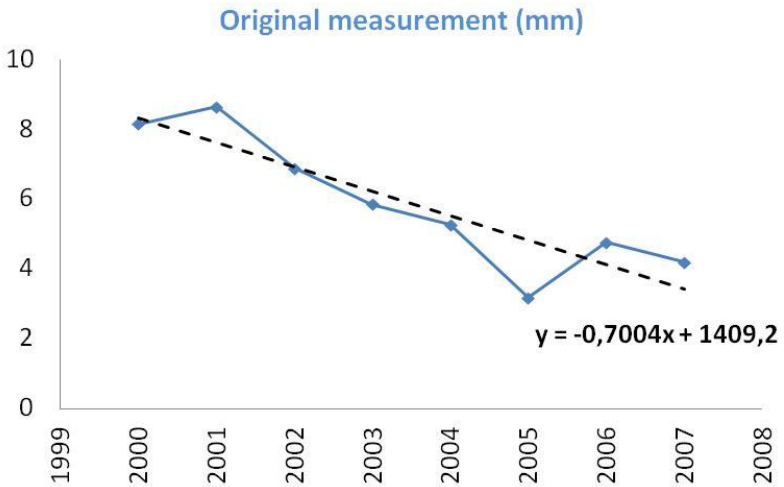
The occurrence of abnormal drought events i.e. in higher frequency or with a higher intensity is a major concern, namely regarding the possible impacts on the cork quality as an industrial raw-material

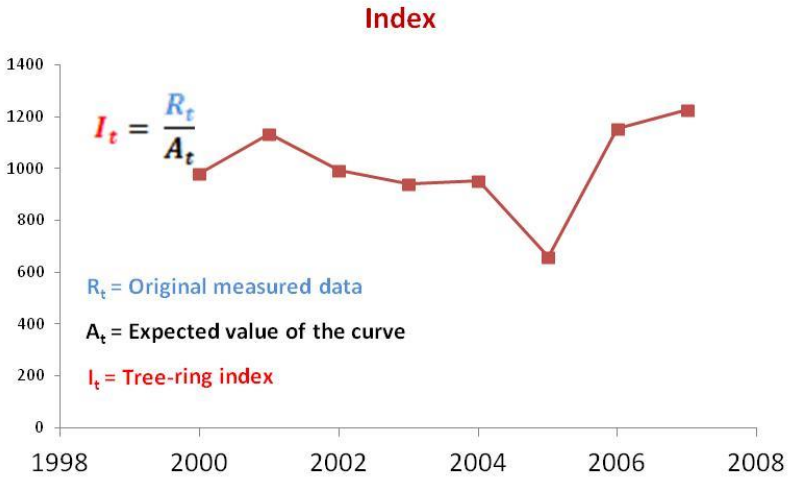
Dendrochronological approaches were applied to cork growth in a few studies that in general showed an influence of rainfall on cork growth: a decrease of cork growth in drought conditions



Cork ring (mm)

Standardisation

Cork index



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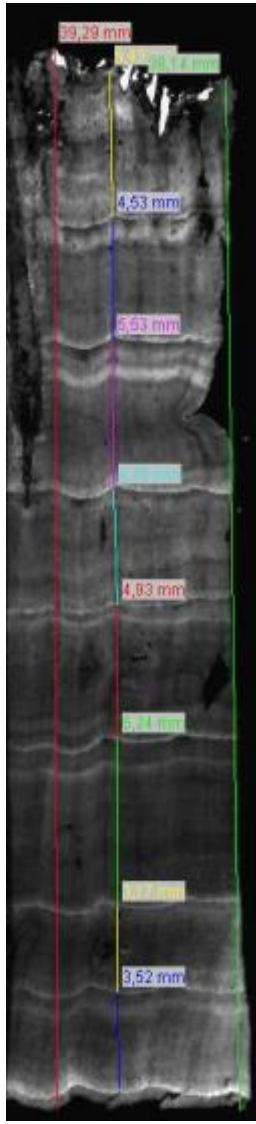
APFC sampling
9 estates
Coruche region
453 samples

