



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
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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



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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



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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?



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Dendroclimatological analysis

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

	<i>P. nigra</i>	<i>P. brutia</i>	<i>Q. cerris</i>
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:

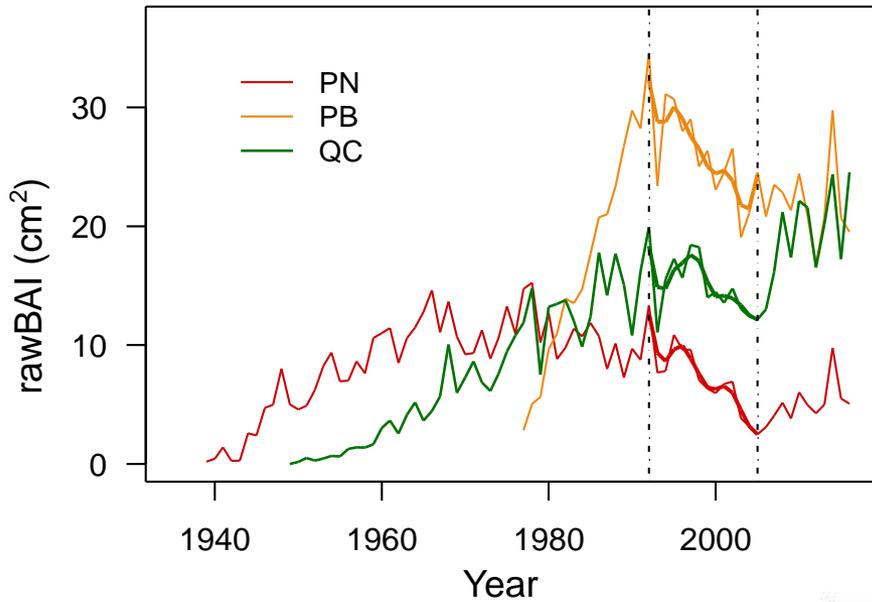
- ✓ drought year vs. prior year: $[(BAI_0 - BAI_{-1})/BAI_{-1}] \times 100$,
- ✓ post-drought year vs. pre-drought year: $[(BAI_{+1} - BAI_{-1})/BAI_{-1}] \times 100$,
- ✓ drought year vs. 5 years pre-drought: $[(BAI_0 - BAI_{-5})/BAI_{-5}] \times 100$,
- ✓ 5 years post-drought vs. drought year: $[(BAI_{+5}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



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Main results: growth trend



Common significant growth decrease
during the period 1992-2005

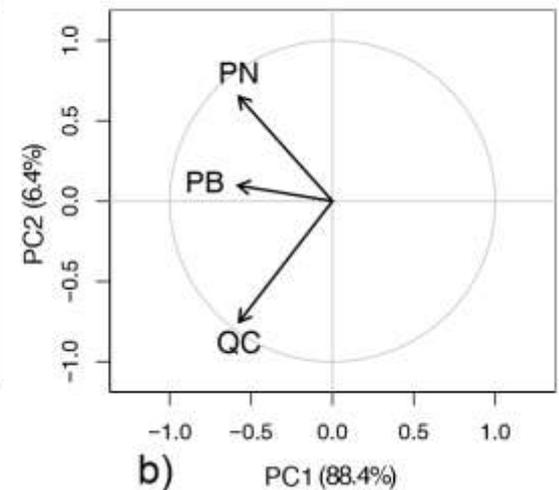
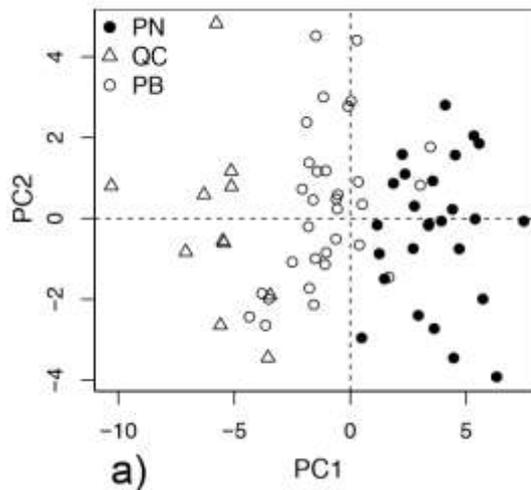


