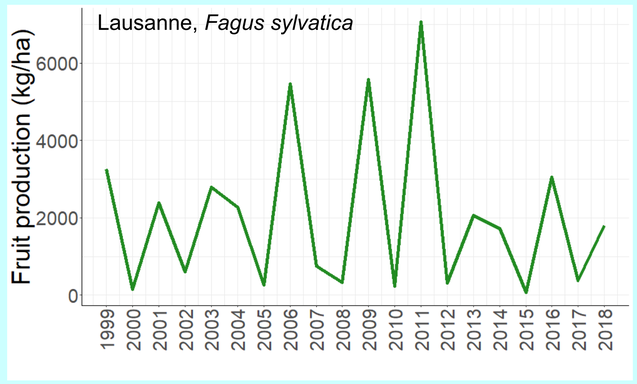
Contrasting resource dynamics mechanisms during mast years for European beech and oak species

Anita Nussbaumer*, members of the ICP Forests

* Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland; anita.nussbaumer@wsl.ch

BACKGROUND

- Mast years: synchronised fruiting at irregular intervals; reproductive strategy in long-lived species



RESEARCH QUESTION

- Which common resource dynamics mechanisms are involved in fruit and leaf production, nutrient allocation and stem growth of *Fagus sylvatica*, *Quercus petraea* and *Quercus robur*?

METHODS

- Superposed epoch analysis for investigation of the resource dynamics at stand scale in the mast year and the previous and subsequent years.
- Linear mixed-effects modelling for investigation of the effect of mast years on nutrient concentration and leaf mass.

