KATHOLISCHE UNIVERSITÄT EICHSTÄTT-INGOLSTADT

Pollen production of birch under differing environmental regimes in International Phenological Gardens across Europe

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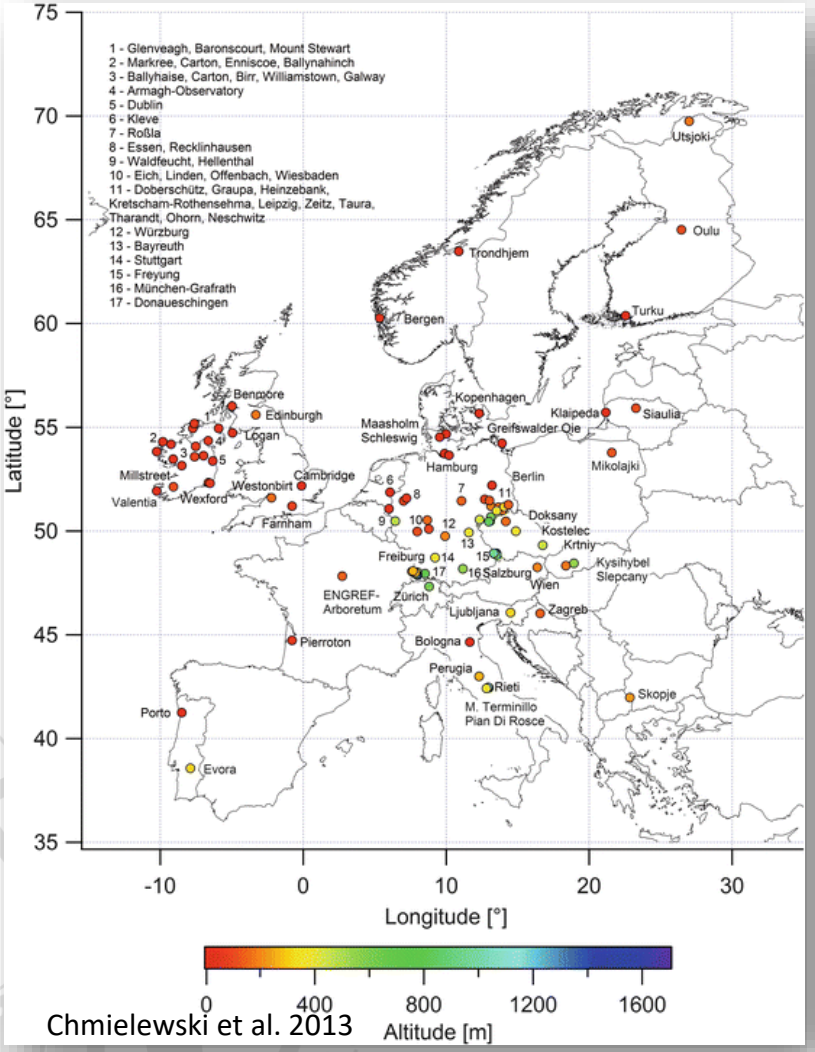
PHENO 2022

Introduction



Chmielewski et al. 2013

International Phenological Gardens

- Long term phenological observation network
- Cloned plant species to exclude genetic effects
- Useful for phenological research as well as for **pollen production**

Introduction

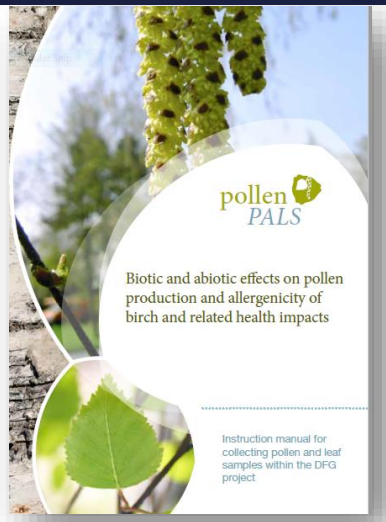
- Pollen production might be higher under warmer conditions.
- However, influence of temperature on pollen production is poorly known.