P. nigra: $\tau = -0.75$, $p < 0.001$;

P. brutia: $\tau = -0.56$, $p < 0.01$;

Q. cerris: $\tau = -0.46$, $p < 0.05$

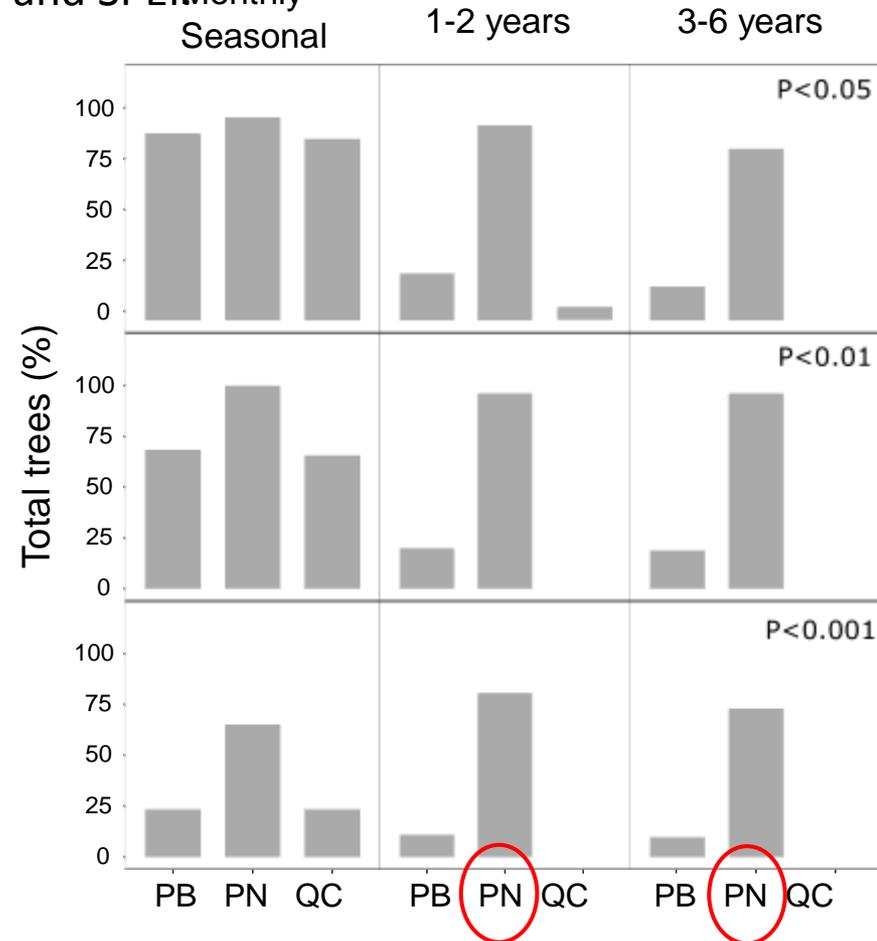
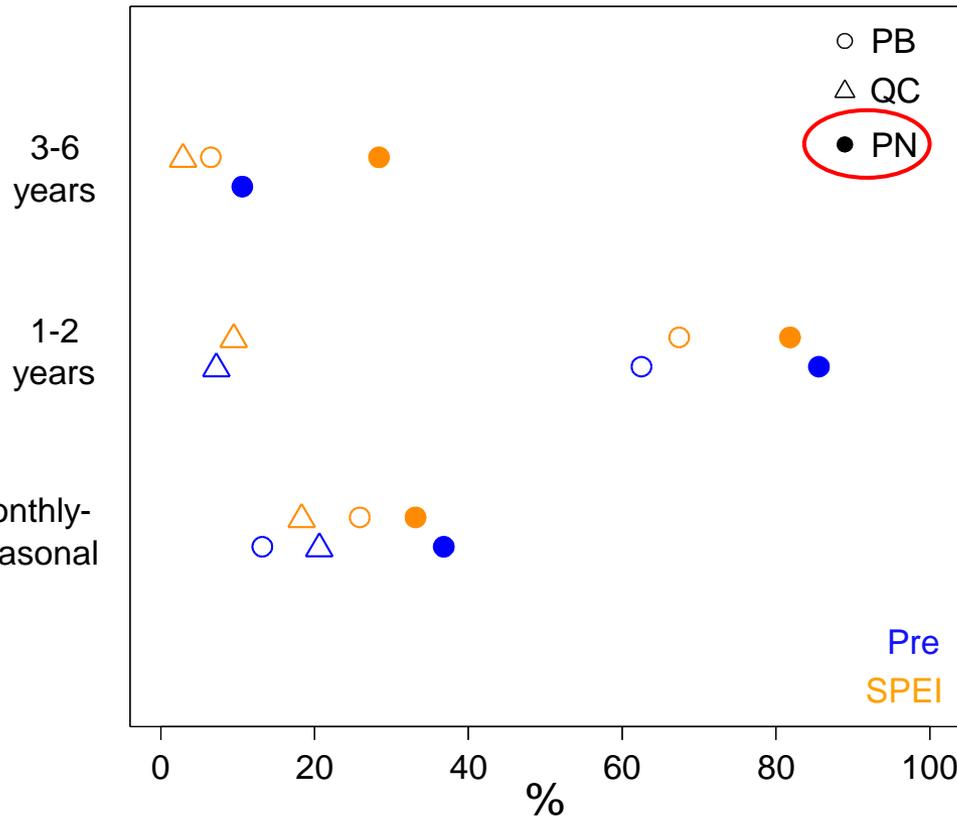
Distinct spatial distribution,
discriminating by tree species



