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Growth responses to climate variability of mixed tree species in a Mediterranean conifer forest (Monte Morello)

Gianluigi Mazza

CREA – Research Centre for Forestry and Wood Arezzo (Italy)

gianluigi.mazza@crea.gov.it

NUOVI APPROCCI PER LA GESTIONE SOSTENIBILE DEL PINO NERO:
biodiversità e mitigazione

MARTEDÌ 14 MAGGIO 2019 | 9.30 - 16.30
Firenze, Sala Giordano - Palazzo Medici-Riccardi

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Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria

Research context

✓ Understanding the dynamics of mixed forests derived from pine plantations in Mediterranean area is important to define proactive management measures towards sustainable adaptation to and mitigation of climate change.

✓ Favouring native broadleaves is widely recognized as one of the main objectives for restoring mature pines plantations with the aim to increase their stability, biodiversity and resilience

Study site:

9 sectors –18 monitoring plots

Basal area (% ha^{-1})

Sector	OtherCon	OtherLat	QC	CS	FO	PB	PN
1	-	-	-	2.6	0.1	97.3	-
2	-	-	-	-	0.2	99.8	-
3	0.9	22.6	1	-	1.1	74.4	-
4	13.8	1.3	45.7	3.9	0.5	-	34.8
5	-	0.3	24	2.3	2.4	-	71
6	-	1	34	7.9	7.4	-	49.7
7	5.3	0.3	22.5	8	2.5	-	60.3
8	-	-	10.4	40.5	1	-	48.1
9	1.4	0.1	3.5	30.3	1.8	-	62.1

Shannon-Weaver Diversity Index (H')

Tree density	Basal area
1.28	1.14
1.51	1.05
3.65	2.36
4.78	4.56
3.49	2.26
3.15	3.03
3.94	3.45
3.32	2.72
3.42	2.56

Main objectives

We carried out an intra-stand tree-ring analysis on *Pinus nigra* Arnold., *Pinus halepensis* subsp. *brutia* Ten. and *Quercus cerris* L. to address the following questions:

i) Do oak and pines differ in the main climatic variables driving tree growth?

ii) Do oak and pines respond differently to past drought events?

Dendroclimatological analysis

P. brutia, *P. nigra* and *Q. cerris* ⟷ precipitation and SPEI*

	P. nigra	*P. brutia*	*Q. cerris*
Time span (N° years)	1939-2016 (78)	1977-2016 (40)	1949-2016 (68)
N° cores/ N° trees	35/33	38/36	12/11
BAI ± SD (cm^2)	8.8 ± 4.5	22.6 ± 8.8	12.5 ± 7.3
Glk	0.74	0.69	0.66
MS	0.32	0.24	0.27

monthly-seasonal and yearly climatic variables for a total of about 280 combination

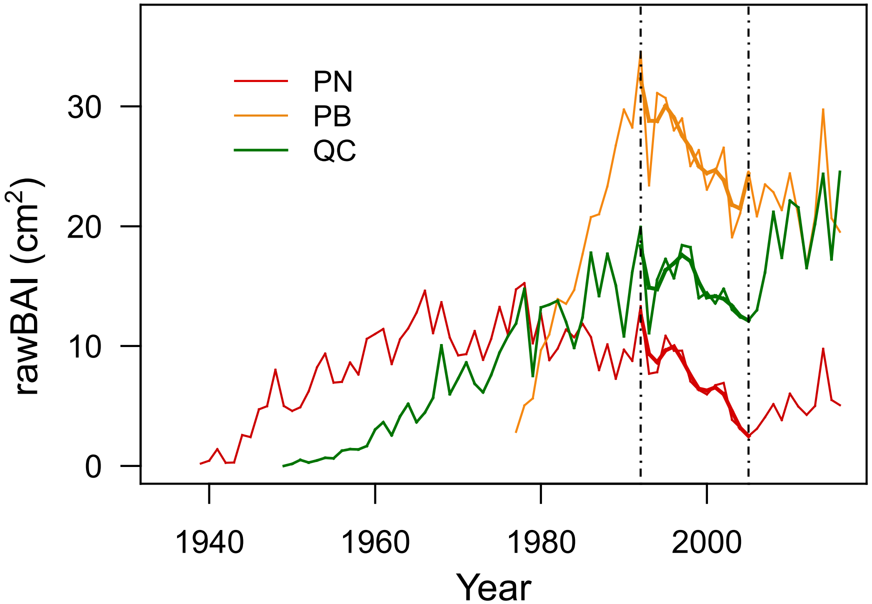
* Standardised Precipitation-Evapotranspiration Index

