

## Canopy and growth response of beech trees after the 2018 drought in Switzerland

B. Rohner, A. Lanz, S. Kumar, K. Liechti, A. Gessler, M. Ferretti Swiss Federal Institute for Forest, Snow and Landscape Research WSL

### **Motivation**

# A severe drought hit central Europe in spring - summer 2018



Ecological Indicators





## **Motivation**

Main research questions

- How severely did the 2018 drought affect beech crowns compared to long-term data?
- What variables explained the likelihood of beech crowns to be affected?
- How was the growth of beech trees affected by the drought?







Main research questions

- How severely did the 2018 drought affect beech crowns compared to long-term data?
- What variables explained the likelihood of beech crowns to be affected?
- How was the growth of beech trees affected by \_\_\_\_\_ the drought?

Defoliation and coloration NFI '18 vs. Sanasilva since '85

Ordinal mixed models incl. 10 potential explanatory variables

Growth comparison among years and crown conditions



### Methods Drought initiative 2018

75 NFI plots measured in spring 2018 as part of the regular NFI survey

n = 271 beech trees



Revisited 24.8. – 5.9. 2018, 2019, 2020

- Diameter
- Defoliation
- Coloration

Sample plots located on a 1.4 x 1.4 km grid



# Methods

### Drought initiative 2018





## Results

#### Effects on crown conditions

#### Defoliation and coloration of beech on plots

- no severe crown transparency, no severe leaf browning
- severe crown transparency only



- 20% of the plots with severe crown transparency
- 13% of the plots with severe leaf browning
- No clear spatial pattern in the lowlands

Rohner et al. (2021) Ecological Indicators



### Results Effects on crown conditions





State of the second second

## Results

### Variables explaining crown conditions

#### Table 4

Ordinal regression model for the probability of a tree to be increasingly severely affected. The explanatory variables are introduced in Table 1 and were standardized before model fitting. A stepwise-backward variable selection procedure based on AIC was performed.

Alexandre De

Tree size	Variable	Estimate	Standard error	P value
Stand density	DBH_5	0.702	0.005	< 0.001
Growth 2010-17	log(NPH) <sup>-</sup> log(BAI45_PLOT)	-1.562	0.005	< 0.001 < 0.001
Precip. deficit	P_PET	-1.604	0.005	< 0.001

Rohner et al. (2021) Ecological Indicators

A Contraction of the second



### Results

#### Effects on tree growth





0

affected severely affected



Rohner et al. (2021)

**Ecological Indicators** 

## Conclusions

Effects on crown conditions

- Higher proportion of SCT and SLB in 2018 than in long-term data
- → Optimising monitoring designs (e.g. timing) without compromising data consistency may allow for better capturing disturbance events

#### Variables explaining crown conditions

- Tree, stand, and climatic factors jointly affected crown conditions
- $\rightarrow$  Complex interplay of tree physiology, forest management and drought

Effects on tree growth

- Growth reduction in 2018, particularly for severely affected trees
- $\rightarrow$  Seemed to recover in 2019; longer-term effects need further studies







### Thank you!

- Financing by the WSL drought 2018 initiative and the Swiss NFI
- Rolf Meile, Christian Hug, NFI field crews

#### Further information:



Tree vitality indicators revealed a rapid response of beech forests to the 2018 drought

Brigitte Rohner<sup>a,\*</sup>, Simpal Kumar<sup>b</sup>, Katharina Liechti<sup>c</sup>, Arthur Gessler<sup>b,d</sup>, Marco Ferretti<sup>a</sup>

<sup>a</sup> Forest Resources and Management, Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland

<sup>b</sup> Forest Dynamics, Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland

<sup>c</sup> Mountain Hydrology and Mass Movements, Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland <sup>d</sup> Institute of Terrestrial Ecosystems, ETH Zurich, Zurich, Switzerland

#### brigitte.rohner@wsl.ch



### Methods Swiss National Forest Inventory

NFI 1: 1983-85 NFI 2: 1993-95 NFI 3: 2004-06 NFI 4: 2009-17 NFI 5: 2018-26

Surveys





## $\frac{500m^2}{200m^2}: dbh \ge 36cm$

Sample plots located on a 1.4 x 1.4 km grid