Aim: To disentangle the **environmental impacts on pollen production** in the natural environment across Europe free from genetic differences.

Downy birch (*Betula pubescens* EHRH.)

Research area

Year	IPGs	Trees	Countries
2019	35	44	9
2020	31	36	8
2021	29	35	9
Consistent	**24**	**28**	**6**



Instructional manual for sample collectors

	Lowest	Highest
Altitude (m a.s.l.)	13	967
Latitude	42° N	64° N
Longitude	8° W	23° E
Mean annual temperature	**5.8° C**	**13.9° C**

Research area: IPGs contributing samples for 3 years

Methods

Code	Visualization	Description
Stage 51		First green spots visible; although negligible stretching.
Stage 52		Catkins increase in length and show green expansion cracks.

BBCH code, Meier 2001

Catkins per volume
(50 × 50 × 50 cm^3)

Damialis et al. 2011

Methods

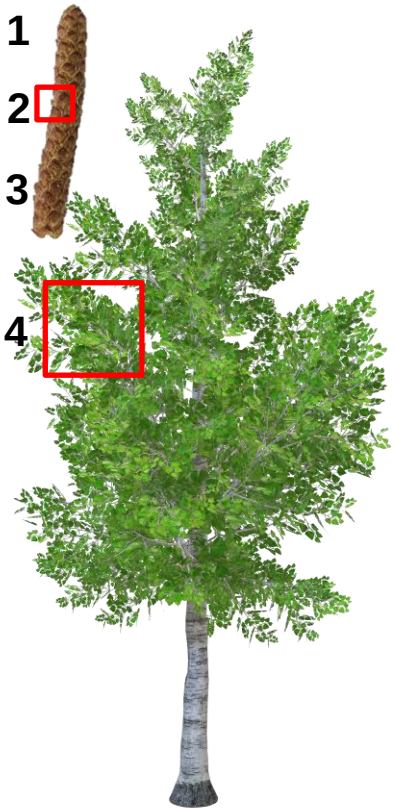
Environmental Data: E-OBS dataset (0.1° x 0.1°)

- Monthly averages from daily gridded meteorological observations (2018-2021)
- Seasonal averages of the climatic variables were considered for the analysis

Winter	—	December, January and February
Spring	—	March, April and May
Summer	—	June, July and August
Autumn	—	September, October and November.

We acknowledge the E-OBS dataset from the EU-FP6 project UERRA and the Copernicus Climate Change Service, and the data providers in the ECA&D project.