Period of analysis
1990 – 2002

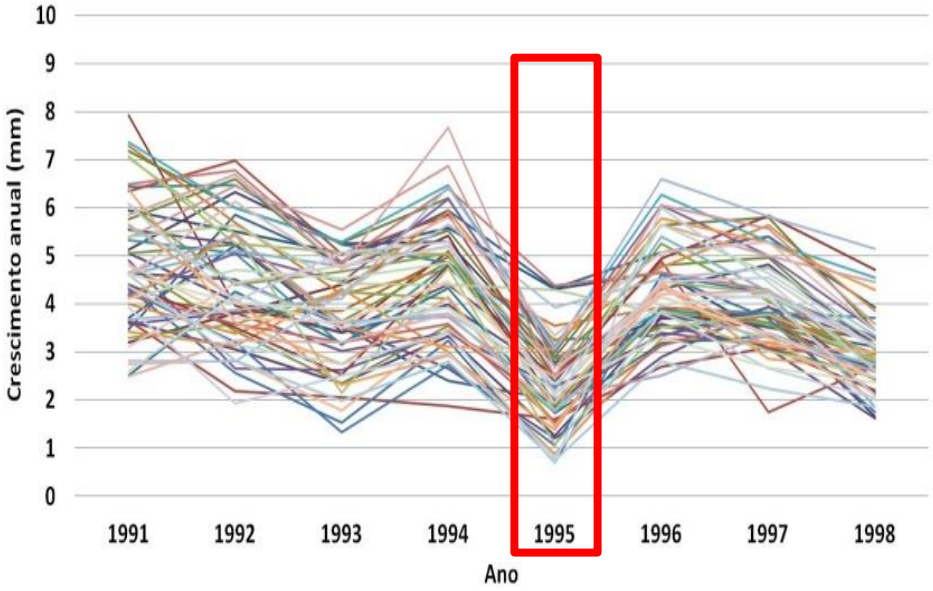
Two drought events:
1994-1995 and 1998-1999

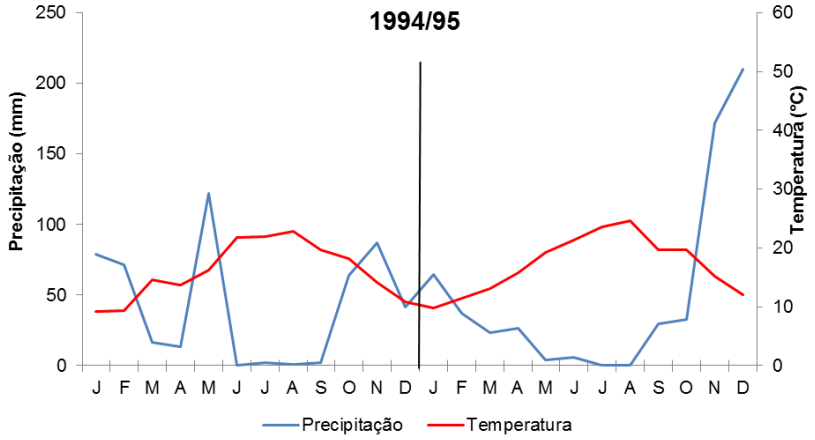
Ring measurement
Visualization with a fluorescence scanner



Drought: precipitation under the mean value or under a certain % of the mean value

Annual precipitation (mm)	
1990	558.2
1991	403.3
1992	442.2
1993	609.8
1994	501.0
1995	605.8
1996	988.0
1997	999.8
1998	445.0
1999	637.4
2000	790.3
2001	796.5
2002	754.6





