Modeling the Role of Self-fertilization in Assisted Gene Flow

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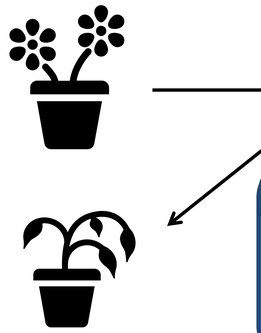
Introduction

As climates change, many plant populations struggle to keep up with new environmental conditions. Populations often lose genetic diversity, making it harder for them to adapt.

Assisted Gene Flow (AGF)
Intentional movement of individuals or genes from one population to another

Self-fertilizing (Selfing)
- When an organism uses its own gametes to reproduce
- May limit genetic diversity



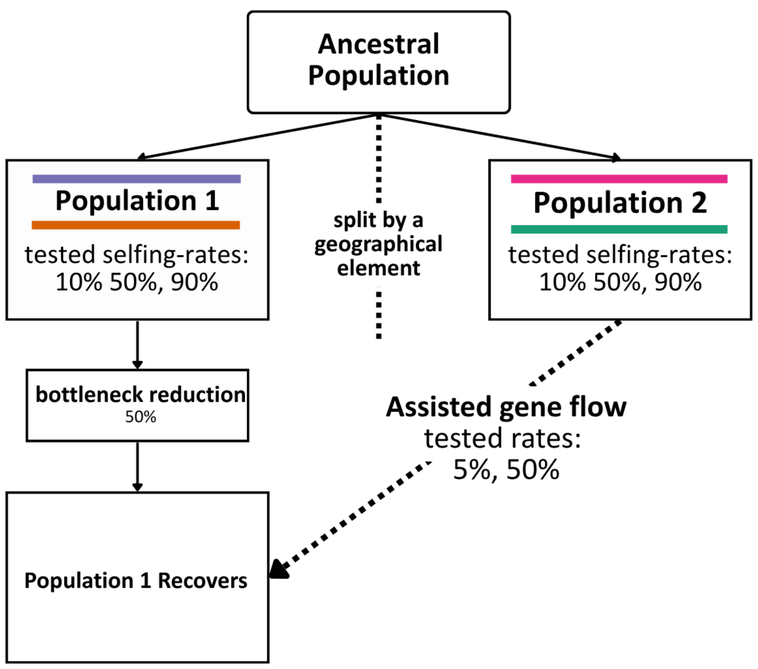
Outbreeding Depression
- Occurs when mixing genetically distinct populations lowers fitness
- Outbreeding depression in selfing plants may function differently

Objective

To use simulation modeling to test how varying selfing and AGF rates influence population fitness. By comparing fitness before and after Assisted Gene Flow (AGF), we assess in which scenario does gene flow promote or reduce adaptive potential in selfing plant populations.

