

When should a pathogen strike: navigating the landscape of birth pulses and mating season.

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Introduction

Seasonal variation in host life history events such as mating and birthing can lead to enhanced opportunities for pathogen transmission. However, for pathogens that also have a limited window for producing infectious propagules, the degree of overlap between these host life events could affect transmission. We developed a seasonal model of host life history to ask: “when is the best time to strike” for pathogens.

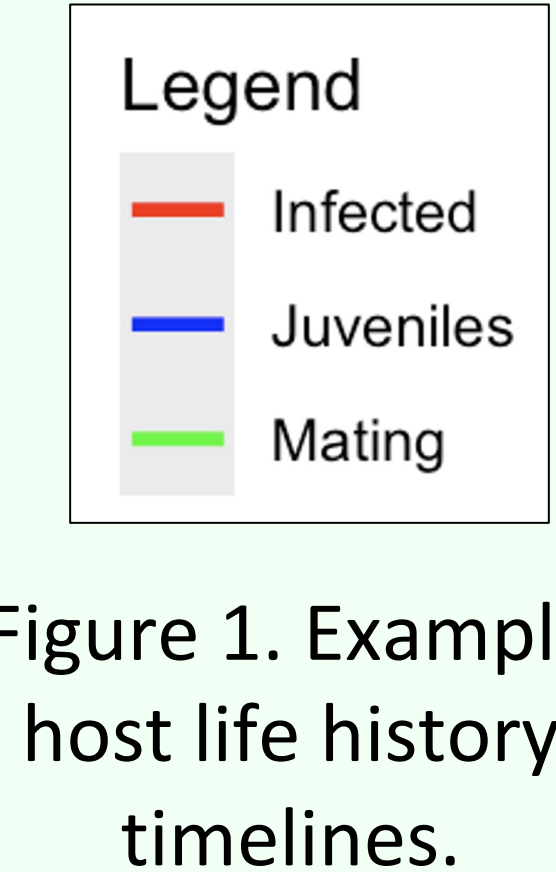
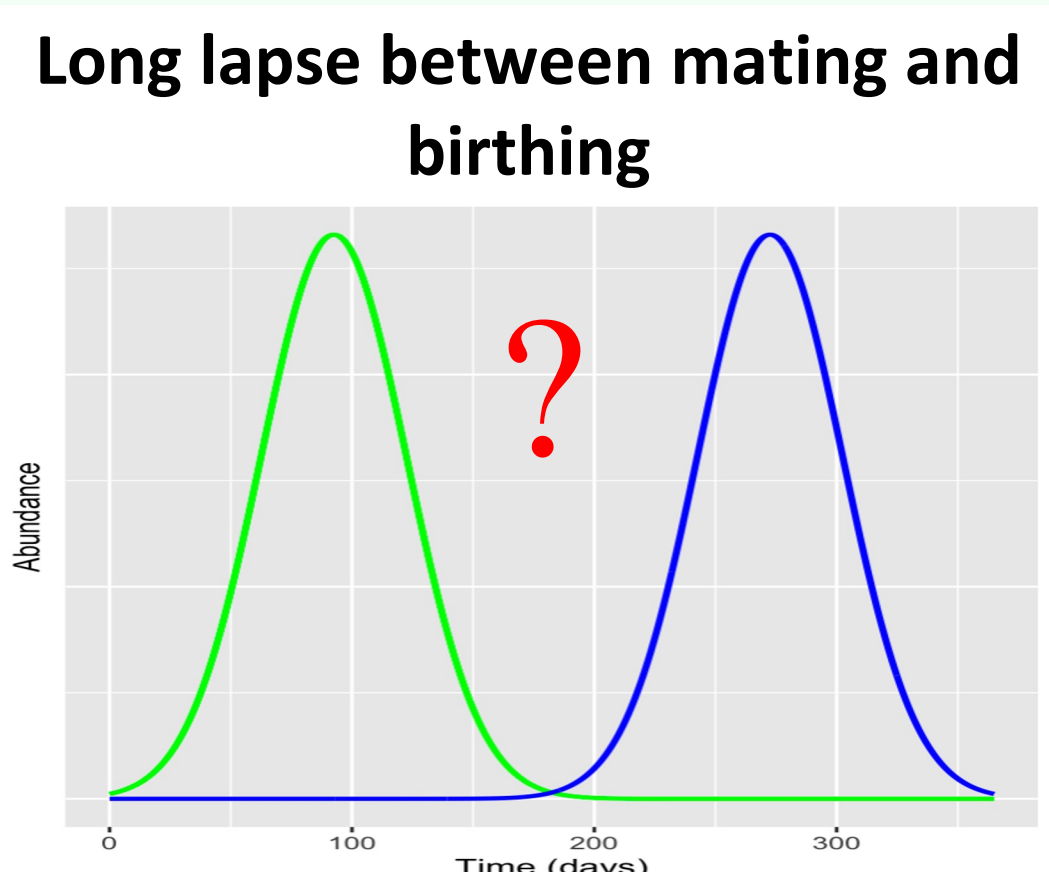
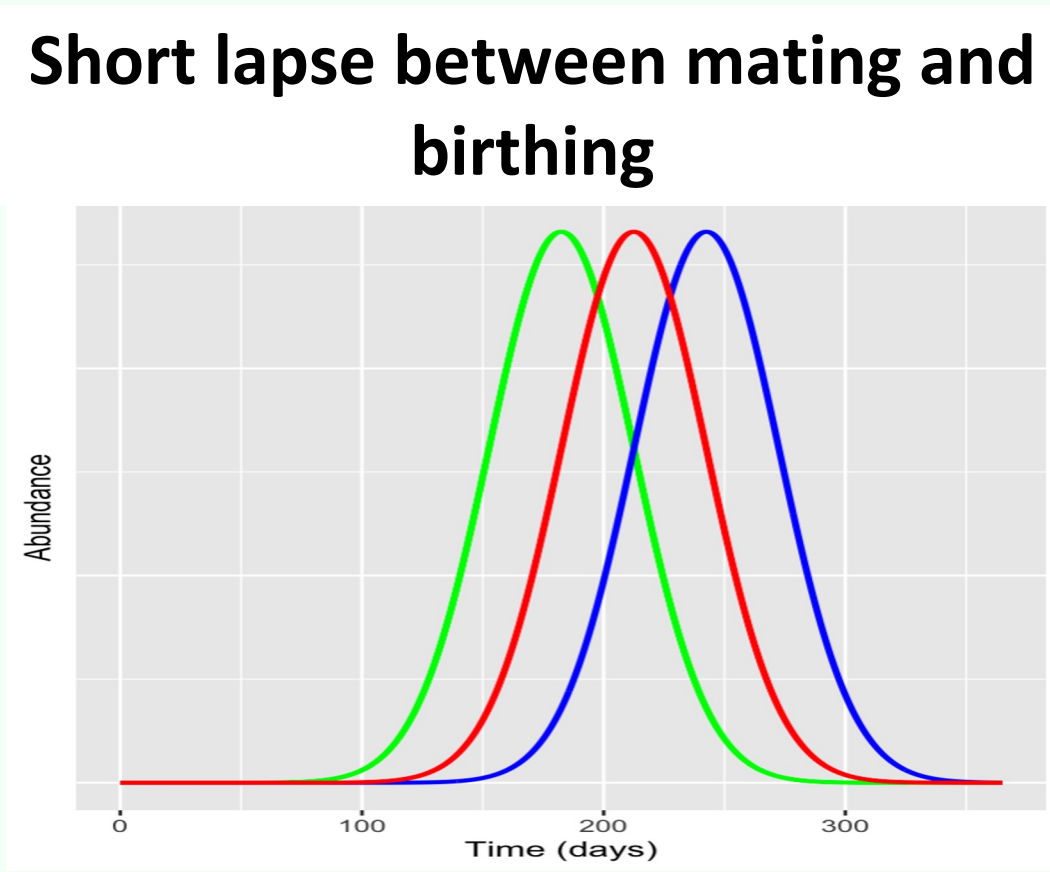
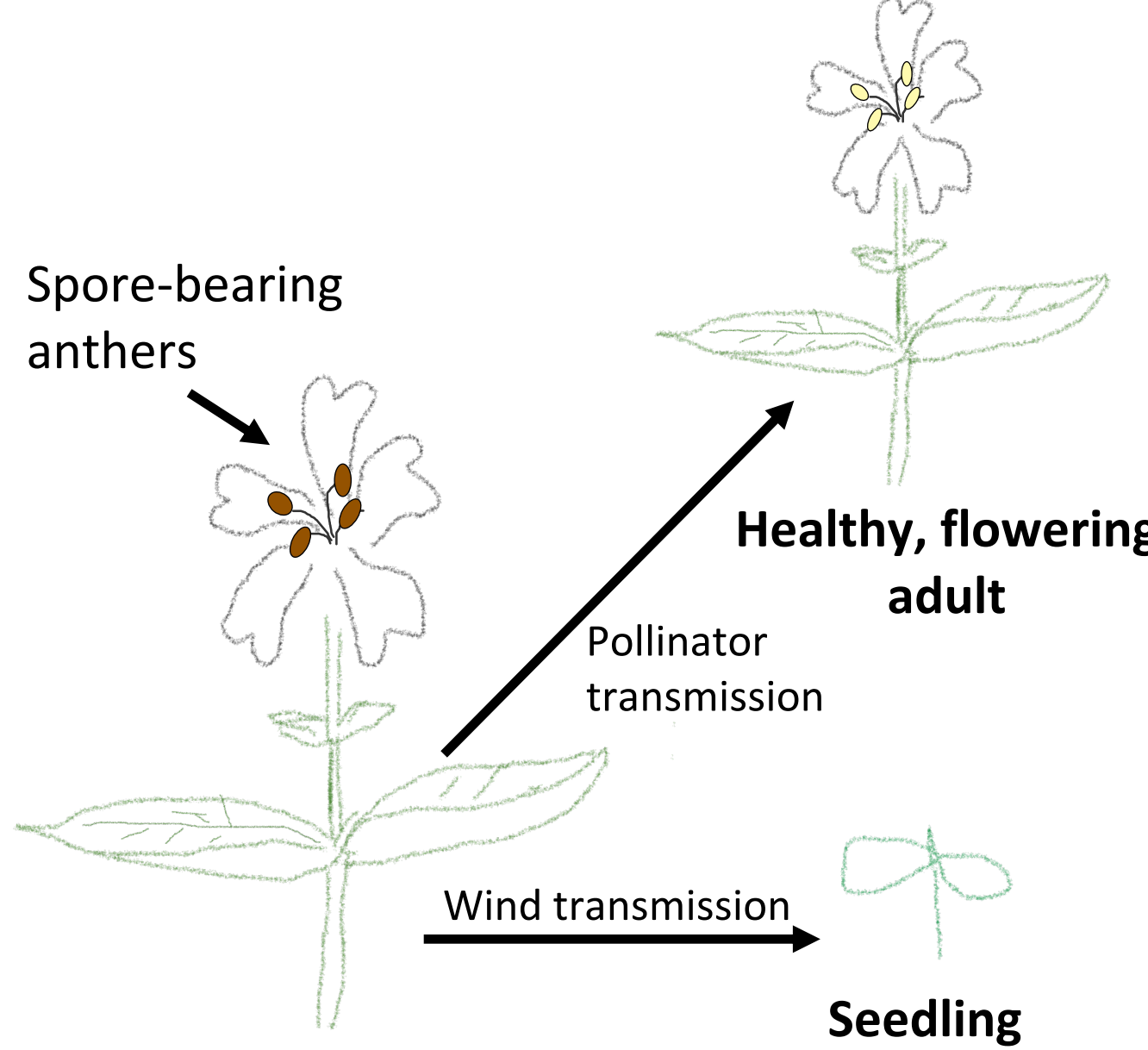