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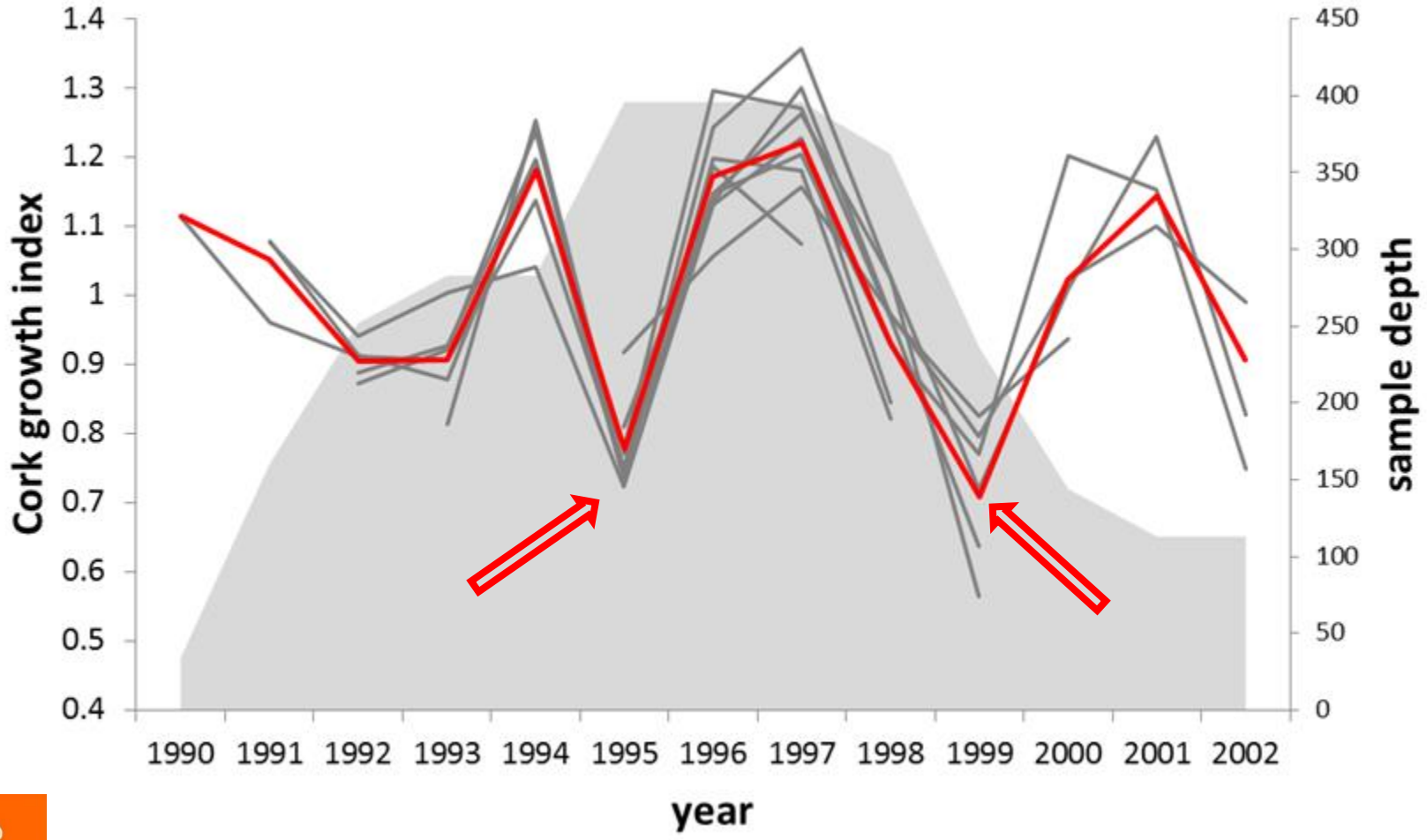
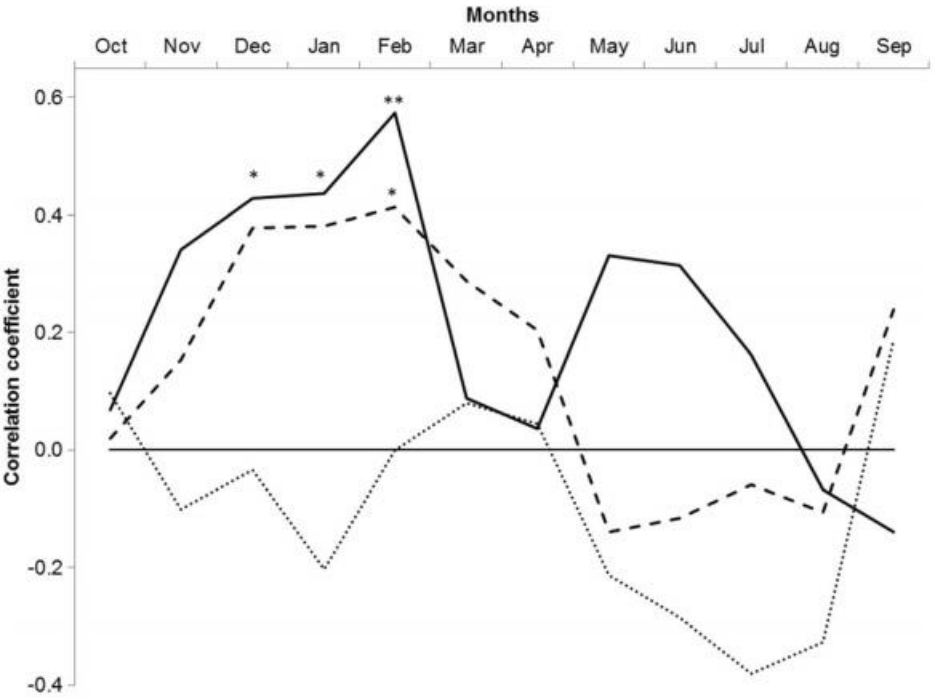
Relevant growth decrease in 1995 and 1999. However when drought conditions ended cork oaks recovered the cork growth revealing high resilience.