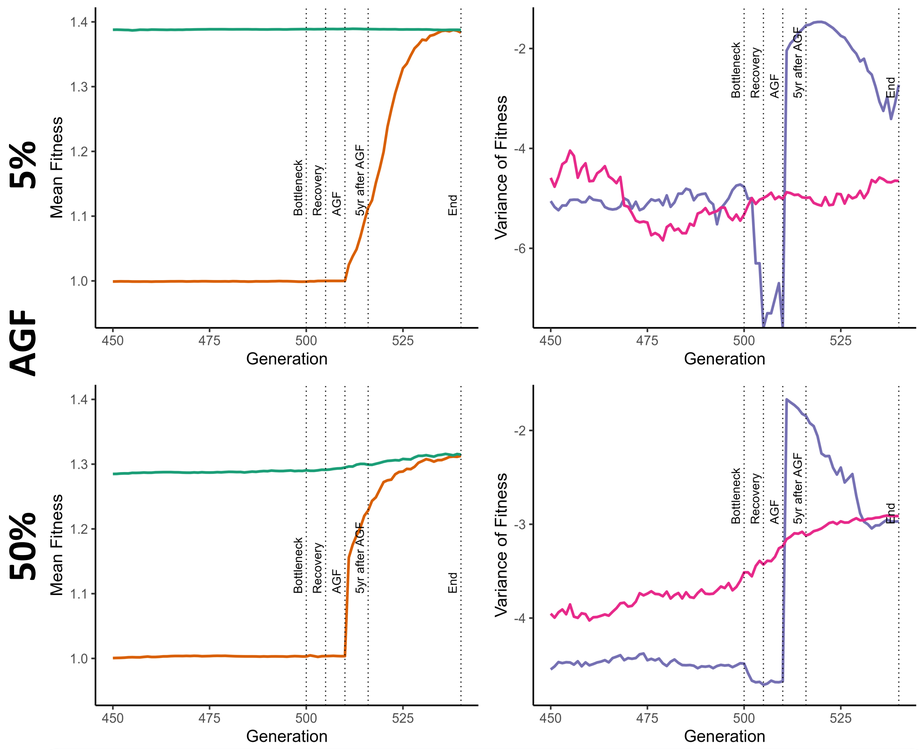
Methods

- Simulated plant populations under varying selfing and AGF rates.
- Recorded mean fitness (to measure adaptation) and variance of fitness (to assess genetic diversity).
- Compared outcomes before & after AGF across six total scenarios.



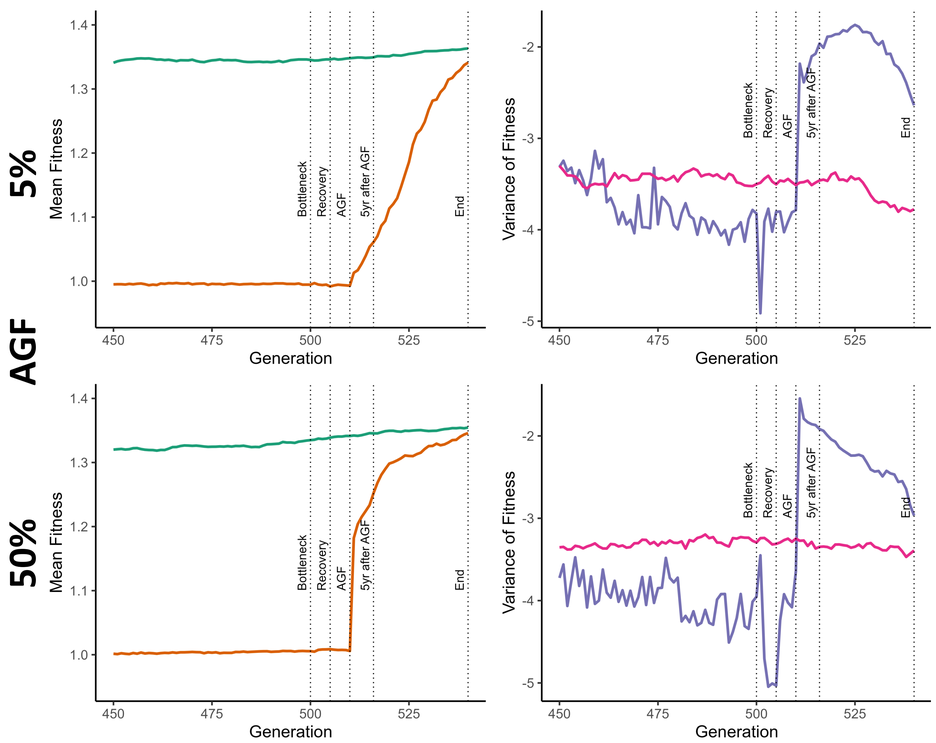
Selfing Rate 90%

High selfing (90%) populations gained short-term fitness benefits from AGF, **losing genetic diversity quickly**, reducing long-term adaptive potential.



Selfing Rate 10%

Low selfing (10%) populations maintained higher diversity and **sustained the benefits of AGF longer**, similar to or higher than the donor population



Findings

- **Both low (10%) and high (90%) selfing populations benefited from Assisted Gene Flow (AGF).** The average fitness increased after gene flow in all cases.
- The **rate of fitness improvement** depended on the **migration rate (AGF amount):**
  - At **5% migration**, fitness increased more strongly but took about **30 generations** to stabilize.
  - At **50% migration**, the benefit appeared **faster (≈5 generations)** but was smaller overall

Model Selfing Plant Populations

- Predict fitness outcomes
- Test migration rates
- Explore effects of selfing on genetic diversity

AGF Outcomes: Selfing and Migration Impact

- High selfing → lower long-term genetic diversity
- Low AGF → fast but small fitness gains
- High AGF → larger gains over generations

Context/Future Directions

- **Model extensions:** Add adaptive traits and environmental stressors (fire, drought, timing shifts) to better reflect real-world pressures.
- **Empirical validation:** Compare model outcomes with greenhouse or field data to test predictions of fitness and diversity.
- **Application:** Parameterize for Southern California species to guide restoration and Assisted Gene

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Simulation modeling was performed in SLiM (Haller & Messer, 2019).