Figure 1. Example host life history timelines.

Anther-Smut Disease



- Caused by fungi in genus *Microbotryum*
- Spores produced in anthers, replacing pollen
→Transmission is linked to flowering period
- Sterilizing (no linked mortality)



- Infected plants can manipulate the onset of flowering in their hosts.
- In some species infected plants flower well before healthy plants.

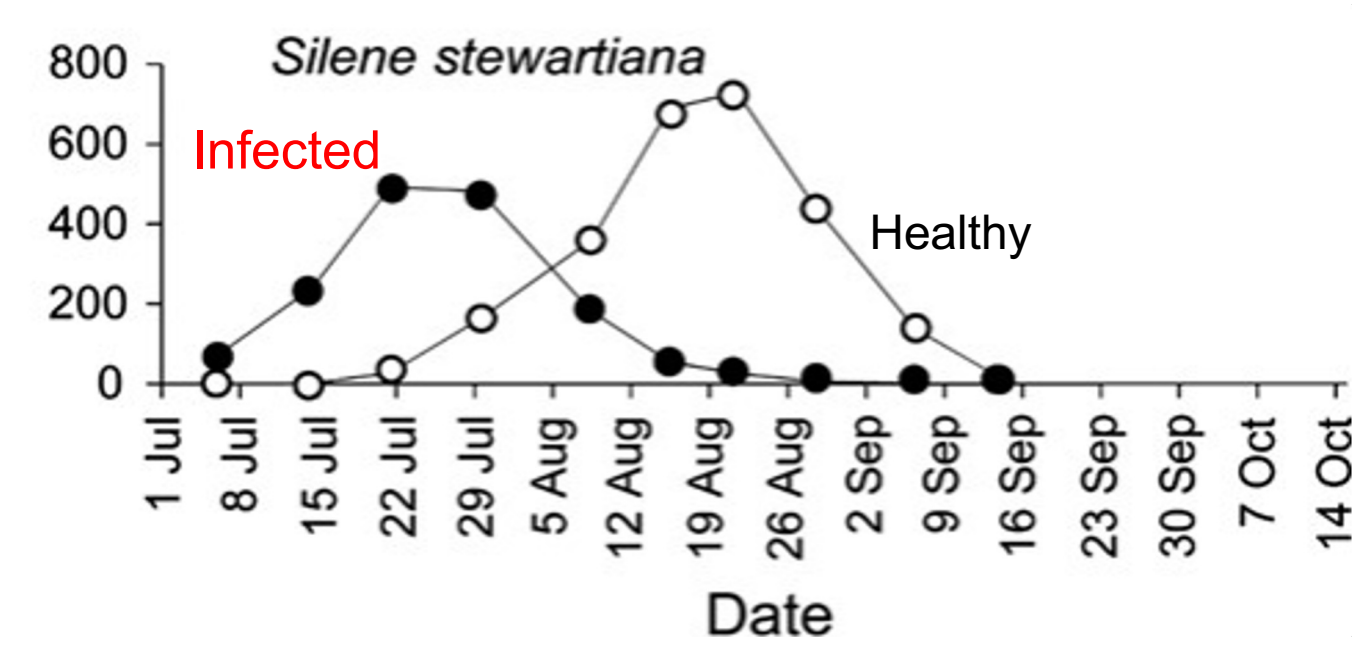


Figure 2. Natural phenology of Himalayan species ¹.

Question: When should infected plants initiate flowering to maximize transmission?

The Model

- Seasonal forcing to vary onset in sexual maturity and germination

- 4 age classes:
- Dormant (S_d)
 - Juveniles (S_j, I_j)
 - Sexually Immature (S_v, I_v)
 - Sexually Mature (S_f, I_f)