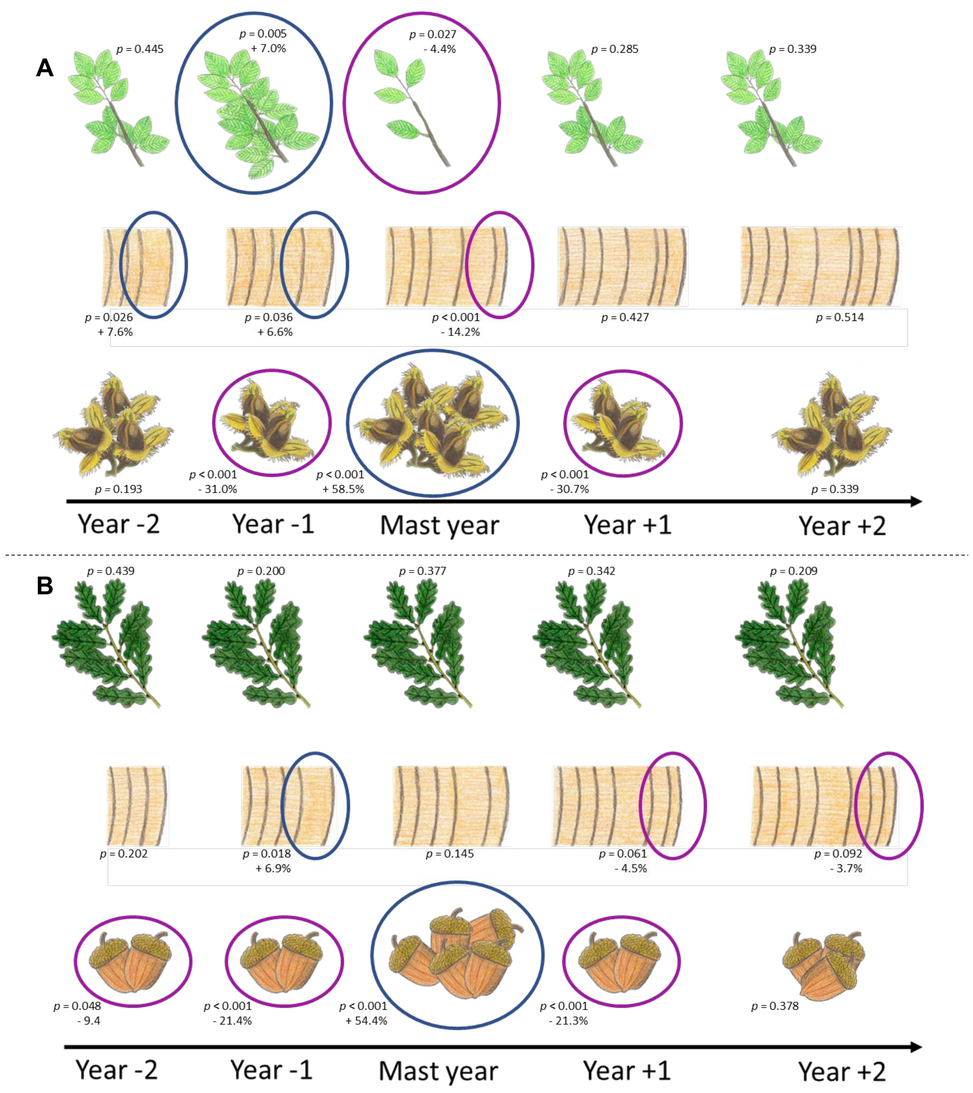


Figure 1 Results from the superposed epoch analyses for Europe. **A**: *Fagus sylvatica*, **B**: *Quercus sp.*, Year -2 = two years before mast year, Year -1 = one year before mast year, Year +1 = one year after mast year, Year +2 = two years after mast year. Blue circles: increase, purple circles: decrease.

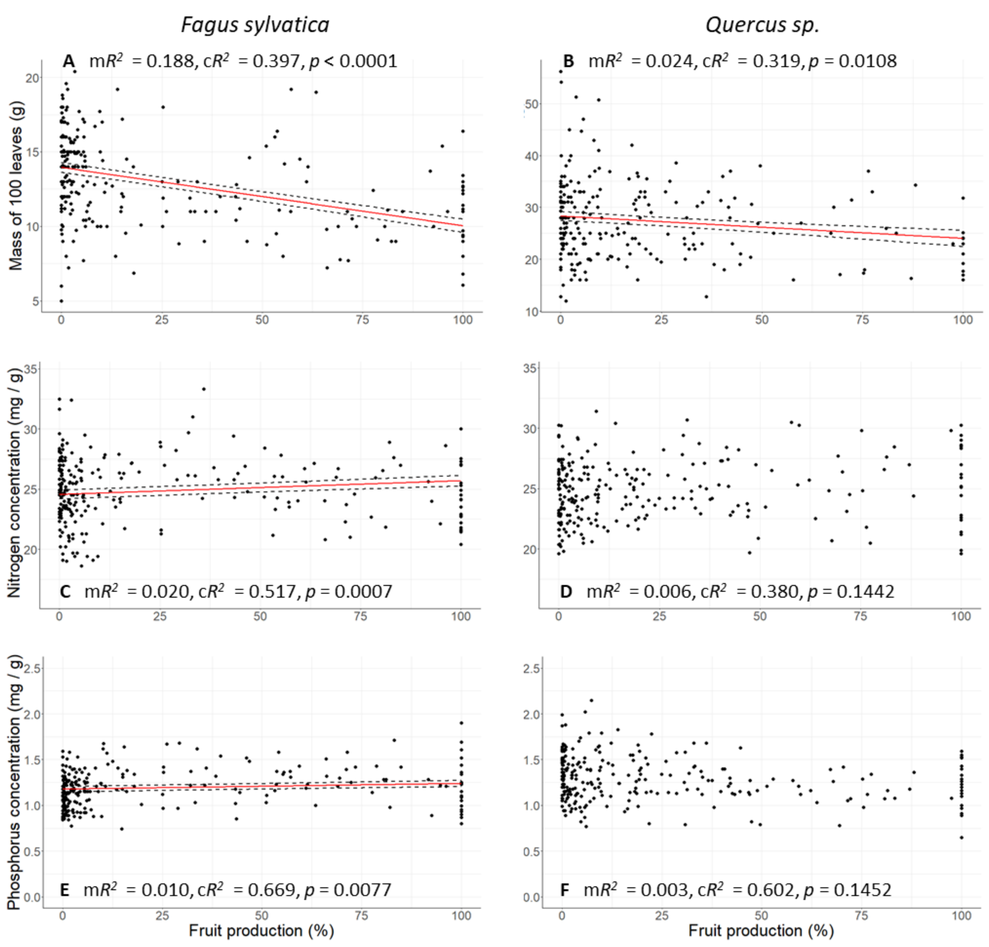


Figure 2 Dry mass of 100 leaves (g), and nitrogen and phosphorus concentrations (mg/g) versus fruit production in percentage of maximum values per plot at European scale for *Fagus sylvatica* (**A**, **C**, **E**) and *Quercus sp.* (**B**, **D**, **F**). **A**, **B**: dry mass of 100 leaves, **C**, **D**: nitrogen concentration, **E**, **F**: phosphorus concentration. Red line: response curve of the linear mixed-effects modelling, dashed line: standard errors, mR^2: marginal R^2, cR^2: conditional R^2.

RESULTS

Fagus sylvatica

- Stem growth is reduced in mast years by 14.2%.
- Leaf production is reduced on cool temperate plots by 6.9%.
- Stem growth and leaf production is enhanced in the years before the mast year (7.1% and 6%).

