Traitors intro

March 6, 2023

1. Spring phenology is ecologically important shaping both ecosystem services and community dynamics
   (a) timing of start of the spring defines the start and overall length growing season = potential for forest carbon storage
   (b) also shapes competitive interactions and the abundance and identity of herbivores and pollinators
   (c) Climate change is shifting these things — changing cues and causing many species to start growing earlier
2. Amidst these trends, spring phenology is highly variable across years and species
   (a) For example, in one of the most well studied systems, forests, we see the budburst and leaf out of understory plants first, followed later in the season by budburst of taller trees
   (b) We have long known inter-annual variation is driven by shifts in temperature and recent advances underscore this (cite Flynn, and Laube)
   (c) These advances have also identified important differences across species, but have provided limited reasons for species differences
3. Within a community different species can start growth each year across several weeks, and will thus experience different selective pressures.
   (a) Species that bb early in the spring = greater abiotic pressures, such as risk of false spring events and frost = potential loss of tissue, but benefit from more light and resource availability
   (b) Late spp have greater selection from biotic pressures = less light available and competition for resources
4. These selective pressures could shape lots of plant attributes ....
   (a) early would thus mean cheap tissues a plant could replace
   (b) late would be costly tissues better at resource acquisition
   (c) these traits (or trade-offs) relate to a full framework about this ...
5. trait ecology's goal = predict sp-level characteristics by traits alone could simplify to ”use traits to predict [stuff]” but i do think it's important to acknowledge that the traits are often pretty distal to the processes they are supposed to capture
   (a) Many leaf and wood traits follow predictable gradients in their trait values, having associations that range from acquisitive (fast) growth strategies to more conservative (slow) growth strategies.

   (b) Collectively, these trait relationships led to the development of the leaf economic spectrum and the wood economic spectrum
   (c) These frameworks have been built into decades of research linking functional traits to species responses to abiotic and biotic factors and community assembly
   (d) But these frameworks have limitations ...
   (e) one is that they don't predict how variable are traits .... this is sometimes used to explain why phenology not incl. in traits
   (f) Integrating phenology within functional traits could both advance the functional trait framework and potentially help explain why species have different phenologies ...

6. As outlined above, early to late season differences in selection pressures — where early season species have high access to resources but risk tissue loss and damage, whereas late season species experience a highly competitive but less environmentally risky environment – would predict variation in leaf and wood traits with phenology.
   (a) Shrubs and other woody understory species that tend to budburst earlier— soil resources and light availability is greatest— would have traits associated with acquisitive growth: shorter, with leaf traits favourable to higher light availability and tolerance of late spring frost (high SLA, high LNC)
   (b) Canopy species that budburst later must be better competitors, and so would have traits associated with conservative growth: taller—requiring greater wood densities, low SLA and LNC.
   (c) This acquisitive to conservative continuum for early to late species may also predict seed size to increase with later budburst.
   (d) This gradient of early-late = driven by cues: early species are low force/chill/photo, later species are high chill or photo or both and likely higher forcing
7. We used available trait data from trait databases and bb data from the OSPREE database of controlled environment studies of woody plant species to test for associations between budburst responses to environmental cues and common functional traits
   (a) Focus on the effects of forcing, chilling, and photoperiod cues and four commonly measured traits — SLA, LNC, height, & seed mass
   (b) Our model attributes phenological variation (day of bb) to species' trait values while including residual variation from species (partial-pooling).
   (c) When traits explain a significant portion of the variation, spp will explain only a small amount — may be able to predict spp growth strategies and phenological responses from trait values.

Angert lab meeting comments about methods and results

1. Generally thought intro was too long, suggested combining paragraphs 1 & 2, 6 & 7
2. Fredi pointed out we never mention freezing resistance
3. Natalie suggested an appendix for how we cleaned the data and a table of how many species/studies used to estimate the parameters in the model
4. Was not clear that the trait data and the OSPREE data were different studies, maybe stress this more
5. Colours should be changed - difficult to see the pale bands in fig 2 and the purple crosses in Fig 3

6. Indifference to having the conceptual fig above the fig vs in the intro
7. possibly add a figure of the response to cue on the y and species on the y - show the variation in response to cue by spp
8. possibly add a figure of the trait data to show that it does correlate with phenology the way we would predict
9. People questioned why we used species that are not the most extreme as the examples in our figures (ie the green is sometimes in the cloud of points).

Move to discussion or such ...

Timing of plant phenological events define species' temporal niche = the partitioning of resources across species over time (Gotelli & Granves 1996 - ch5).

1. temporal niche differences determine the abiotic environment during growth and biotic interactions – for example, competitive landscape and pressures from herbivory/disease.
2. Distribution of temporal niche within community influences its potential invasibility— invasive spp tend to be early bb with the can fill vacant niche space early in the season.

Despite the lack of integration between functional trait and phenological research, both are likely to shape species growth strategies
more constant light compensates for their slower overall growth rates.
Associations are intuitive but few studies have tested for similar gradients in growth strategies in phenological events across diverse species