Tree growth enhancement drives denser stands and biomass gains in mature temperate forests

Search for more info below

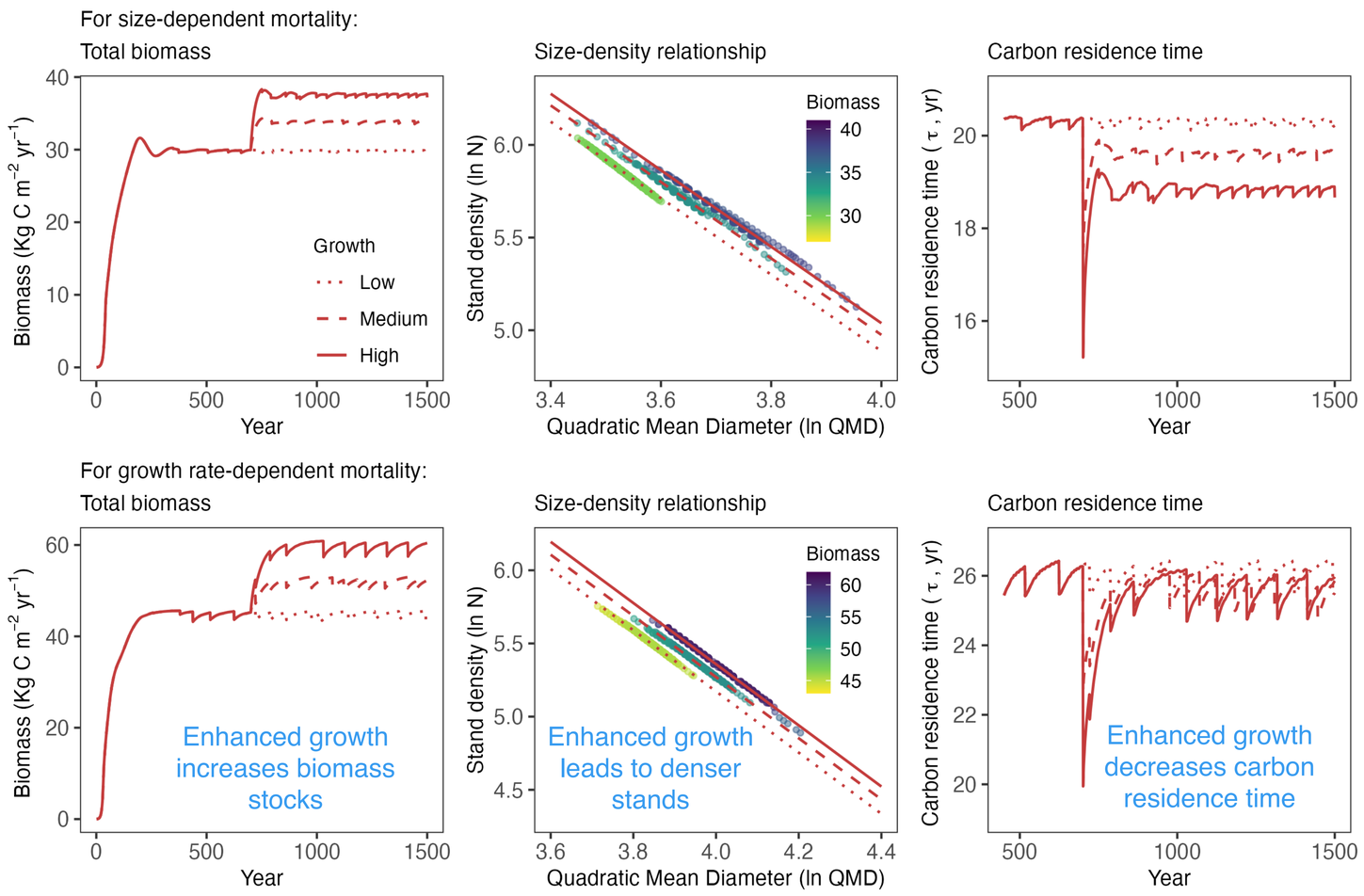
The thinker @what_is_the_matter

Tree growth enhancement could be translated into an #increase in biomass stocks or associated with a #reduction in tree longevity to a degree that nullifies any change in biomass, as suggested by the #GFDY.

We investigate the link between #growth and #biomass and its relation to changes in #tree density.