Growth responses to drought

Raw basal-area increments (BAIs) during drought years were compared to the years before and after the drought to quantitatively analyze growth decreases and recoveries. Percent growth changes were calculated as follows:

- ✓ drought year *vs*. prior year: $[(BAI_0 - BAI_{-1})/BAI_{-1}] \times 100$,
- ✓ post-drought year *vs*. pre-drought year: $[(BAI_{+1} - BAI_{-1})/BAI_{-1}] \times 100$,
- ✓ drought year *vs*. 5 years pre-drought: $[(BAI_0 - BAI_{-5})/BAI_{-5}] \times 100$,
- ✓ 5 years post-drought *vs*. drought year: $[(BAI_{+5} - BAI_0)/BAI_0] \times 100$,
- ✓ 5 years post-drought *vs*. 5 years pre-drought: $[(BAI_{+5} - BAI_{-5})/BAI_{-5}] \times 100$

Main results: growth trend



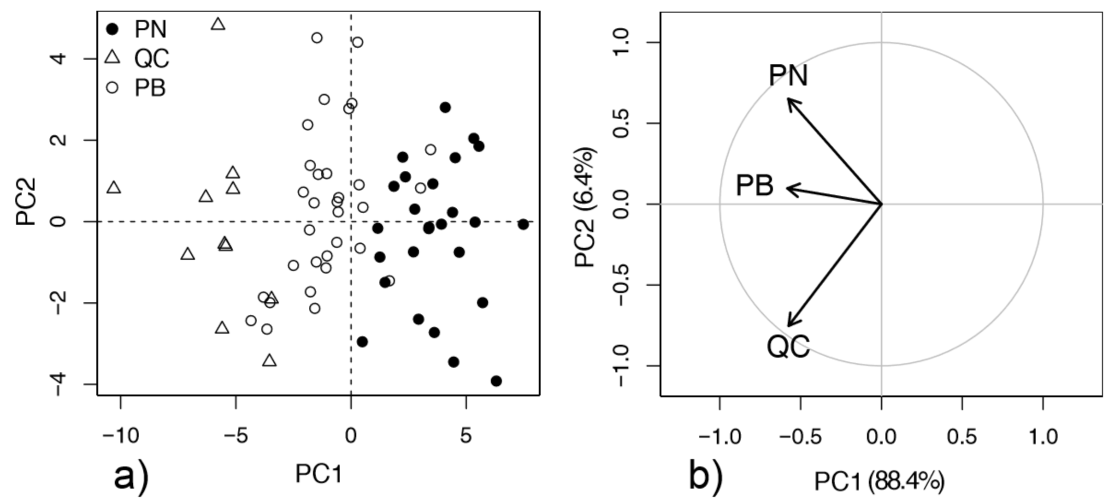
Common significant <u>growth decrease</u> during the period <u>1992-2005</u>

