

Limiting cues: How spring warming, winter chilling and daylength will shape climate change responses

THE LAB AS IT WAS IN 2017^{1,2}

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1 Overview of OSPREE

Studies versus papers ... how many crops versus wild species

We built the Observed Spring Phenology Responses in Experimental Environments (OSPREE) database, by searching both ISI Web of Science and Google Scholar the following terms:

1. TOPIC = (budburst OR leaf-out) AND (photoperiod or daylength) AND temperature*, which yielded 85 publications
2. TOPIC = (budburst OR leaf-out) AND dormant*, which yielded 193 publications

49 papers in budburst table ... here we present 84 of which 21 are focused on crops (*Actinidia deliciosa*, *Malus domestica*, *Vitis vinifera*, *Ribes nigrum*, *Vaccinium ashei*, *Vaccinium corymbosum*, *Prunus persica*). Studies spanned a variety of plant materials, though studies on ‘seedlings’ (51 studies) and ‘cuttings’ (55 studies) were most common.

2 Trends in experimental treatments over space

The actual cues studied varied across latitude with a general trend toward examining more extreme values at higher latitudes. Thus, forcing and chilling treatments decline 0.1°C per 1 ° latitude (for forcing, min is -0.1, for max it’s -0.06, see Fig S3; for chilling it’s -0.06 for min and -0.09 for max); and the maximum studied photoperiod increases with latitude (0.09 hr per degree ° latitude).

3 Comparing experimental treatments to forecasted trends

Treatment differences were calculated as the differences within varying forcing and chilling treatments within a single study (e.g., a study with a 1 and 4°C chilling treatment would yield a value of 3°C).

19 studies for *Fagus sylvatica* and 17 for *Betula pendula*,

136 total studies

4 References

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Supplemental Tables

Table S1: **Dataset names and references for papers in the OS-PREE database.**

Dataset	Reference
ashby62	(Ashby, 1962)
basler12	(Basler & Körner, 2012)
basler14	(Basler & Körner, 2014)
biasi12	(Biasi <i>et al.</i> , 2012)
boyer	(Boyer & South, 1986)
caffarra11a	(Caffarra & Donnelly, 2011)
caffarra11b	(Caffarra <i>et al.</i> , 2011)
calme94	(Calmé <i>et al.</i> , 1994)
campbell75	(Campbell & Sugano, 1975)
cannell83	(Cannell & Smith, 1983)
charrier11	(Charrier <i>et al.</i> , 2011)
chavarria09	(Chavarria <i>et al.</i> , 2009)
cook00b	(Cook & Jacobs, 2000)
cook05	(Cook <i>et al.</i> , 2005)
cronje03	(Cronjé <i>et al.</i> , 2003)
dantec14	(Dantec <i>et al.</i> , 2014)
devries82	(De Vries <i>et al.</i> , 1982)
falusi03	(Falusi & Calamassi, 2003)
falusi90	(Falusi & Calamassi, 1990)
falusi96	(Falusi & Calamassi, 1996)
falusi97	(Falusi & Calamassi, 1997)
fu13	(Fu <i>et al.</i> , 2013)
gansert02	(Gansert, 2002)
ghelardini10	(Ghelardini <i>et al.</i> , 2010)
gianfagna85	(Gianfagna & Mehlenbacher, 1985)
gomory15	(Gömöry <i>et al.</i> , 2015)
granhus09	(Granhus <i>et al.</i> , 2009)
guak98	(Guak <i>et al.</i> , 1998)
guerriero90	(Guerriero <i>et al.</i> , 1990)
gunderson12	(Gunderson <i>et al.</i> , 2012)
hawerth13	(Hawerth <i>et al.</i> , 2013)
hawkins12	(Hawkins & Dhar, 2012)
heide03	(Heide, 2003)
heide05	(Heide & Prestrud, 2005)
heide08	(Heide, 2008)
heide11	(Heide, 2011)
heide12	(Heide & Sønsteby, 2012)
heide15	(Heide & Sønsteby, 2015)
heide93	(Heide, 1993a)
heide93a	(Heide, 1993b)
howe95	(Howe <i>et al.</i> , 1995)
jones12	(Jones <i>et al.</i> , 2012)
junttila12	(Junttila & Hänninen, 2012)
karlsson03	(Karlsson <i>et al.</i> , 2003)
lamb37	(Lamb, 1948)
laube14a	(Laube <i>et al.</i> , 2014a)
laube14b	(Laube <i>et al.</i> , 2014b)