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

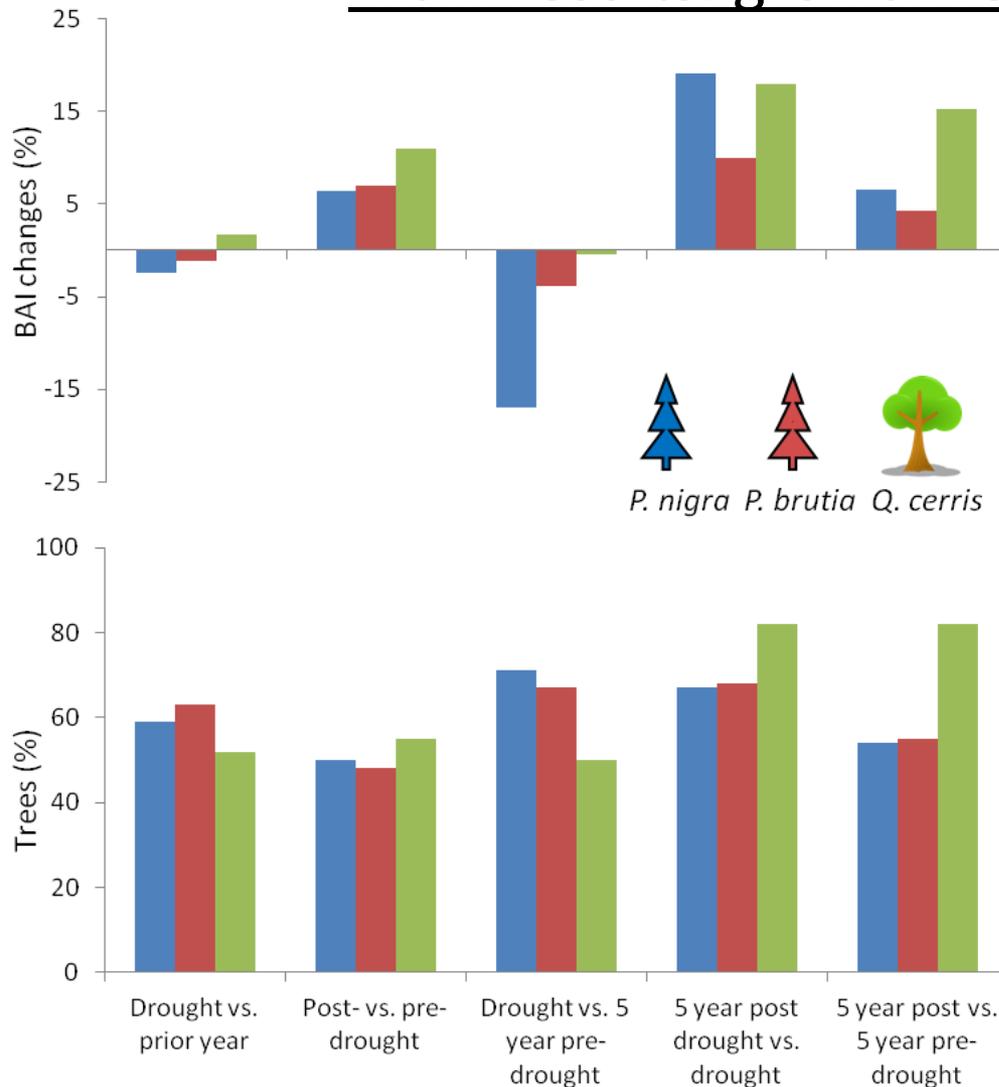
Total predictors (%)



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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 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



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