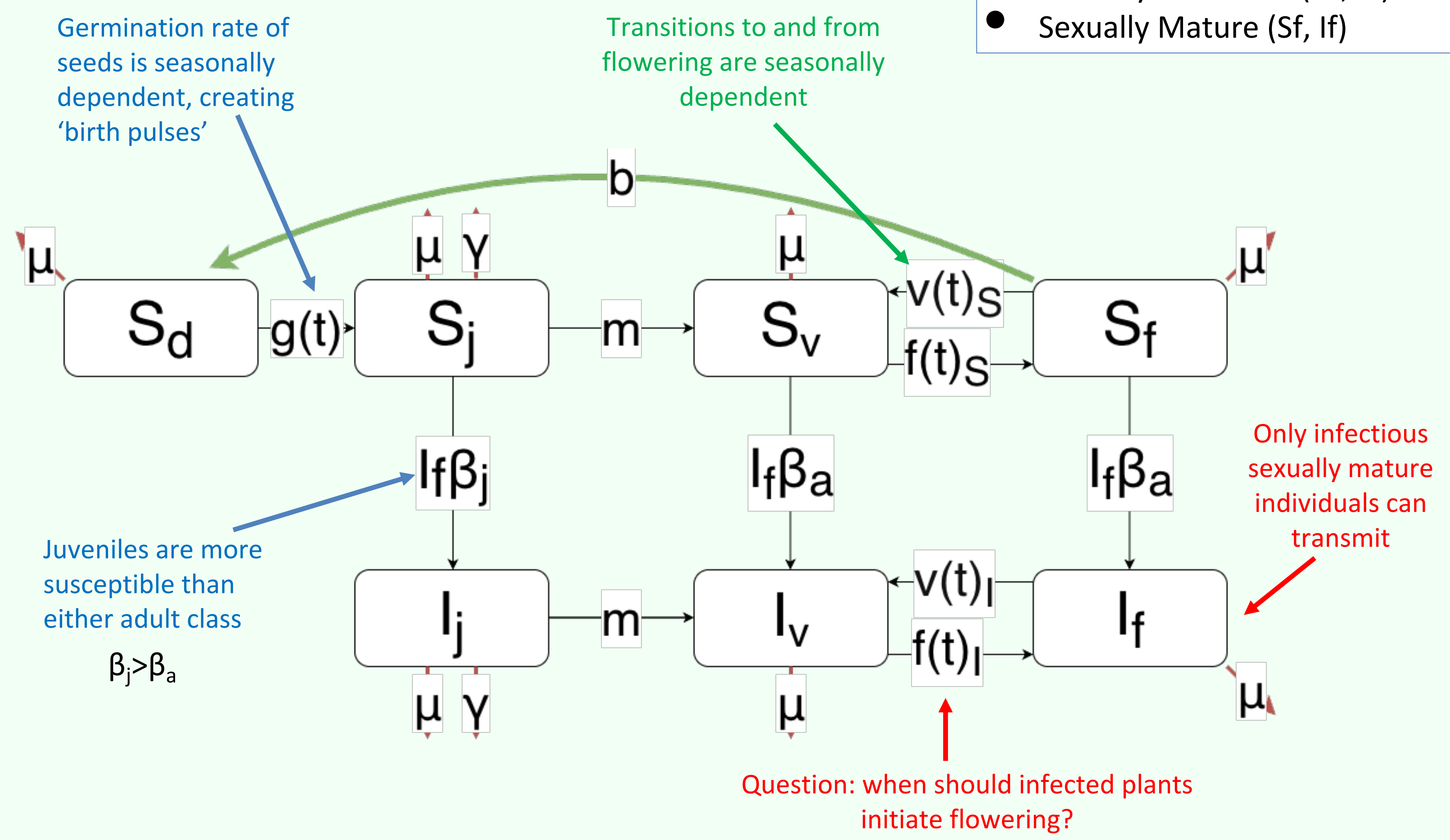


Figure 3. Diagram of the age-structured model.

Host Life History Affects Equilibrium

Seasonal life history differences can affect long term dynamics.