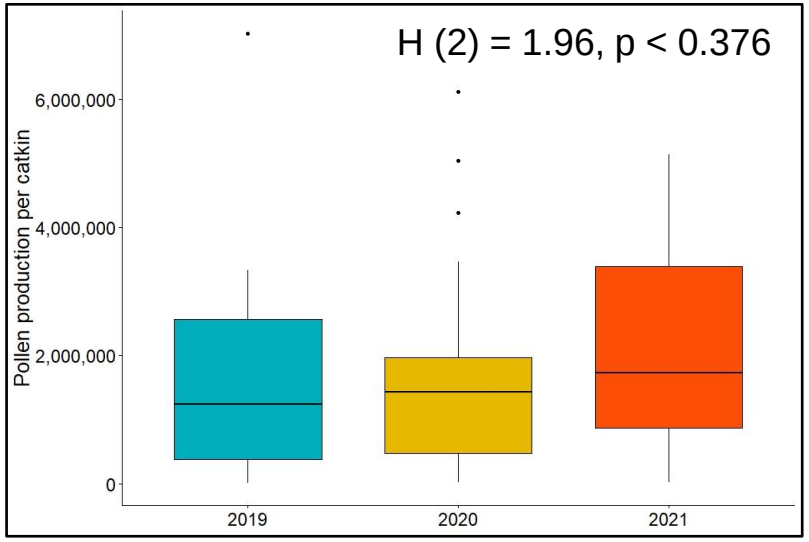
Results

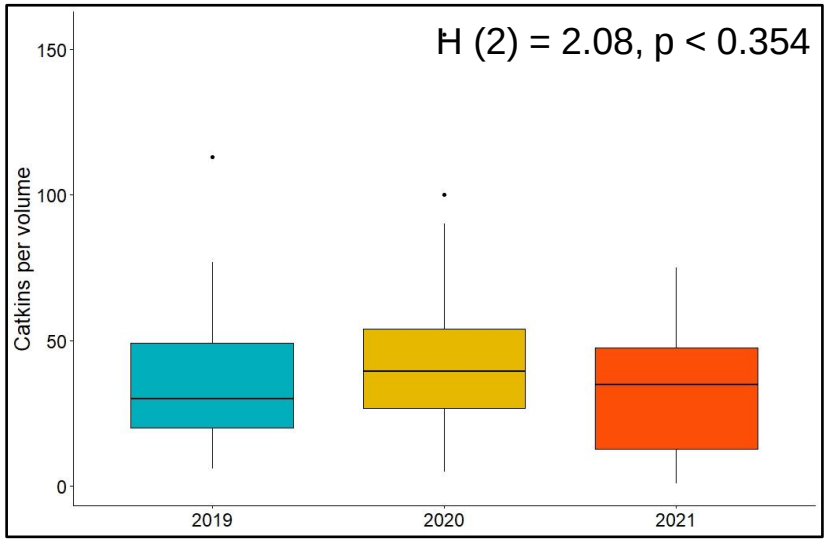


Reproductive metrics	Minimum	Maximum	Mean	Standard deviation
1. Flower per catkin	87	145	114	14
2. Pollen per flower	53	5.9×10^4	1.6×10^4	1.4×10^4
3. Pollen per catkin	7×10^3	7×10^6	**1.8×10^6**	1.6×10^6
4. Catkins per volume	1	155	38	27

Results

Annual variation: not significant





However,

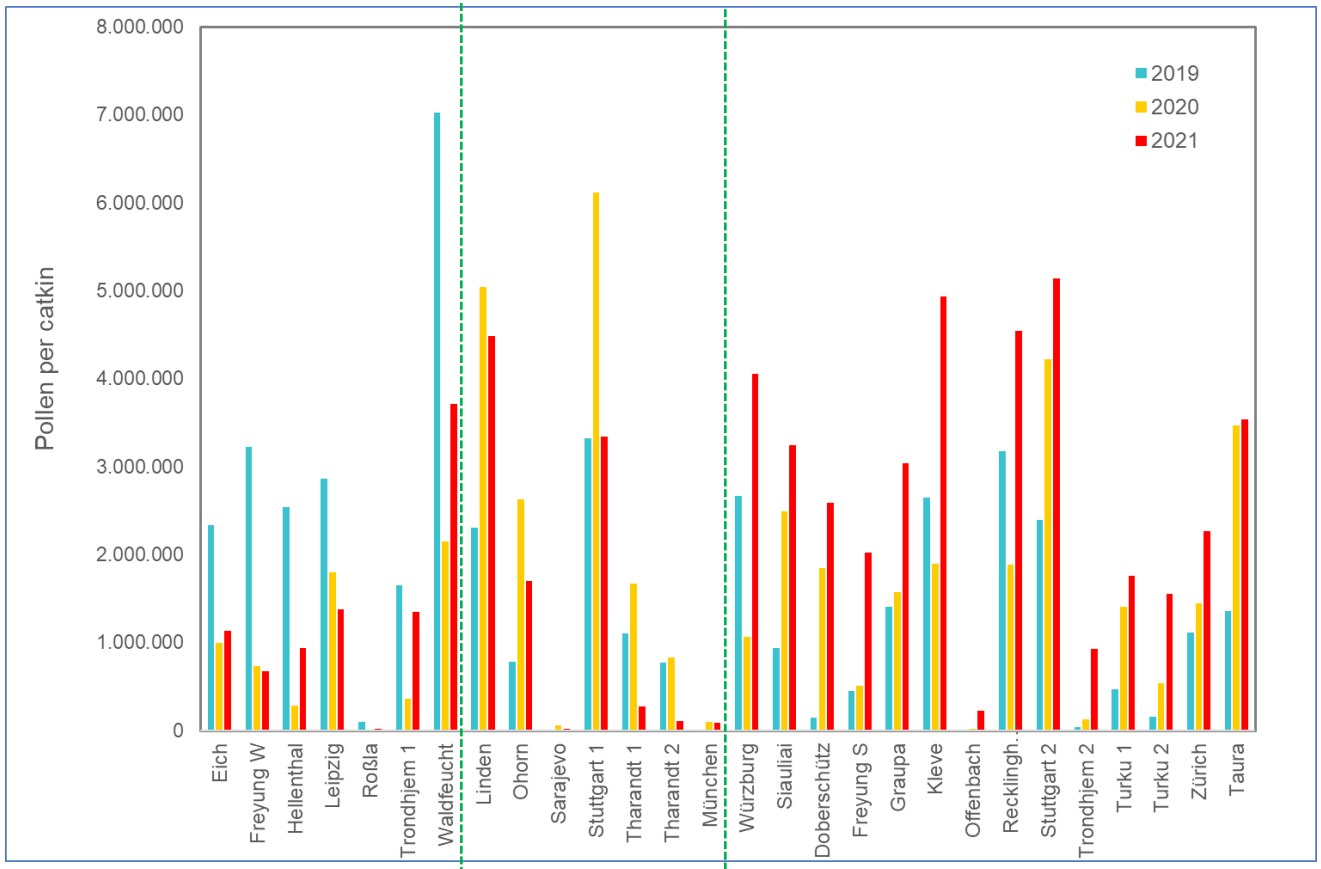
- Increasing median from 2019 to 2021,
- smallest variability in 2020, highest in 2021.

