



Climate warming causes increased within-species variation in the timing of leaf unfolding in *Fagus sylvatica*

Constantin M. Zohner* and Susanne S. Renner, Munich University (LMU)



The spring phenology of *Fagus sylvatica* is known to be under strong photoperiodic control. The heritability of this trait, and its variation within and among populations, however, are poorly understood.

We have conducted twig-cutting experiments on 11 individuals of *F. sylvatica* to study their leaf-out behavior under different day length treatments and simulated climate warming (A). Results show that there is marked variation in day-length sensitivity among individuals (B). Individual differences explained >50% of the variation in leaf-out dates (under natural day-length conditions) (C). Growth chamber experiments showed that, under short winter conditions (SWC), individuals without day-length limitation were far better able to advance leaf unfolding than individuals strongly responding to day length. Under SWC, individual variation in the timing of leaf unfolding was twice as high as under long winter conditions (D).

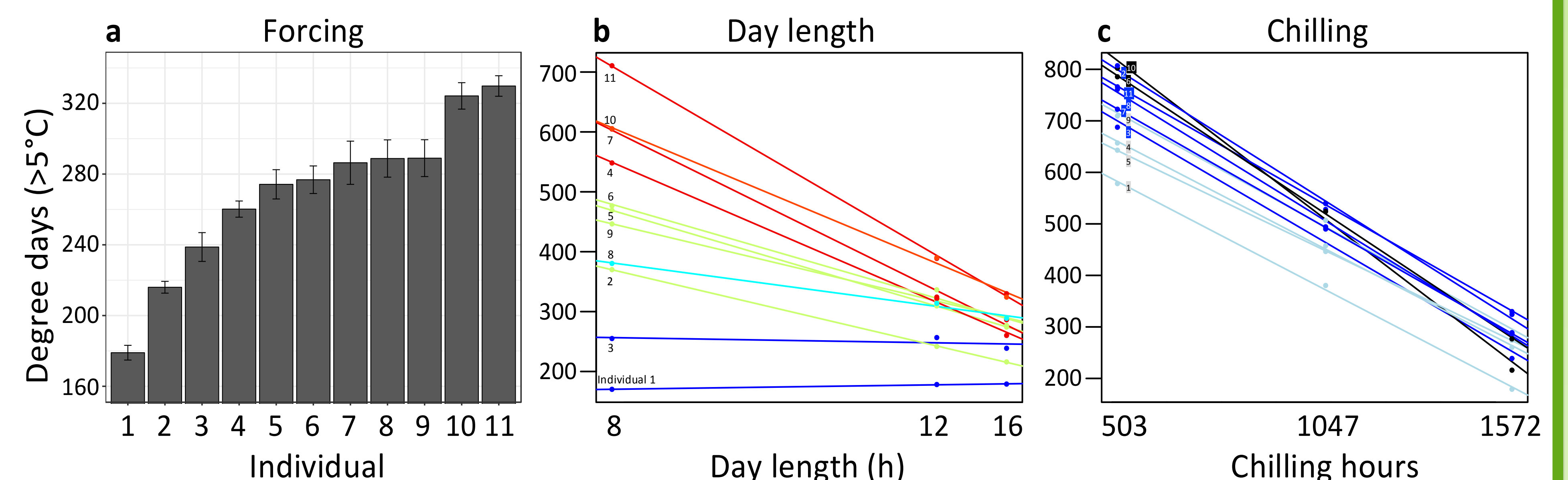
These results emphasize the importance of day-length sensitivity as a source of within-species phenological variation and suggest that climate warming will lead to increased local variation in the timing of leaf unfolding within *F. sylvatica*. Our finding that day-length-sensitive individuals are less able to track climate warming raises the question if day-length-sensitive or day-length-independent individuals will be favored under future climates, which are expected to lead to earlier, but less predictable spring conditions.