Quercus sp.

- Vegetative growth is not immediately affected by mast years.
- Stem growth is reduced in the years after the mast year on warm temperate plots by 5.2%.

All species

- Mass of 100 leaves decreases with increasing fruit production but leaf nutrient concentrations do not.

CONCLUSIONS

- In mast years, *Fagus sylvatica* shows resource switching from vegetative to generative growth.
- All species show resource accumulation before mast years.
- *Quercus sp.* shows resource depletion after mast years.
- *Fagus sylvatica* cannot substitute for smaller leaves in mast years.
- For all species, leaf nutrient uptake is not compromised by high fruit production.

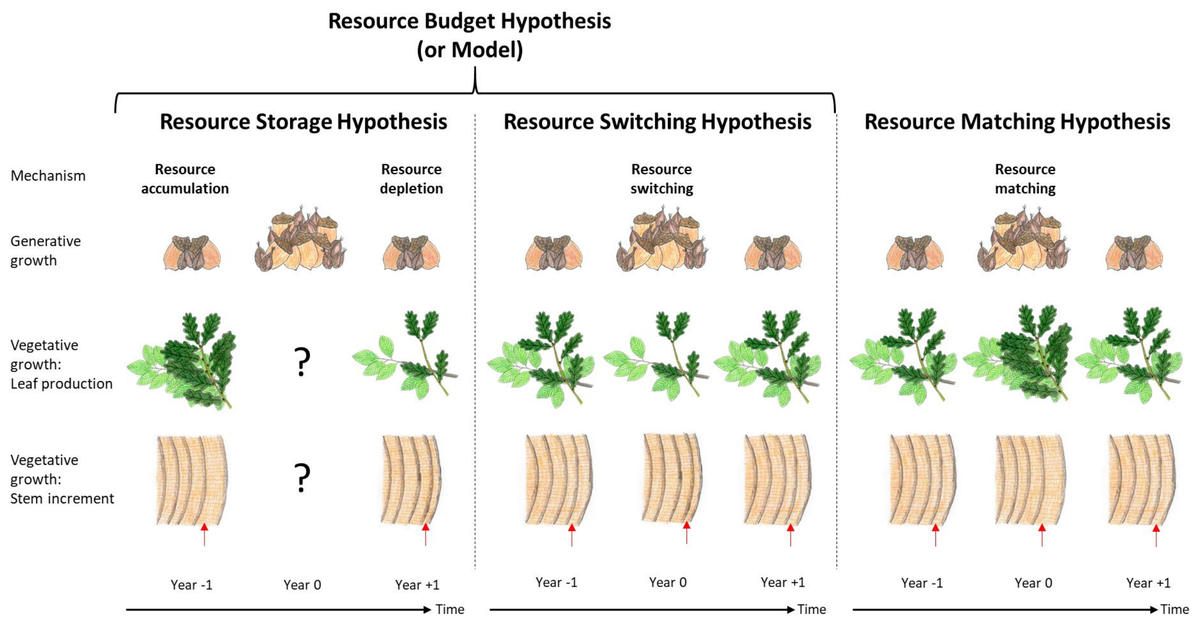


Figure 3 Proximate mast hypotheses concerning resource dynamics: *Resource storage hypothesis*: resources have to be accumulated before high amounts of fruits can be produced (resource accumulation). After the mast year, resources are depleted (resource depletion) and have to be accumulated again before another mast year occurs. *Resource switching hypothesis*: during the mast year, resources are shifted from vegetative to generative growth. *Resource matching hypothesis*: in environmentally favourable years vegetative and generative growth are equally enhanced. ?: resource dynamics in mast years can vary. Red arrows: stem growth of the current year. Year -1 = one year before mast year, Year 0 = mast year, Year +1 = one year after mast year.

Reference:

Anita Nussbaumer, Arthur Gessler, Sue Benham, Bruno de Cinti, Sophia Etzold, Morten Ingerslev, Frank Jacob, François Lebourgeois, Tom Levanic, Hrvoje Marjanović, Manuel Nicolas, Maša Zorana Ostrogović Sever, Tibor Priwitzer, Pasi Rautio, Peter Roskams, Tanja G.M. Sanders, Maria Schmitt, Vít Šrámek, Anne Thimonier, Liisa Ukonmaanaho, Arne Verstraeten, Lars Vesterdal, Markus Wagner, Peter Waldner, Andreas Rigling (in revision). Contrasting resource dynamics in mast years for European beech and oak – a continental scale analysis. In revision in Frontiers in Forests and Global change.