Similar results with other reproductive metrics.

Reproductive metrics	p value
Flower per catkin	0.204
Pollen per flower	0.264

Results

Annual variation: not significant



High in 2019 (n=7)

High in 2020 (n=7)

High in 2021(n=14)

Results

Correlations: Mean Seasonal Temperature vs reproductive metrics

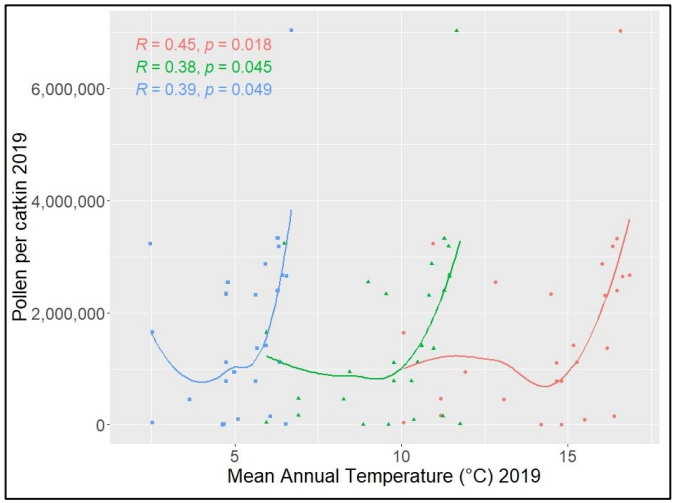
2019	Summer	Autumn	Winter	Spring	Mean annual
Flowers per catkin	n.s.	n.s.	n.s.	n.s.	n.s.
Pollen per flower	n.s.	n.s.	0.45 (p=0.02)	n.s.	0.37 (p=0.056)
Pollen per catkin	n.s.	n.s.	**0.45 (p=0.02)**	n.s.	0.38 (p=0.045)
Catkins per volume	n.s.	n.s.	0.36 (p=0.06)	n.s.	n.s.