Table S1: **Dataset names and references for papers in the OS-PREE database.**

Dataset	Reference
li05	(Li <i>et al.</i> , 2005)
linkosalo06	(Linkosalo & Lechowicz, 2006)
man10	(Man & Lu, 2010)
manson91	(Manson & Snelgar, 1991)
morin10	(Morin <i>et al.</i> , 2010)
myking95	(Myking & Heide, 1995)
myking97	(Myking, 1997)
myking98	(Myking, 1998)
nienstaedt66	(Nienstaedt, 1966)
nishimoto95	(Nishimoto & Fujisaki, 1994)
okie11	(Okie & Blackburn, 2011)
pagter15	(Pagter <i>et al.</i> , 2015)
partanen01	(Partanen <i>et al.</i> , 2001)
partanen05	(Partanen <i>et al.</i> , 2005)
partanen98	(Partanen <i>et al.</i> , 1998)
pettersen71	(Pettersen, 1972)
pop2000	(Pop <i>et al.</i> , 2000)
ramos99	(Ramos & Rallo, 1999)
rinne94	(Rinne <i>et al.</i> , 1994)
rinne97	(Rinne <i>et al.</i> , 1997)
ruesink98	(Ruesink, 1998)
san-perez09	(Sanz-Perez <i>et al.</i> , 2009)
san-perez10	(Sanz-Pérez & Castro-Díez, 2010)
schnabel87	(Schnabel & Wample, 1987)
skre08	(Skre <i>et al.</i> , 2008)
skuterud94	(Skuterud & Dietrichson, 1994)
sogaard08	(Søgaard <i>et al.</i> , 2008)
sonsteby13	(Sønsteby & Heide, 2013)
sonsteby14	(Sønsteby & Heide, 2014)
spiers74	(Spiers & Draper, 1974)
swartz81	(Swartz & Powell Jr, 1981)
thielges75	(Thielges & Beck, 1976)
viheraaarnio06	(Viherä-Aarnio <i>et al.</i> , 2006)
webb78	(Webb, 1977)
worrall67	(Worrall & Mergen, 1967)
yazdaniha64	(Yazdaniha, 1967)
zohner16	(Zohner <i>et al.</i> , 2016)