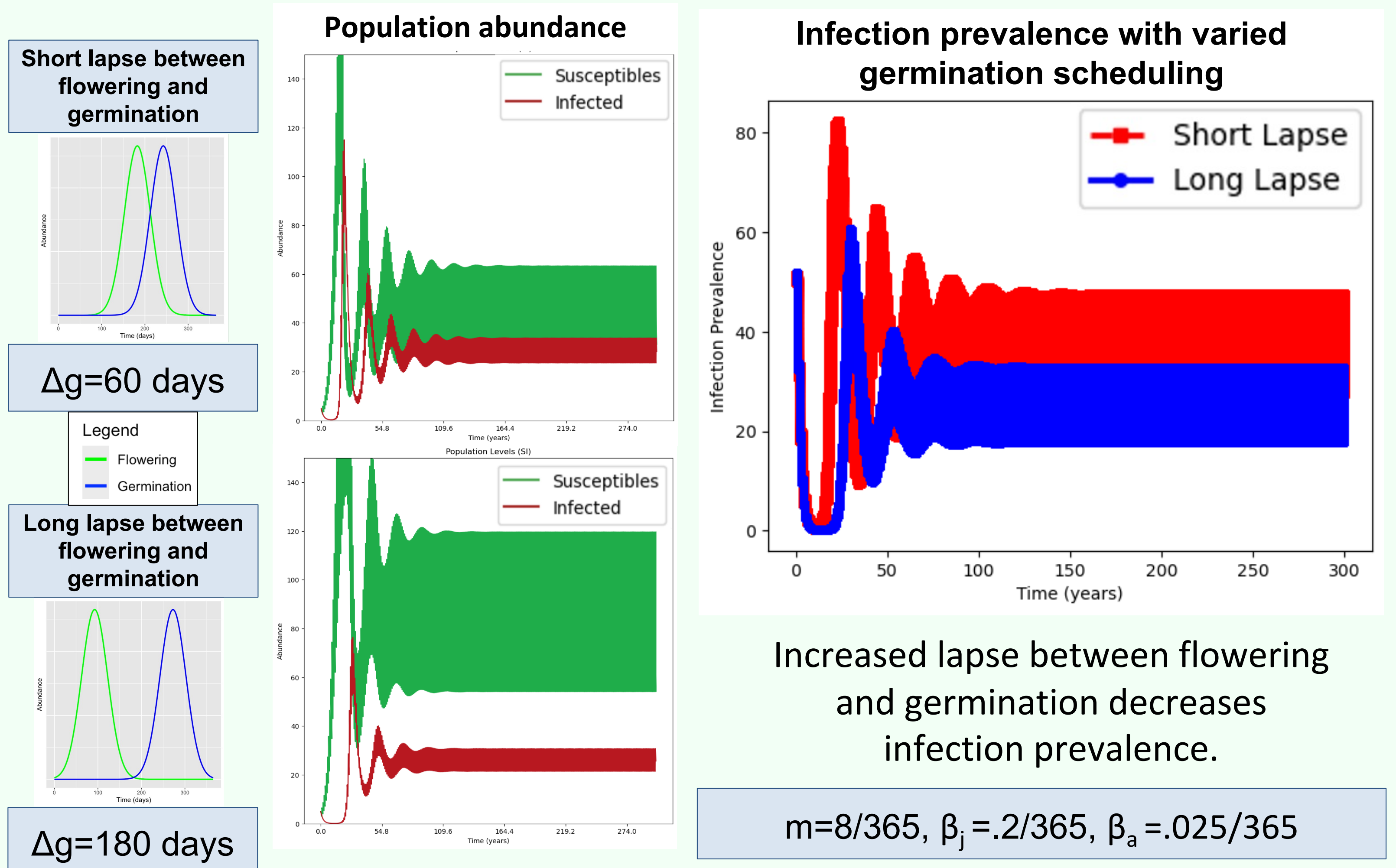


Figure 4. Example results for two different host life history schedules.

Results + Conclusions

- Kept healthy flowering constant and adjusted germination timing.
- Evaluated optimal timing for infectious flowering.

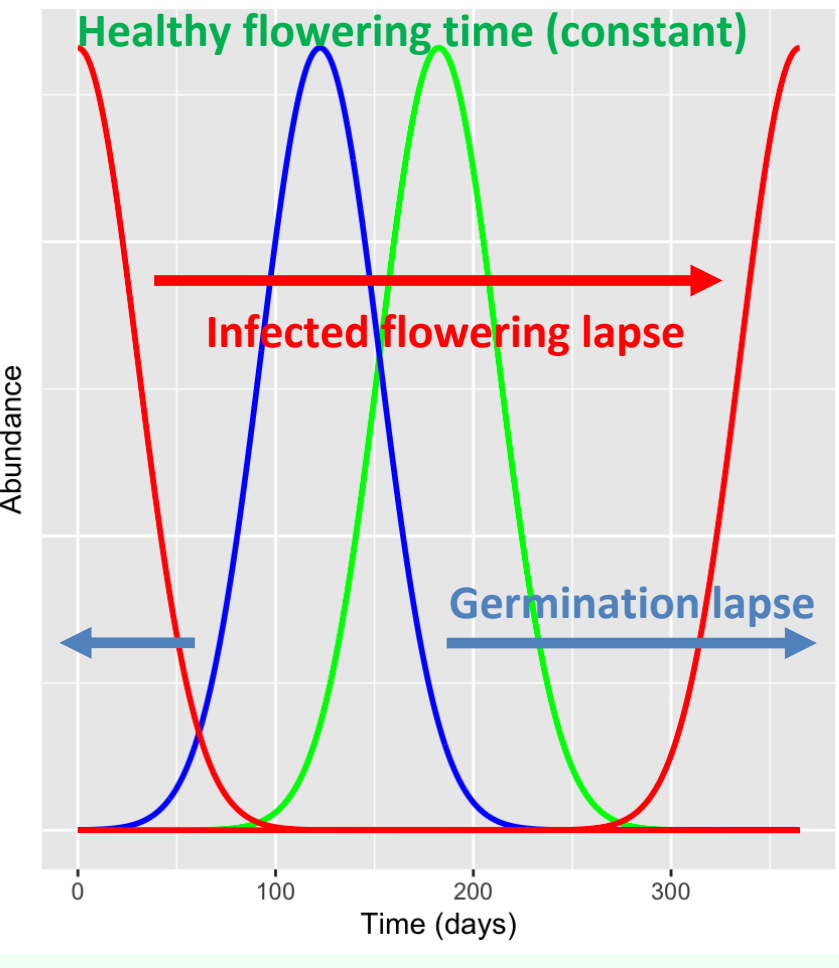


Figure 5. Rastering process.

