Evolutionary history—more than phenological cues—explain temporal assembly of woody plant communities

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Introduction

1. Climate change = altering the timing of life history events across the tree of life.
   (a) But see high variability in phenological shifts between species and habitats
   (b) E.g. plants understory species often budburst earlier than canopy trees—while within a habitat individual bird species can vary their reproduction by several months
   (c) Understanding relative importance of environmental versus species traits to phenology = needed to understand and predict future impacts of climate change and ecosystem services—carbon sequestration, species interactions
2. While phenological variation often attributed to species-level differences—considerable influence of geographic variation in environmental cues as well
   (a) Phenotypic differences—physiological traits and growth strategies—allow species to vary timing of phenological events and optimize their temporal niche.
   (b) But within species could still get local adaptation = population differences due to gradients in environmental cues
   (c) Declines in both temperature and photoperiod with latitude have the potential to create similar gradients in cues across populations.
   (d) But still unclear what the relative effects of population versus species-level variation in shaping phenology and communities overall.
3. Spring budburst offers an excellent system to study the drivers of phenological events.
   (a) Decades of work = under controlled environments budburst cues are consistent.
   (b) Woody plants = cool winter and warm spring temperature cues, and daylength
   (c) Cues can also have interactive effects—provide compensatory mechanisms if individual cues are insufficient
   (d) While in nature phenology is highly variable—its consistency in experimental settings provides unique opportunity to test for generalizable trends across cues and communities.

4. Differences in cues shape forests adaptive potential, altering the competitive landscape across the growing season = determining species diversity and persistence.
   (a) Understanding these mechanisms is critical as global warming is disproportionately affecting high latitude communities
   (b) Warmer temperatures could = lead to faster accumulation of temperature cues and greater advances in phenology
   (c) But, species with strong photoperiod = reduced fitness—ability to adapt constrained by constant photoperiod cues
   (d) Identifying the ways in which climate change will reshape forest communities is needed to predicting the changes to forest communities likely to arise across species ranges
5. While climate change effects on temperature cues are recent, we must account for the longer timescales over which communities assembled—historic conditions shaped traits, like phenology, that we observe today.
   (a) More closely related species may express similar phenotypes—including their phenological traits—than more distantly related species.
   (b) But different species have experienced different historic cues, possibly driving variation in phenotypes and cue responses.
   (c) To better predict responses and community assembly w/ climate change = must account for species history and the present cues driving budburst.
6. In this study we:
   (a) Combined results from two growth chamber studies of woody plant phenological cues
   (b) Data from four populations, from eastern to western North America and a range of 4-6° latitude
   (c) Allows us to detect general trends in how bb of N Am. deciduous forest communities respond to forcing, chilling, photoperiod
   (d) But also community specific responses—detect differences between Western and Eastern forest communities, and at different latitudes
   (e) And trends across different functional groups, exploring differences between the shrubs that dominate the forest understory and tree species.