The effect of extreme drought events on *Pinus sylvestris* (L.) xylem plasticity in pure and mixed forests and contrasting climatic conditions

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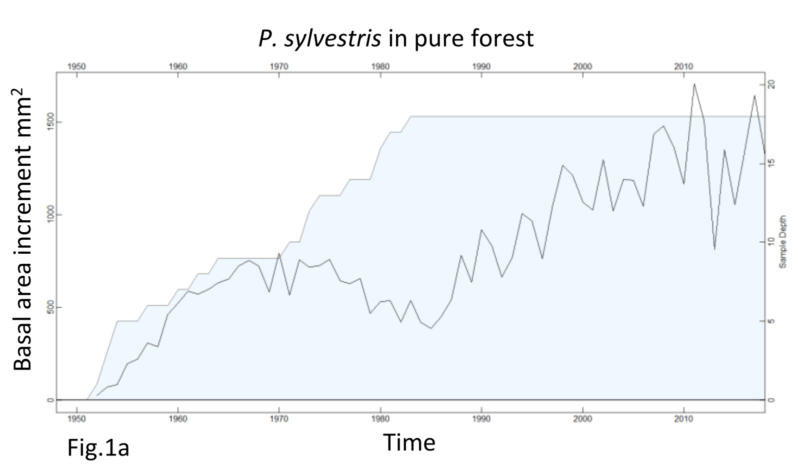
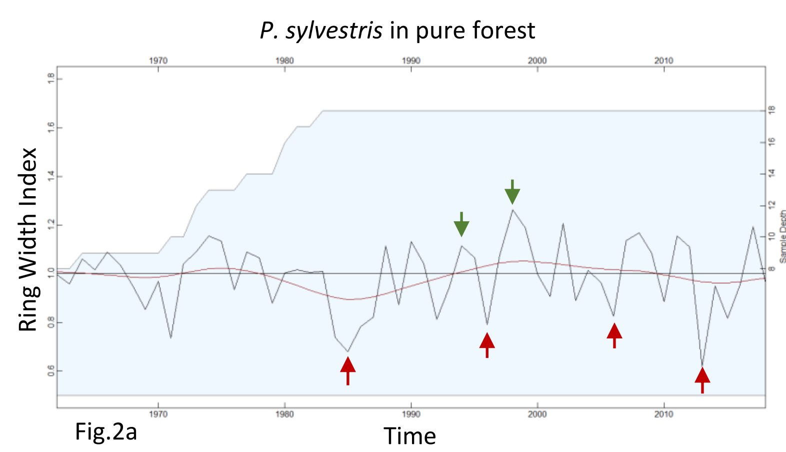
Background

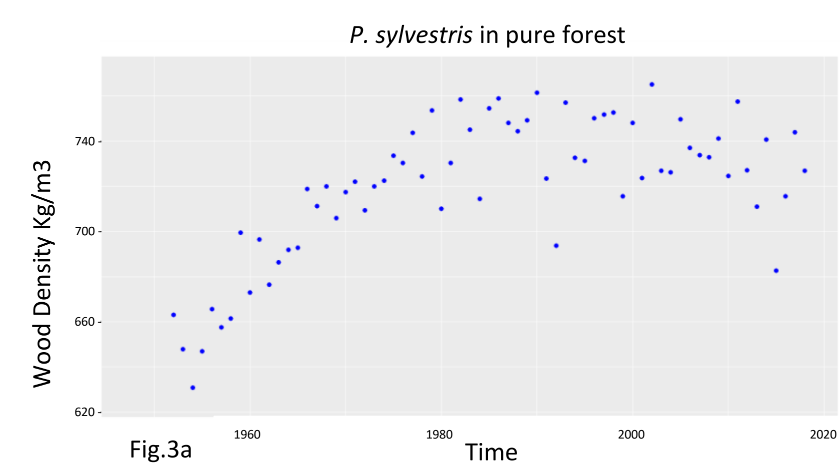
The last decades the climate conditions of Europe were caracterized by an increasing in intensity and frequency of climate extremes as heat waves and drought events. Following the future climate scenario, such events will become normal features characterizing our climate. Dendrochronological studies on last decades, can be informative on trees acclimations and adaptations to such extreme events, implementing our understanding on future trees resilience. Specifically, in Central Europe monocultures consisted mostly of secondary conifer forests, which showed low resistance to such climatic extreme.