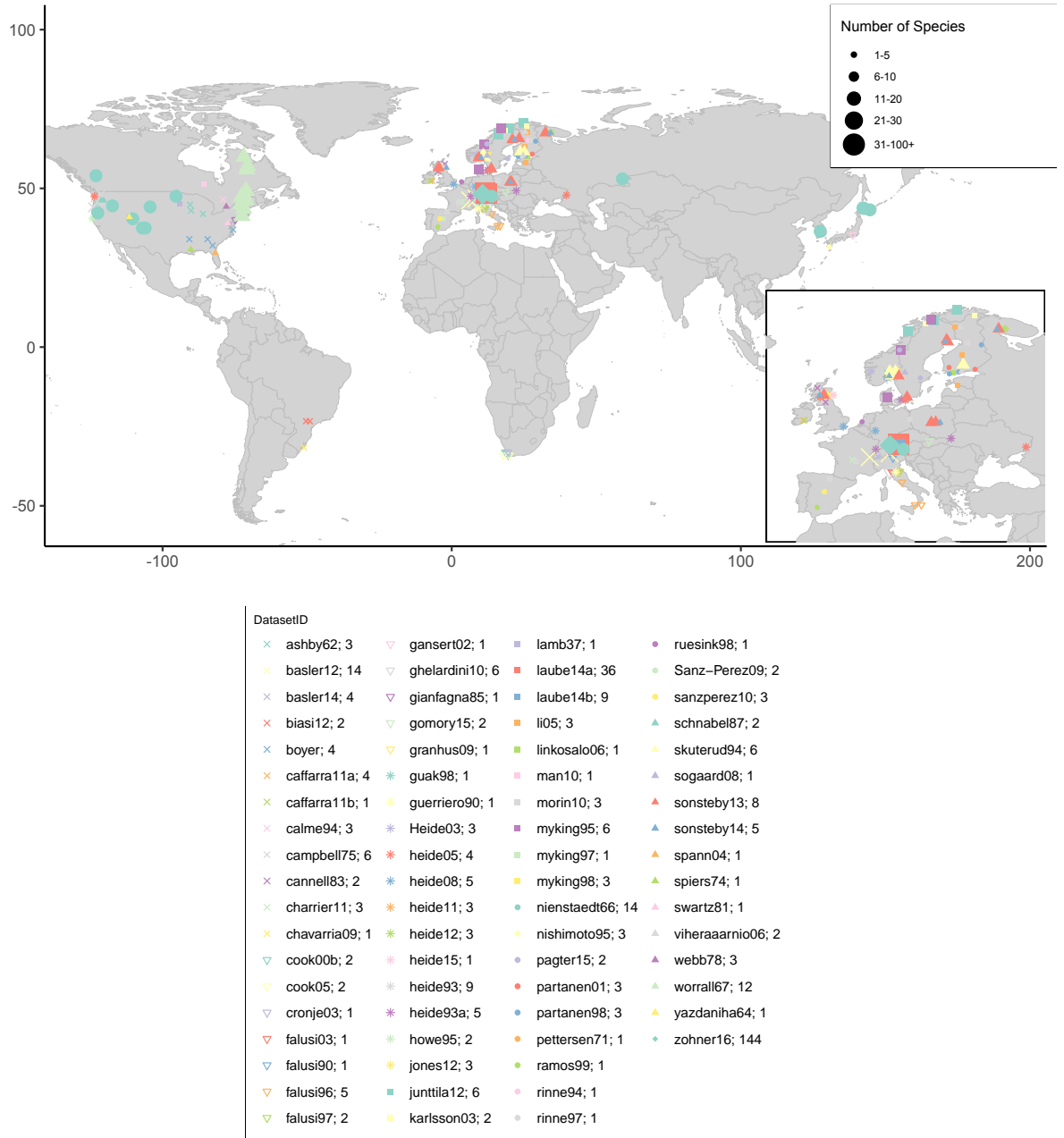


Figure S1: We review seven decades of controlled environment studies, from Lamb (1948) to Zohner *et al.* (2016), conducted across the globe generally on 1-3 species in each experiment (size of circles and exact number of species given after each study).

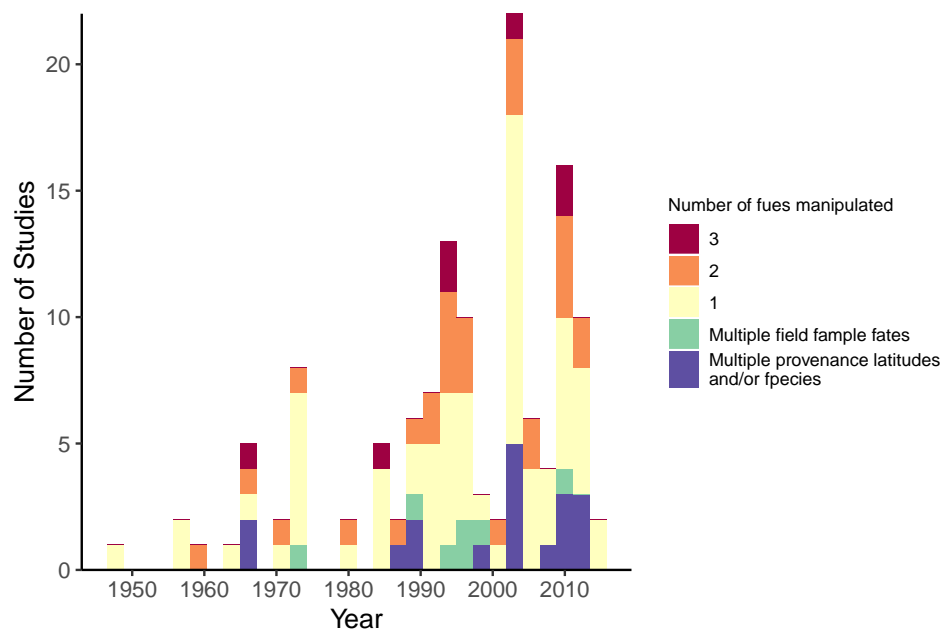


Figure S2: Cues manipulated over time.