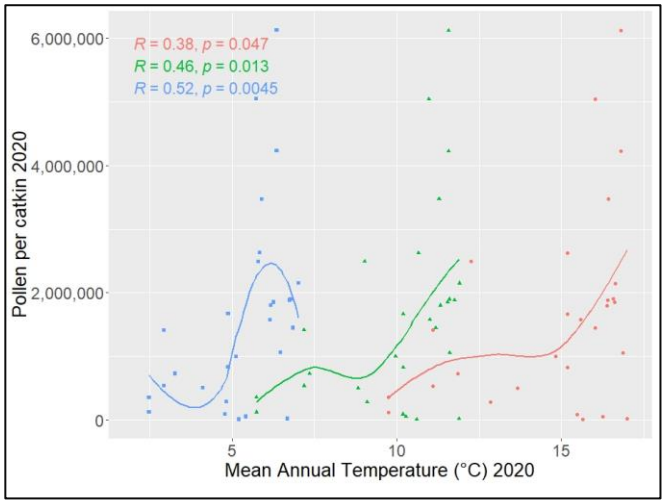
2020	Summer	Autumn	Winter	Spring	Mean annual
Flowers per catkin	n.s.	n.s.	n.s.	n.s.	n.s.
Pollen per flower	0.40 (p=0.030)	0.36 (p=0.060)	0.49 (p=0.008)	0.42 (p=0.03)	0.46 (p=0.013)
Pollen per catkin	0.42 (p=0.030)	0.36 (p=0.060)	**0.51 (p=0.006)**	0.41 (p=0.03)	0.46 (p=0.013)
Catkins per volume	0.39 (p=0.040)	0.50 (p=0.006)	n.s.	0.49 (p=0.009)	0.42 (p=0.030)

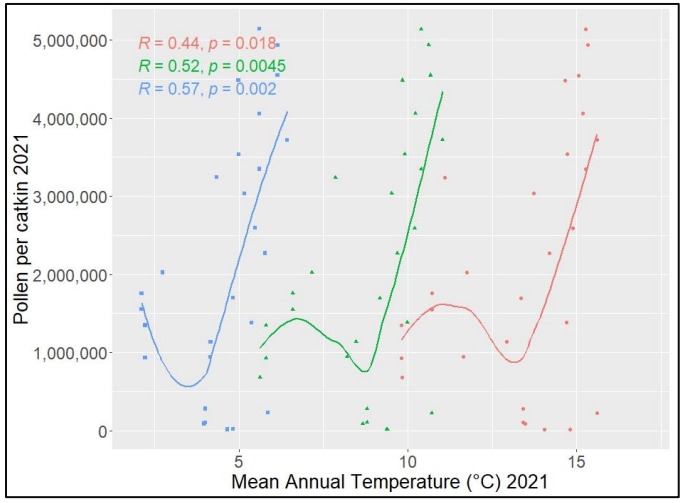
2021	Summer	Autumn	Winter	Spring	Mean annual
Flowers per catkin	0.55 (p=0.003)	0.41 (p=0.030)	n.s.	0.36 (p=0.060)	n.s.
Pollen per flower	0.43 (p=0.020)	0.55 (p=0.003)	0.47 (p=0.010)	0.43 (p=0.020)	0.50 (p=0.007)
Pollen per catkin	0.47 (p=0.010)	**0.56 (p=0.002)**	0.48 (p=0.010)	0.49 (p=0.008)	0.52 (p=0.005)
Catkins per volume	n.s.	n.s.	n.s.	n.s.	0.41 (p=0.040)

