The PhenObs initiative - Linking plant phenology to functional traits in herbaceous species in Botanical Gardens

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PhenObs – Botanical Gardens as a Global Phenological Observation Network

Background

- Changes in phenology are fingerprints of climate change
- In herbaceous species phenological observations are rare, as they are time consuming and not straight forward
- Species responses to environmental changes can be captured via traits indicating their dispersal capacity, competitiveness and environmental tolerances
- ➢ **Are plant traits linked to phenology?**
- ➢ **If so, are models using local trait measurements outperforming models relying on data from trait databases?**

Methods

- We investigated 260 herbaceous species in six Central European Botanical Gardens (Berlin, Frankfurt, Halle, Jena, Leipzig, Vienna) in 2019 and 2020 (following Nordt et al., 2021)
- Phenology and functional traits were monitored and measured on the same population in each garden
- Effect of intraspecific trait variability on phenology-trait relationship was tested using global mean trait data from TRY database (Kattge et al., 2020)

Results

- Phenological stages were in most cases better predicted by garden specific trait data than by available global mean trait data (Table 1)
- Begin and duration of flowering were related to traits associated with competitiveness (plant height, Figure 2) and dispersal ability (seed mass, Figure 3)
- Begin of senescence was related to resistance associated traits (LDMC, Table 1)

Conclusion

The results suggest that the easy to measure traits have a high potential to capture phenology and may thus be included in models to predict the effects of changes in climate.

Traits from databases are suitable to predict phenological responses, though data from local measurements lead to higher model performances.

Figure 1. Developmental stages of *Paeonia officinalis* during the year (Photos: B. Nordt)

Table 1. Results of linear models. Multiple R^2; *p*-value, *** $p<0.001$; in brackets '+' indicates positive and '–' indicates negative relationships.

	R^2, *p*-value **garden**	R^2, *p*-value **TRY**
Begin flowering ~ plant height	(+) 0.32, ***	(+) 0.24, ***
Flowering duration ~ seed mass	(–) 0.11, ***	(–) 0.06, ***
Begin senescence ~ LDMC	(+) 0.17, ***	(+) 0.18, ***