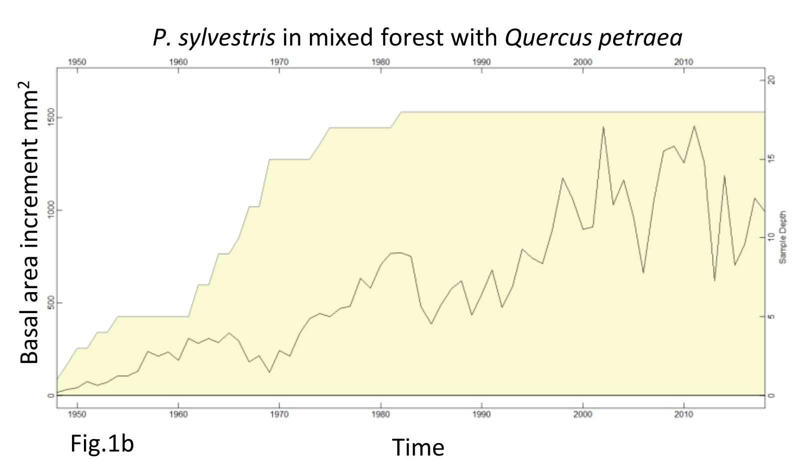
Preliminary results

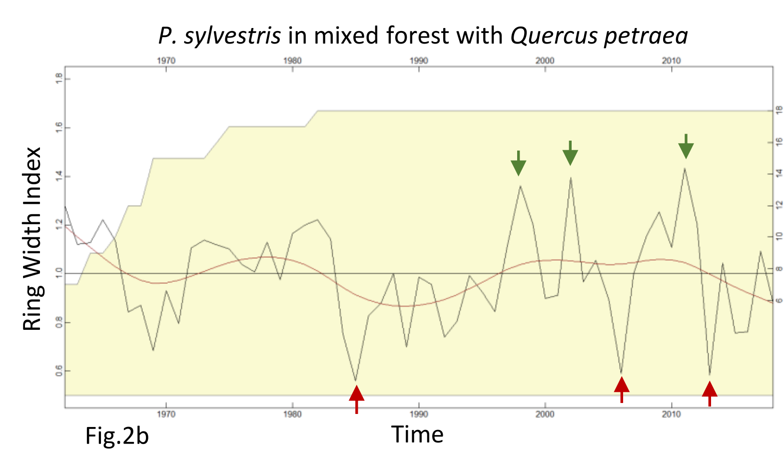
Forest characteristic	Pure Forest	Mixed forest
No. plot	3	3
No. trees ha $^{-1}$	500	590
Sd	191	77
Characteristics of the cores	**Pure Forest**	**Mixed forest**
Range	67 years	71 years
Span	1952 – 2018	1948-2018
Avg series length	52.27 years	55.5 years
Mean raw ring width (mm)	1.698	1.60
Median (mm)	2.033	2.353
Mean sensitivity	0.260	0.257
Standard deviation	0.795	0.955
Mean first order autocorrelation	0.531	0.616











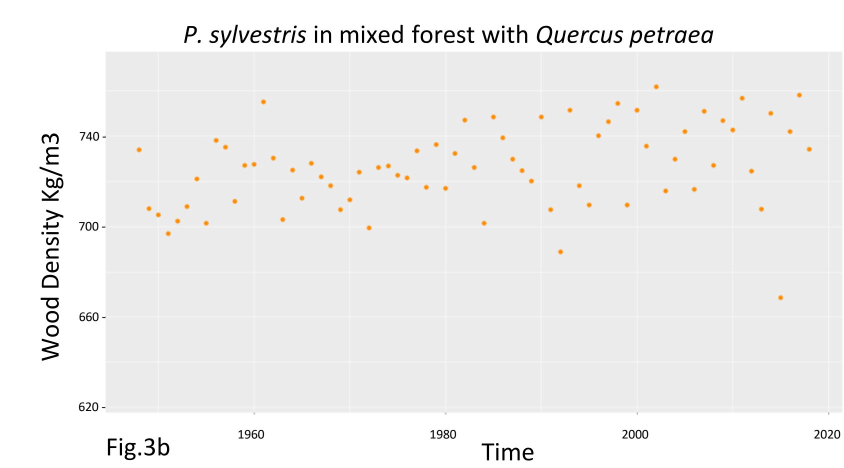


Fig. 1 Basal area increment in mm² of *P. syslvestris* in pure forests (1a) and in mixed forests (1b)

Fig.2 Ring width indices chronologies with EPS > 0.85 of *P. syslvestris* in pure forests (2a) and in mixed forests (2b). In red the arrows pointing the narrowest rings, indicating critical years (1985, 1996, 2006, 2013). The green arrows are pointing the widest rings indicating years with good conditions (1994,1998,2011).

Fig.3 Mean ring wood density of *P. sylvestris* in pure forests (3a) and in mixed forests (3b).

Goals

By comparing *Pinus sylvestris* in pure forests and *Pinus sylvestris* in mixed forests with *Quercus petraea*, we want to answer the following questions:

1) Does the growth of *P. sylvestris* in pure and mixed forests showed differences?
2) Does the growth of *P. sylvestris* in pure and mixed forests showed differences during critical years?
3) Can the extent of such differences be explained by the "mixing effect?"

Methods

In Rogow, Central Poland, 36 dominant *P. sylvestris* were selected, 18 in pure forests and 18 in adjacent mixed forests with *Q. petraea*. 1 core per tree was taken at 1 mt height. Temperature and precipitation data from 1950 were obtained by the meterologogical station of Skierniewice, 30 km from the study site.

The ring width and tree ring wood density were analyzed with LIGNOSTATION™, at the Technische Universität München. At the Free University of Bozen the cores have been crossdated and analyses on the wood anatomy is being performing.