Results

Mean annual temperatures vs Pollen per catkin



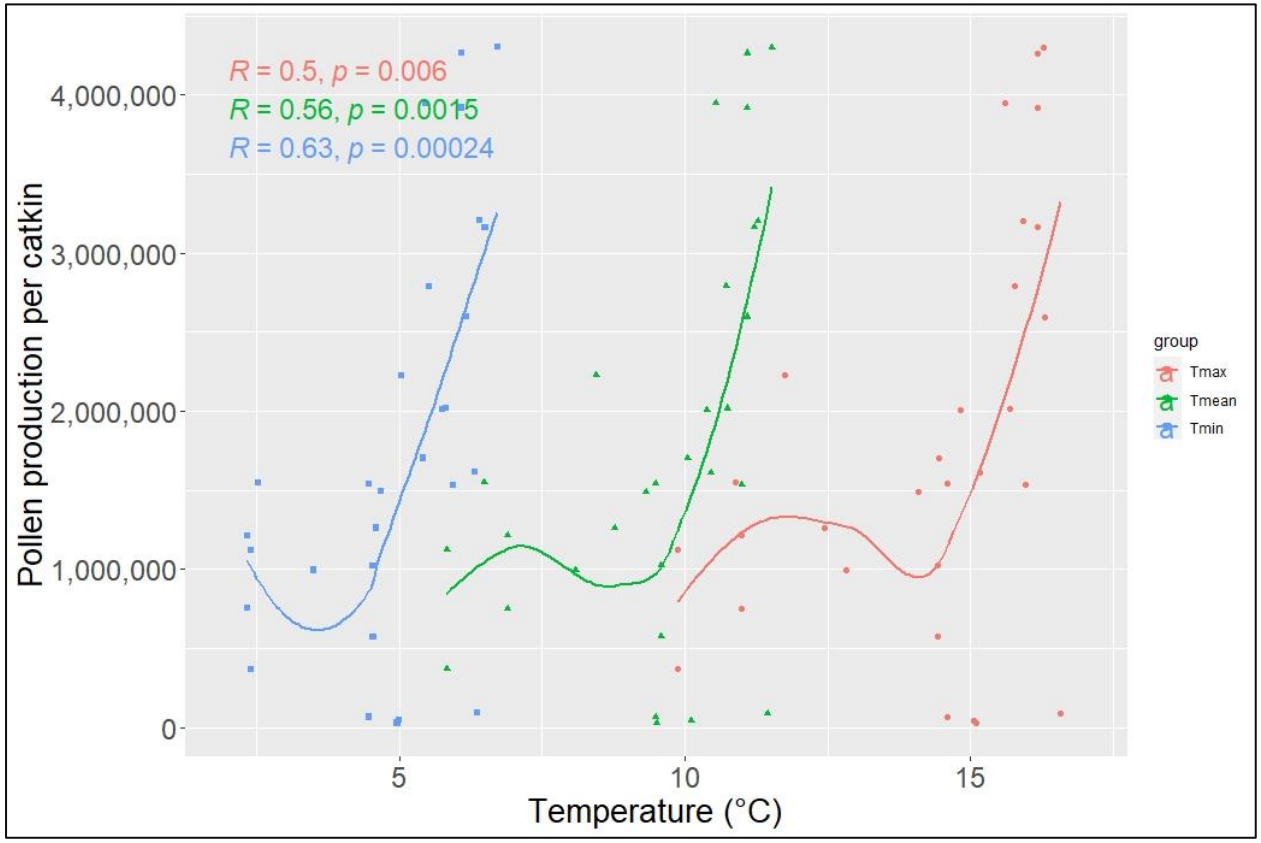




Tmax
Tmean
Tmin

Results

Mean temperatures (2018-2021) *vs.* mean pollen production (2019-2021)



Other environmental factors such as relative humidity, global radiation, pollution and urban index did not show significant correlations with mean pollen production.

Conclusion

- **Autumn** and **winter mean temperatures** showed the strongest correlation to pollen production.
- Flowers per catkin and catkins per volume were often not correlated to temperature.
- Catkins per volume might be additionally affected by masting events that could differ temporally across populations/regions.
- Up to a certain threshold (approx. mean of 10 °C) temperature does not influence pollen production a lot;
- above this threshold, there is a steep increase in pollen production.
    - **Climate change will probably further increase pollen production and therefore allergy related problems.**

Thank you for your attention

Merci pour votre attention