P. nigra: τ = - 0.75, $p<0.001$;

P. brutia: τ = - 0.56, $p<0.01$;

Q. cerris: τ = - 0.46, $p<0.05$

Distinct spatial distribution, discriminating by tree species



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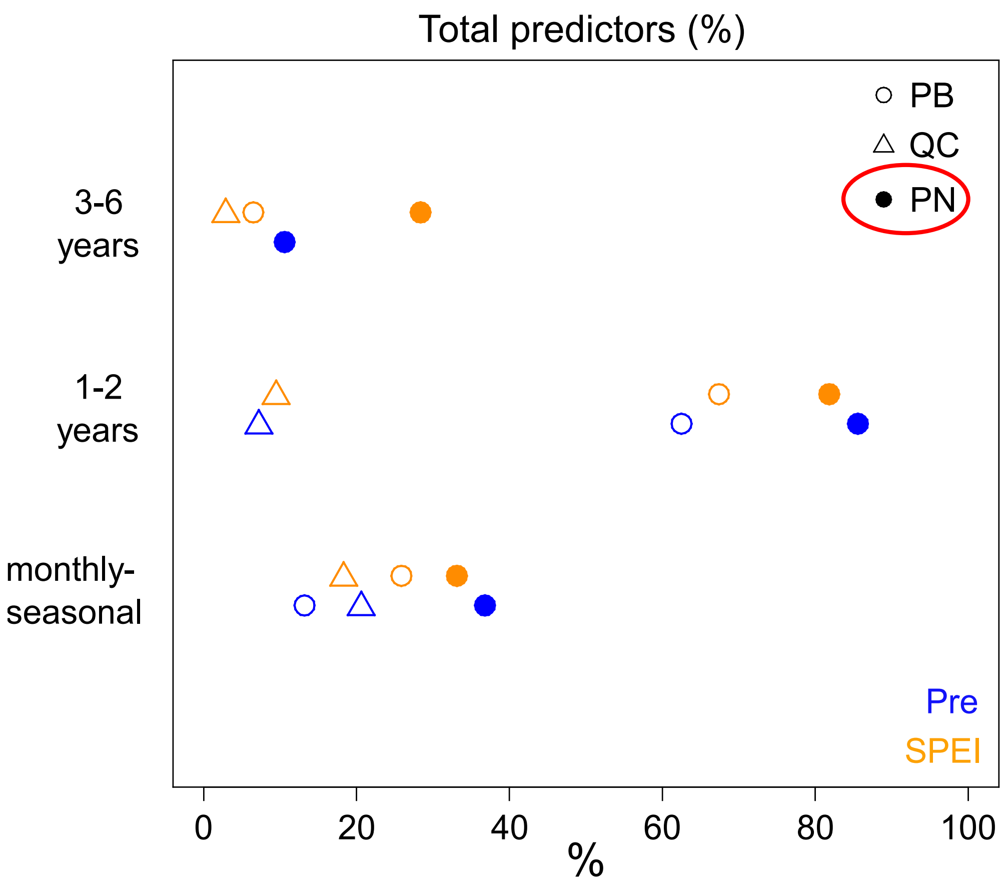
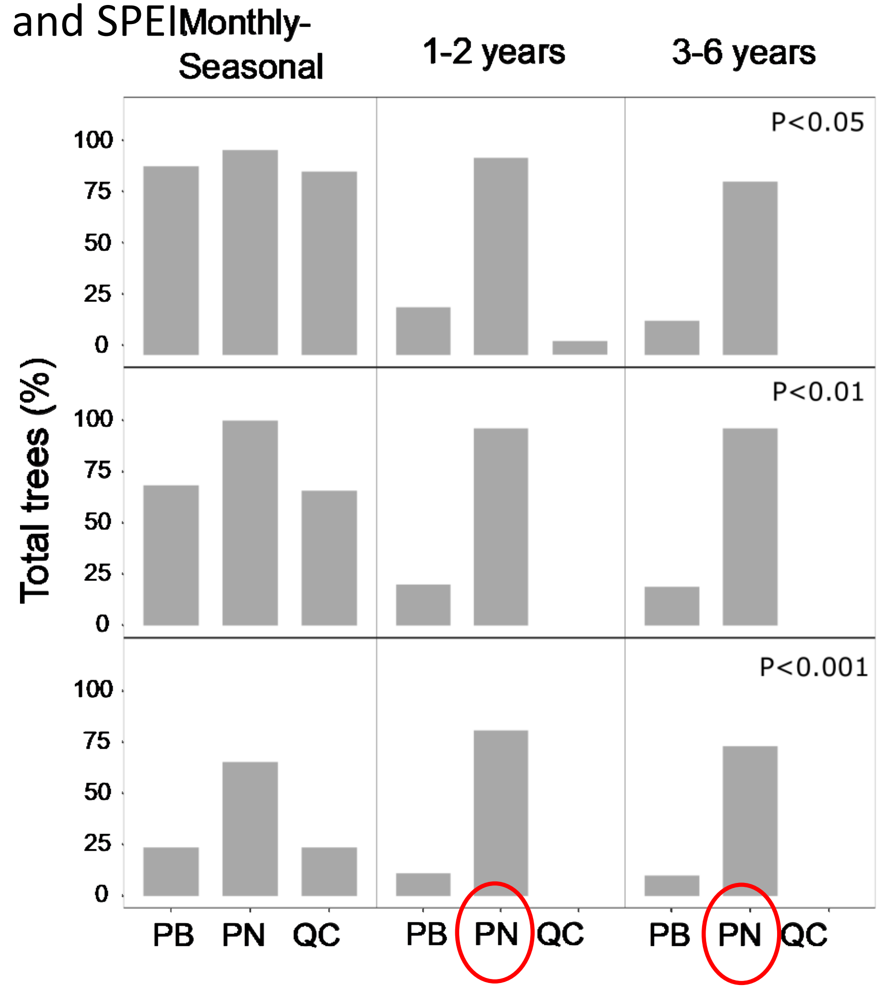
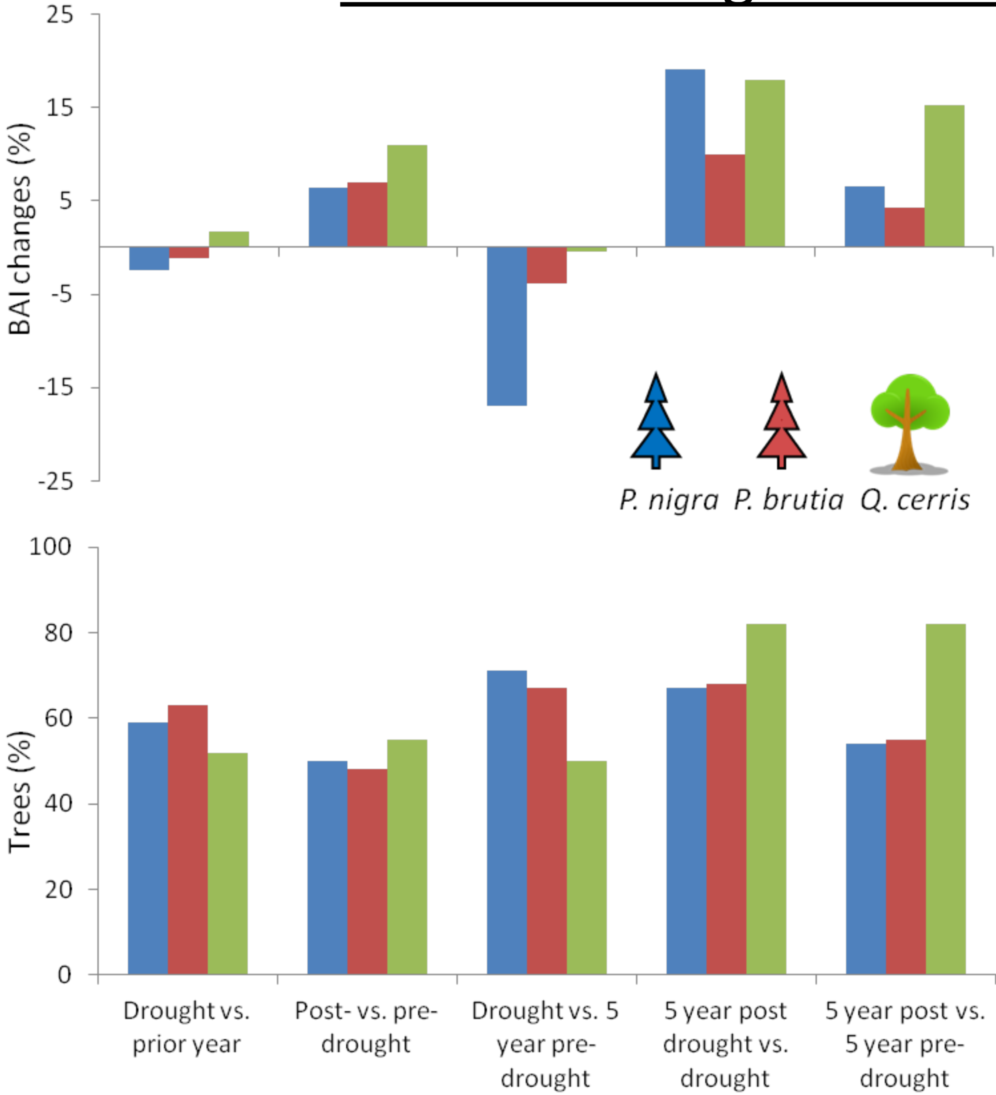
Main results: climate growth relationships