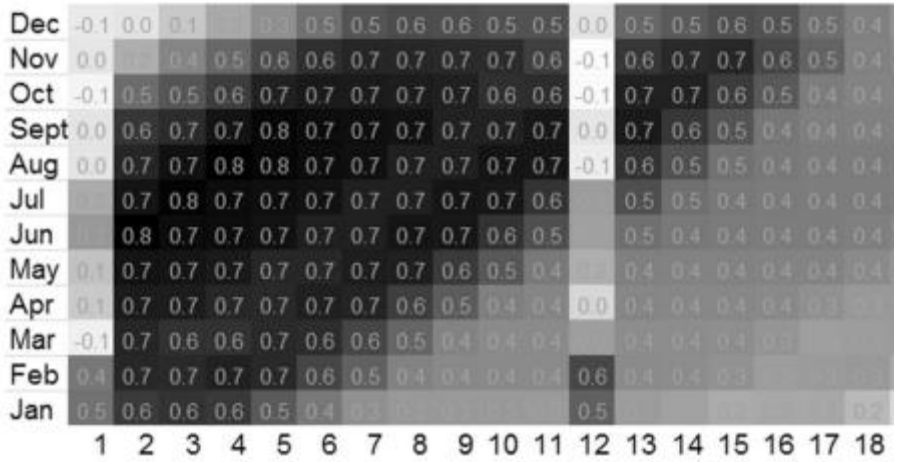
The annual cork growth index was analysed in relation to:

- precipitation (monthly and in periods)
- temperature (monthly)
- standard precipitation evapotranspiration index (SPEI)



Winter precipitation previous to the growth year has a significant influence on cork growth, as well as the February mean minimum temperature

The strongest SPEI-growth were observed for time-scales that include the previous winter and spring months of the growth year



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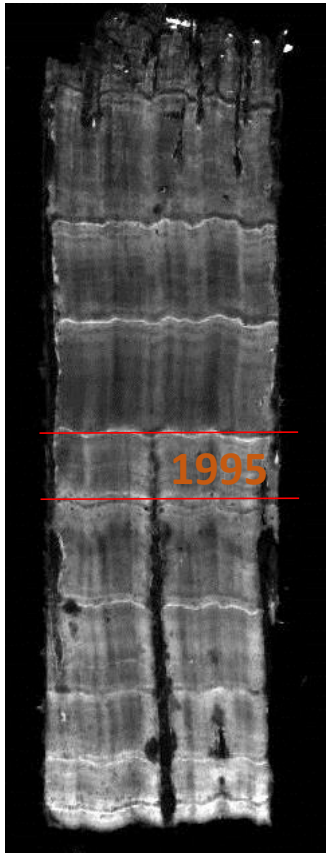
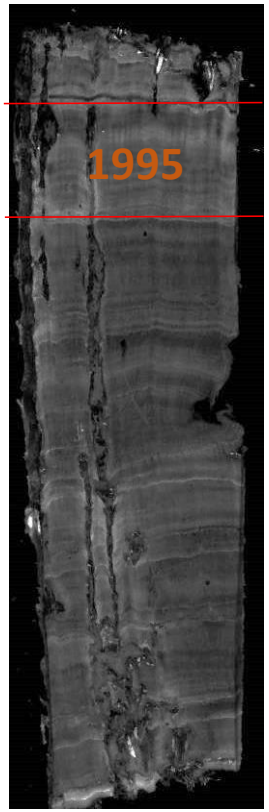
Localization of droughts in the cork production cycle



1995	Mean index	Std.dev.
1st year	0.86	0.16
3rd/4th year	0.75	0.15
5th/6th year	0.74	0.17



1999	Mean index	Std.dev.
5th year	0.77	0.17
8th year	0.65	0.21

Drought occurrence at the beginning of the production cycle have less influence on the cork growth than when occurring at the middle of the cycle

Final considerations

- The cork-ring chronology showed significant response to climatic variables with a relevant growth decrease in 1995 and 1999 matching the severe drought events of 1994-1995 and 1998-1999.
- When drought conditions ended cork oaks recovered the cork growth revealing high resilience.
- Practical consequences of drought in relation to corkboard calliper will depend on the number of droughts and their localization in the cork production cycle. An adjustment of the silvicultural cork management e.g. production cycle, may be needed.

Thank you

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vandaoliveira@isa.ulisboa.pt

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