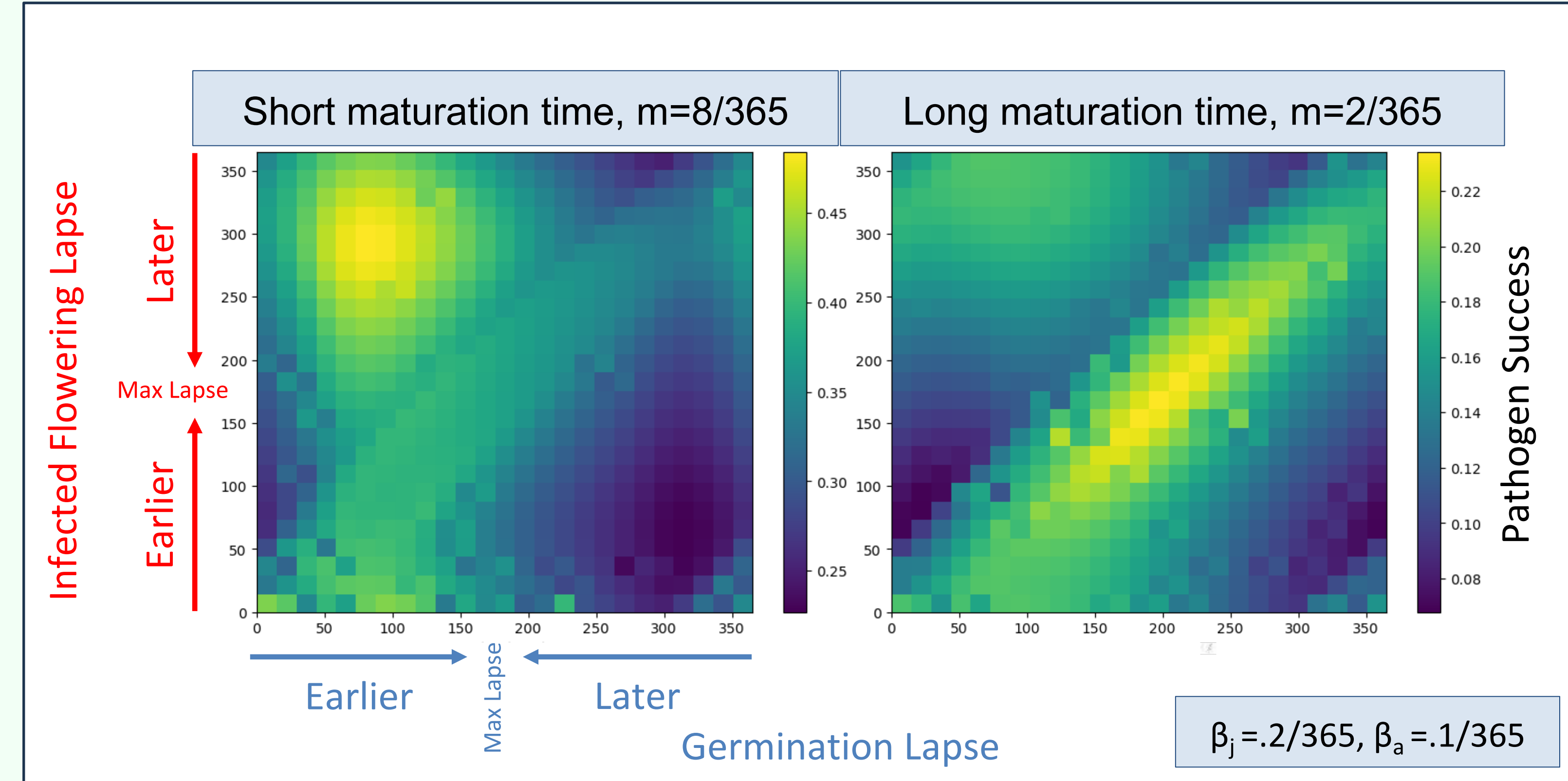


Figure 6. Finding optimal infection prevalence with varied infectious flowering and germination times.

