*Lathyrus*

Stuff to do and notes

* Data from 1987-1996 in one file, and 2006-2017 in another one
* 1996: Some plants were used for an experiment, but we are not sure of what was done. There is a column called “treatment”, but there are no differences in any of the response variables among treated and non-treated plants. Therefore, all of them can be used 🡪 But keep track of the treated ones so they can be identified if problems arise
* Volume is calculated in mm3
* Selection models: number of intact seeds 🡨 phenology + n flowers + (volume?)
* Variables needed for each individual: three traits (phenology, n flowers [i.e. buds and flowers], volume), number of fruits, total number of seeds, number of predated seeds, measure of grazing (proportion of flowers removed). Values missing should be imputed using the corresponding set of years (i.e. either 1987-1996 or 2006-2017)
* We can later calculate, for each individual: fruit set (fruits/flowers), seed set (seeds/ovules), seeds per fruit
* Grazing was noted as proportion (or %) of biomass removed, but we need to get the proportion of flowers removed (more important for fitness). We can do that using information on number of shoots/bud counts in different dates.
* Data from 2006-2017: Sometimes there was grazing and FFD was taken from a newly produced shoot. We do not want to take that FFD into account but instead to calculate which will be the FFD if the original shoot had not been grazed.
  + If there is no FFD 🡪 impute
  + If the plant is grazed before FFD, and FFD was taken from a replacement shoot 🡪 impute
  + If the plant is grazed before FFD, and FFD was taken from a non-grazed, original shoot
    - And >= 50% original shoots remain 🡪 use
    - And < 50% original shoots remain 🡪 impute
* Impute FFD using n flowers and volume (using data from the whole set of years)
* It takes more than 2 weeks after grazing until new shoots with flowers have developed and started to flower. Therefore, open flowers at dates less than 2 weeks after grazing should come from original shoots. However, FFD can still be biased as eaten shoots might have had an earlier phenology than the non-eaten shoots. Grazed shoots usually have on average an earlier phenology, but there is also a strong correlation among FFD of different shoots within an individual
* Data from 1987-1996: plants visited on different dates and when seen flowering for the first time, FFD was calculated as the mean among that date and the previous date, adjusted some days earlier or later depending on bud size on previous date and number of flowers open at current date (=FFD\_corr)
* Data from 2006-2017: here FFD is noted as the first date when the plant was seen flowering. We need to recalculate this as done before (=FFD\_corr):
  + For example, for plants seen flowering on 10/5 where the previous census was on 6/5, we can assign buds size XL to have started flowering on 7-8/5 and buds size L to have started flowering on 9-10/5.
  + Then buds size XL with higher number of flowers open on 10/5 would have started flowering earlier (i.e. on 7/5), while buds size XL with lower number of flowers open on 10/5 would have started flowering later (i.e. on 8/5).
  + In the same way, buds size L with higher number of flowers open on 10/5 would have started flowering earlier (i.e. on 9/5), while buds size X with lower number of flowers open on 10/5 would have started flowering later (i.e. on 10/5).
  + What if buds have different sizes but same number of flowers within size? 🡪 See each case… (draw line with dates etc. for each FFD noted in the file)
* With this method, we should get FFD with only ±1 day error
* Selective agents are: beetles (predation on seeds), grazers (removal of flowers) and pollinators (determine fruit and seed set, although this could also be related to resources)
* Bud size, n estimated flowers, cumulative n flowers open should not have been recorded in replacement shoots (but might have been sometimes – check)
* Fbuds, frukt 🡪 we do not need these columns
* Shoot volume
  + Ungrazed: Use diameters and sizes for each shoot
  + Grazed
    - All shoots grazed: Use diameters of grazed shoots if available (and for sizes, re-estimate using correlation among diameter and size), otherwise use diameters and sizes of replacement shoots
    - Some shoots grazed: Use diameters of grazed shoots and sizes of largest intact shoots up to the right number of shoots at the time of grazing
* Total n blm = best estimate of number of produced flowers 🡪 Use for ungrazed, for grazed 🡪 check and estimate when needed
* LFD 🡪 use but add half the subsequent recording interval (=LFD\_corr)
* Start: Work with data from year 2006 only
  1. Create a column to mark where FFD is taken from a new shoot (grazed ones)
  2. Calculate FFD as done in earlier years (=FFD\_corr, not in plants where FFD is taken from a new shoot)
  3. Impute values of FFD in plants where it was taken from a new shoot (but wait and use regression with all years in set 2006-2017?)

QUESTIONS:

* Paper 1: Are there differences in selection (gradients) on flowering time among years? Who mediates selection for early / late flowering? Is this related to grazing, seed predation, temperature…?

Grazers tend to select for (late?) flowering (more grazing on the early ones?), but selection by seed predators is inconsistent among years

Get temperature data from nearest weather station – probably will have data for each day

Mean FFD could also indicate if it is a warm or cold spring, and then we could use it to assess the effect of climate 🡪 maybe check this by correlating mean FFDs with weather data

* Paper 2: Are there differences in selection on flowering time among populations or is selection consistent among them? Is it driven by the same factors in all populations?

Use another dataset with 8-9 years from other sites

* Paper 3: Is there selection on (elevation and/or slope of) reaction norms (of flowering time against temperature) instead of on flowering time?

Each individual might react differently to changes in temperature among years (and within a year!), and as there is data on the same individuals for several (many) years, we can plot for each individual flowering time (FFD) against temperature (mean of… think about). From here we get a reaction norm and we can calculate its elevation and slope. We then can use these as covariates in our selection models (instead of phenology), and see if there is selection on them mediated by different agents.

* Paper 4 (would be another 3 papers): Data on demography from ? + vegetative phenology + flowering phenology – Relation among vegetative and flowering phenology? Selection on them?

READ (again?)

Ehrlén, J. (2002). Assessing the lifetime consequences of plant-animal interactions for the perennial herb *Lathyrus vernus* (Fabaceae). *Perspect. Plant Ecol. Evol. Syst.*, 5, 145–163.

Ehrlén, J. & Münzbergová, Z. (2009). Timing of flowering: opposed selection on different fitness components and trait covariation. *Am. Nat.*, 173, 819–830.