The overall distinctive feature was the contrasting range of climatic variables driving tree-growth: the primary influence of current year **monthly-seasonal** climatic drivers on ***Q. cerris*** and **multiple-years** on **pines** both for precipitation and SPEI





Main results: growth responses to drought



- ✓ Pines exhibited a similar pattern, but *P. nigra* highest % values

- ✓ *Q. cerris* showed in most cases positive growth changes with the lowest % values when drought years were compared with both 1 and 5 pre-drought years;

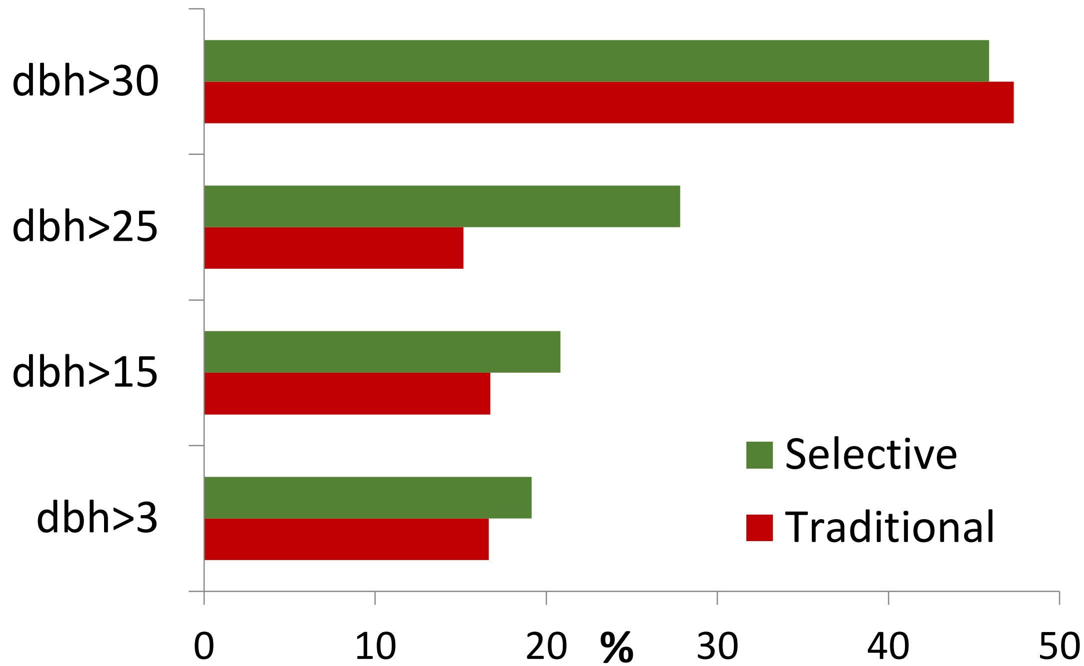
- ✓ *Q. cerris* showed the highest % trees able to recover the growth level of pre-drought when comparing 5 year post drought with both 1 and 5 year pre-drought years

Main results: effect of thinning

In Monte Morello site **Selective thinning**, favouring the more drought resistant and resilient species, appeared more appropriate for increasing and/or improving the resilience at the stand level under future drought intensification.

Selective removed:
(basal area)

+15.6 % *P. brutia*
+17.9 % *P. nigra*



Main conclusion

✓ The primary influence of current year **monthly-seasonal** (mainly June and May-June-July) climatic drivers on ***Q. cerris*** and **multiple-years** on **pines** both for precipitation and SPEI.

✓ *P. nigra* resulted the species with the highest % of single trees correlated with the climatic variables driving growth (limiting factors): high sensitivity to climate in the study site.

✓ *Q. cerris* resulted the species less affected by drought events showing the highest growth recovery.

✓ Selective thinning appeared more appropriate for increasing the resilience at the stand level.

Thanks for your attention