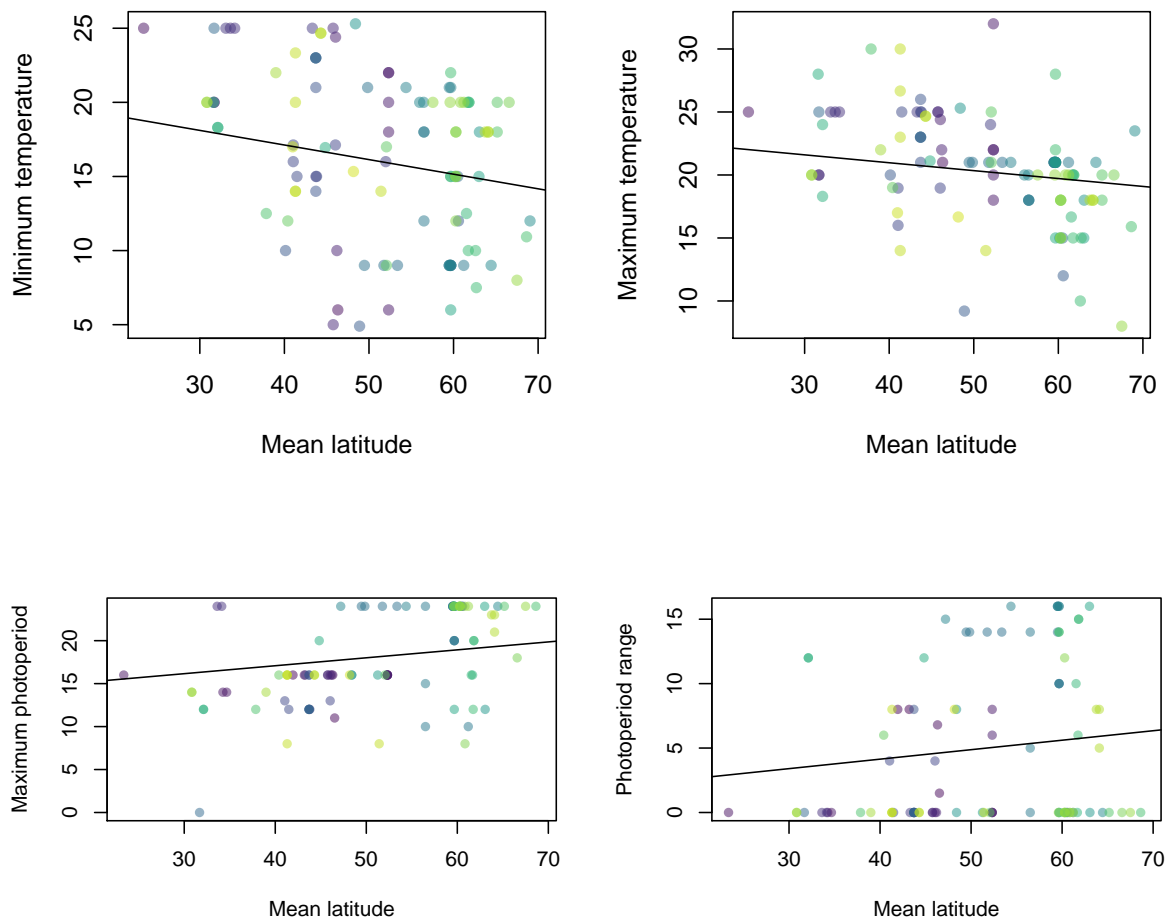


Figure S3: Some correlations with latitude plots.