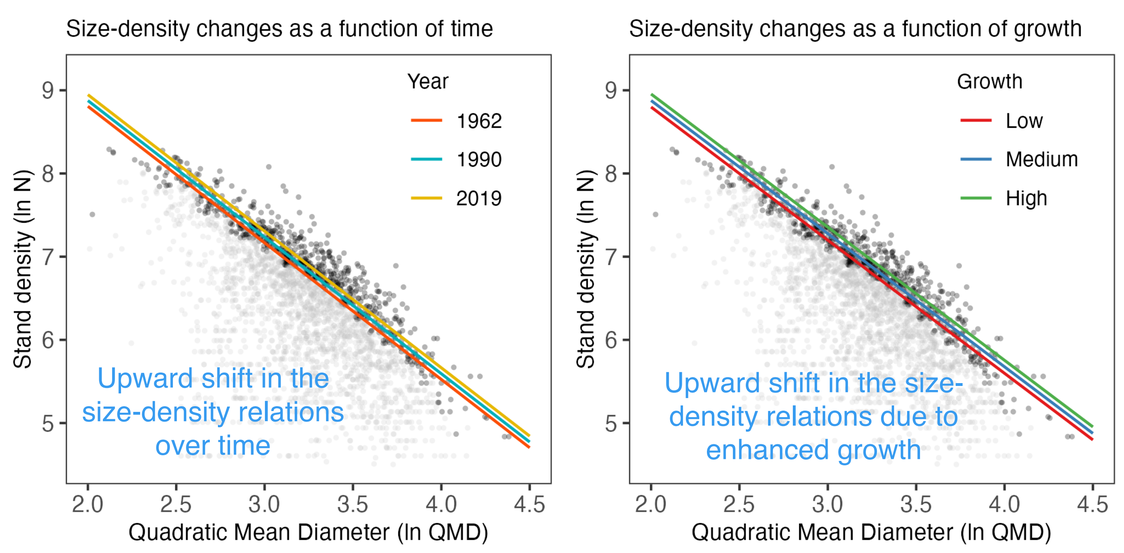
The modeler @models_are_useful

We use the mechanistic model #LM3-PPA to test the #GFDY under two alternative mortality formulations based on #tree size and #growth rate.
Simulated growth enhancements lead to increases in #biomass stocks and #stand density, independently of the assumption about drivers of #tree mortality.



The empiricist @but_show_me_the_data

Empirical forest data from #NFI, #EFM and #NFR show that #unmanaged mature forests in #Switzerland are densening over #time and as #growth rate increases.



The convener @take_home_message

Tree growth enhancements lead to higher #biomass stocks and #denser stands, despite reductions in #carbon residence time and #tree longevity. The gains compensate the losses; they are not mutually exclusive.

Key concepts and details

Research question
Does an enhancement in tree growth lead to increases in biomass stocks and tree density in mature forests?

#GFDY
Grow-Fast-Die-Young hypothesis
Refers to the shorter longevity of fast-growing trees.

We test the #GFDY hypothesis theoretically and empirically.

Modelling approach

#LM3-PPA
Vegetation demography cohort-based model which links leaf physiology, tree-level C balance, demographic rates and stand dynamics (Weng et al. 2015).

Model calibration
For Swiss forests with data from the Lägeren flux site (CH-Lae).

2 mortality forms
Size-dependent mortality: tree mortality increases with tree size in the upper-canopy.
Growth rate-dependent mortality: tree mortality increases as a function of biomass increment.

Empirical support

From unmanaged close-canopy Swiss forests (808 plots). We study the **size-density relations** with linear mixed-effects models.

#Size-density relation
Negative relationship between stand density (N) and average size (QMD) from competition.

#NFI
Swiss National Forest Inventory (Fisher & Traub 2019).

#EFM
Experimental Forest Management plots (Forrester et al. 2019).

#NFR
Natural Forest Reserves (Hobbi et al. 2020).

References:
Weng ES et al. 2015. Biogeosciences 12, 2655–2694.
Fischer C & Traub B. 2019. Springer International Publishing.
Forrester DI et al. 2019. WSL.
Hobi ML et al. 2020. EnviDat.

Home
Explore
Notifications
Messages
Bookmarks
Lists
Profile
More

Tweet

Follow the authors

- **Laura Marqués**
  D-USYS, ETH
  @L4ur4M4rqu3s
  laura.marques@usys.ethz.ch
- **Ensheng Weng**
  Columbia University
- **Harald Bugmann**
  D-USYS, ETH
- **David I. Forrester**
  CSIRO
- **Martina L. Hobi**
  WSL
- **Brigitte Rohner**
  WSL
- **Esther Thürig**
  WSL
- **Volodymyr Trotsiuk**
  WSL
- **Benjamin D. Stocker**
  D-USYS, ETH

Who to thank

ETH zürich
WSL
FNSNF

Want to know more?

Visit our site here:

#BIFoR
Annual Meeting 2022

BIFOR
BIRMINGHAM INSTITUTE OF FOREST RESEARCH