- When host maturation is fast, optimal infectious flowering tracks the healthy flowering period.
- When host maturation is slow, optimal infectious flowering strongly tracks the germination period.

Future Directions

- Explore evolutionary dynamics of pathogen transmission timing using adaptive dynamics.
- Fit flowering times for different host species observed on iNaturalist to predict germination periods.

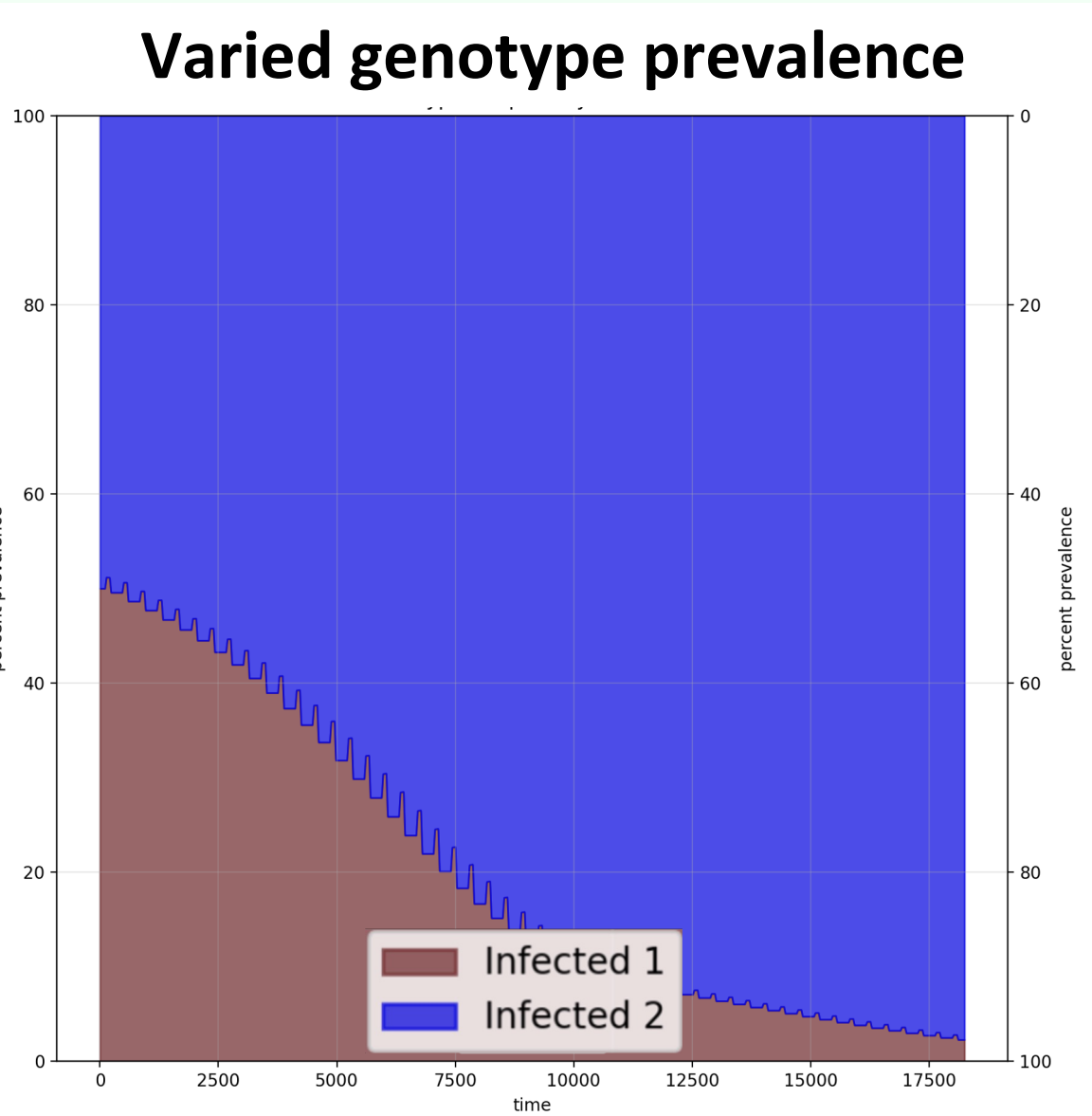


Figure 6. Allelic Invasion approach with separate pathogen genotypes.

References

¹ Tang et al. 2019.J. Evol. Biol. 32 451-462.