A Twig-cutting experiments

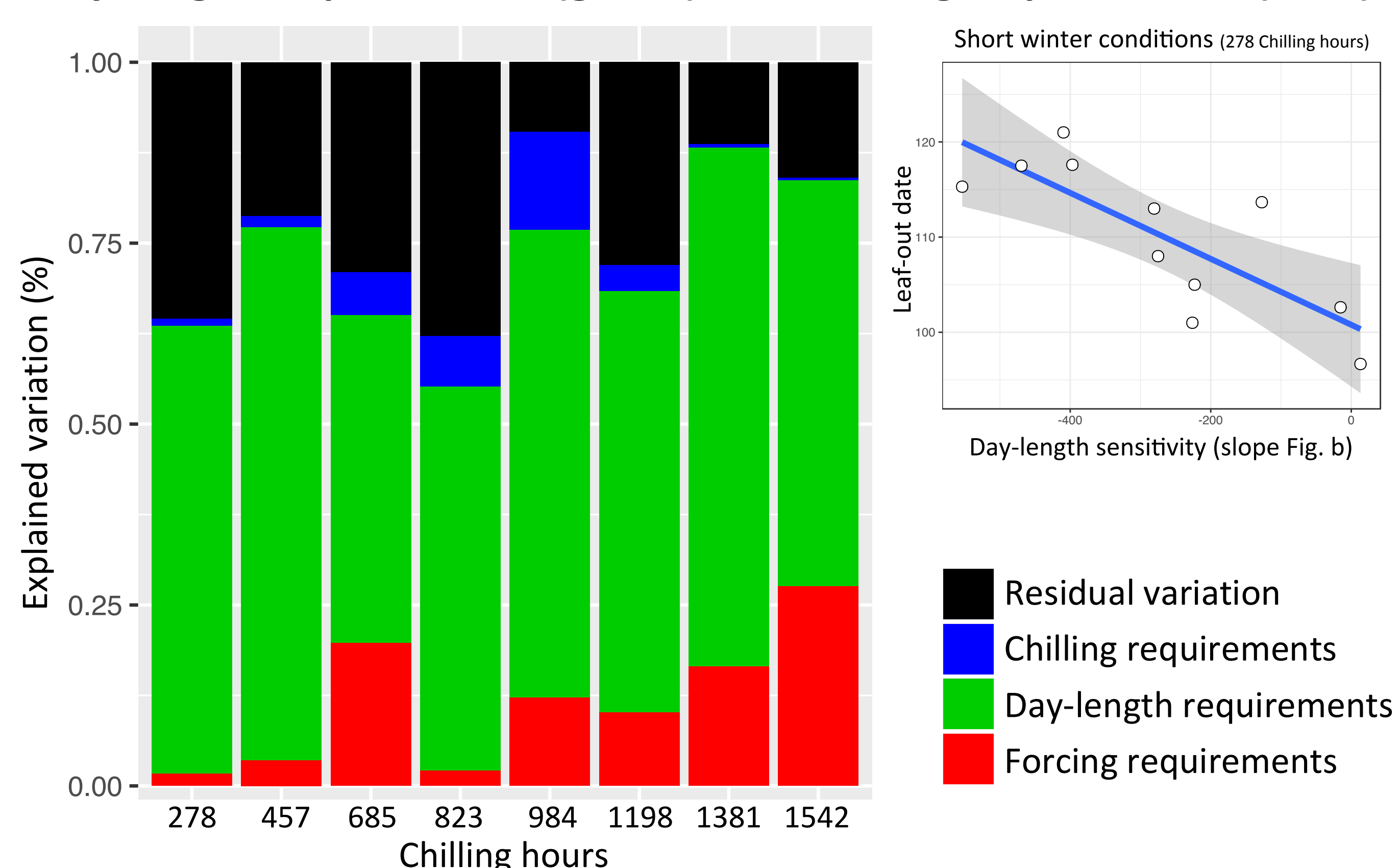


B Within-species variation in forcing (a), day-length (b), and chilling (c) requirements



- a, Degree days until budburst under long chilling and constant 16-h day length.
b, Degree days until budburst under 8-h, 12-h, and 16-h day length (and long chilling).
c, Degree days until budburst under short, intermediate, and long chilling (constant 16-h day length).

C Percentage of within-species variation in leaf-out date explained by individual forcing requirements (red), day-length requirements (green), and chilling requirements (blue)



D Within-species variation in leaf-out dates at different winter lengths