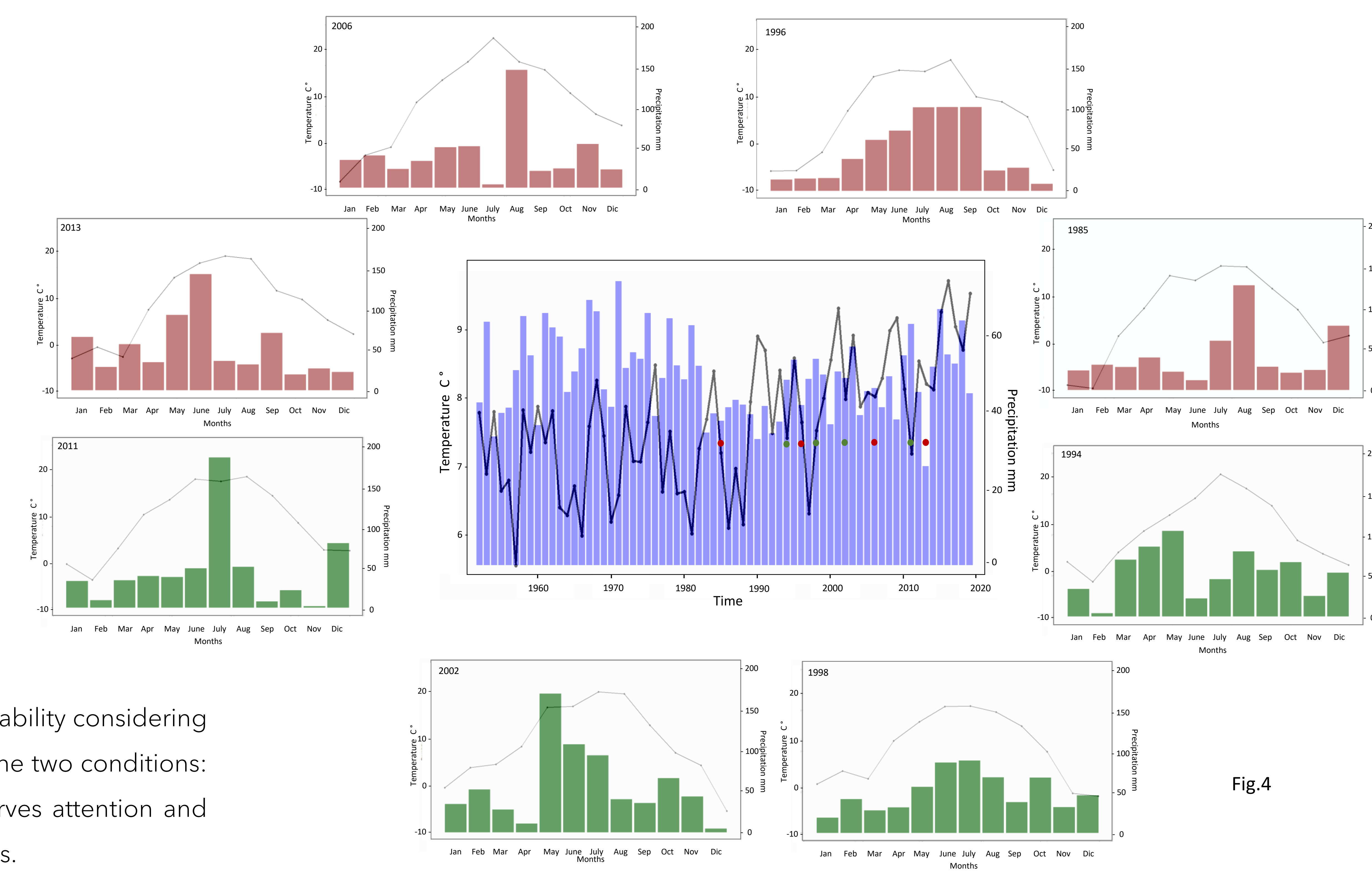


Fig. 4 Main graph: mean annual Precipitation and Temperature for the period 1952-2019. In red the critical years, in green the good ones. The other graphs rapresent the mean monthly Precipitation and Temperature data for critical year (in red, above:1985,1996,2006,2013), and good years (in green, below: 1994,1998,2002,2011).

Conclusion

P. sylvestris in pure and mixed forest showed similar growth trends, but data from trees in pure forests showed less width variability considering consecutive years rather than trees in the mixed forests. The fig. 3 highlights different wood density trends in *P. sylvestris* in the two conditions: trees in pure forests present wood with more heterogeneous densities rather than trees in mixed ones: this aspect deserves attention and further investigation since density is a powerful proxy of trees performance and it is an important feature for economic aspects.

In fig. 4, is possible to observe the trend in Temperature and Precipitation from 1952 in Rogow, and the climatic differences regarding critical and good years. Further analyses at higher resolution (i.e. intra-annual level and wood anatomy level) on the cores are needed to assess trees responses during critical years and to understand to which extent such differences are related with the "mixing effect".

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