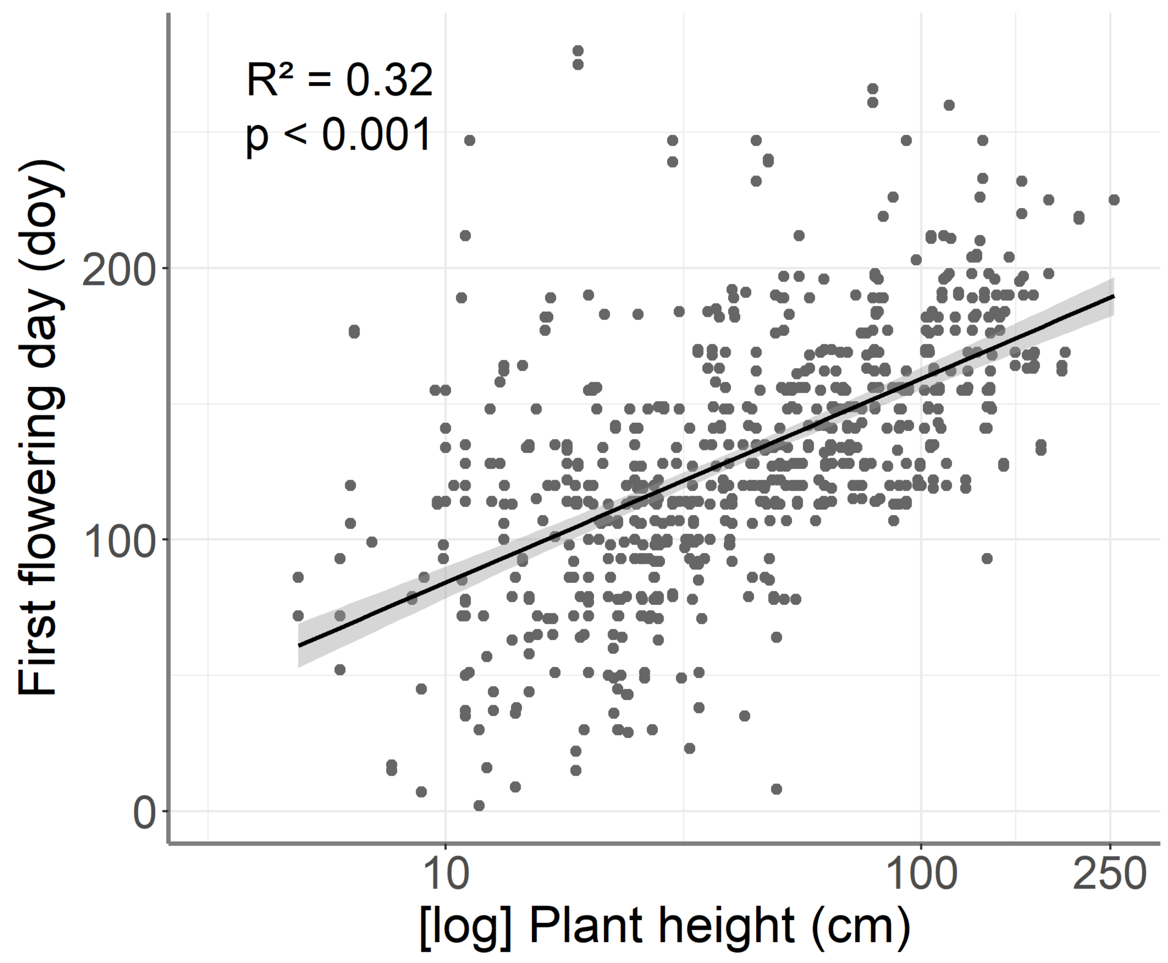

Figure 2. Taller species start flowering later than shorter ones.

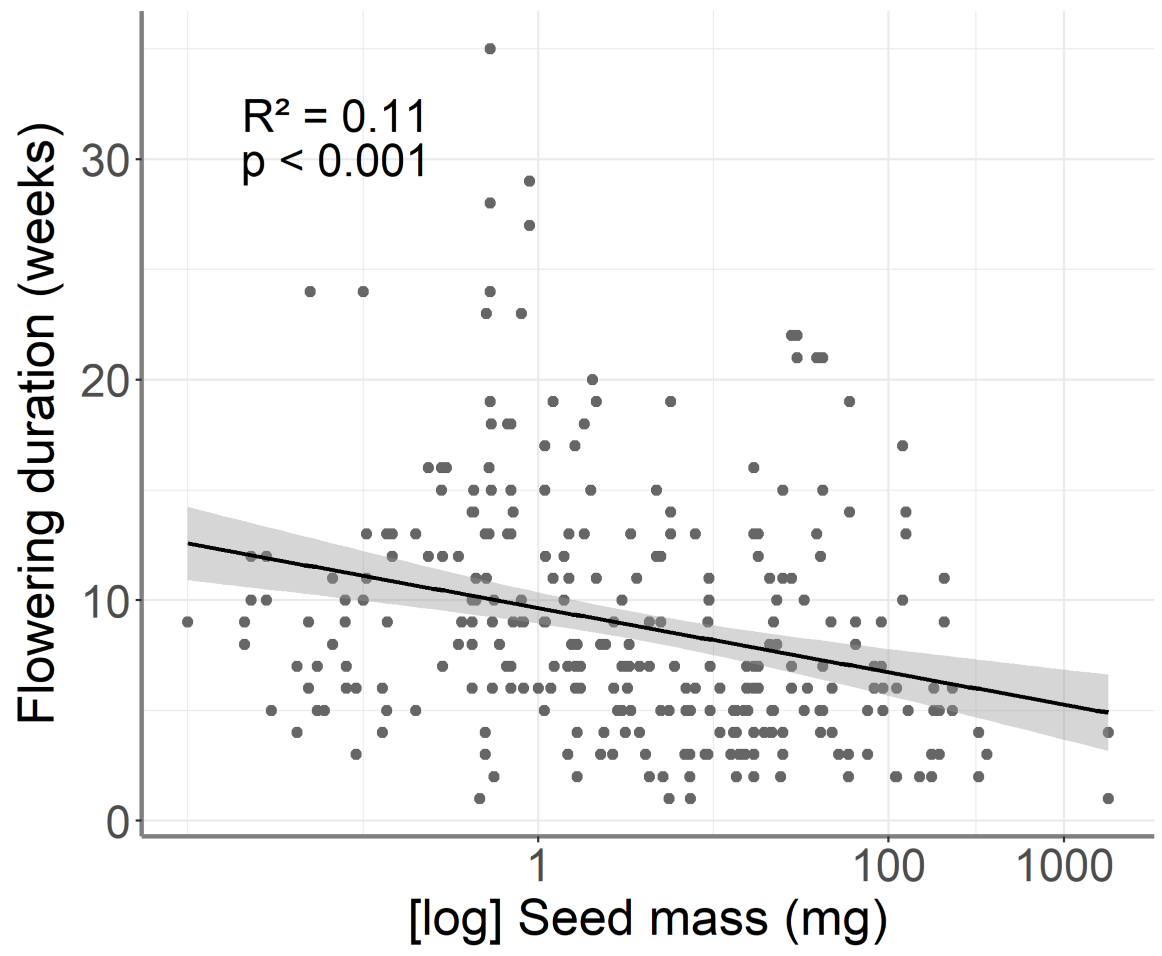

Figure 3. Longer flowering duration was associated with lighter seed mass.

Kattge, J., *et al*. (2020) TRY plant trait database – enhanced coverage and open access. *Global Change Biology*, *26*, 119-188.

Nordt, B., et al. (2021). The PhenObs initiative: A standardised protocol for monitoring phenological responses to climate change using herbaceous plant species in botanical gardens. *Functional Ecology*, *35*, 821-834.

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