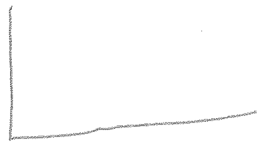
Aster Fitness Landscape.

$\boxed{2016}$

\# of Days to emerge



Dist. from Seed source (km)

- Prairie pop^{n}s closer to fitness optima are those furthest away geographically

GL-Alvar pop^{n}s are on top of fitness optima

Seed mass is response variable
Fitness estimate reflects 2016 Seed mass estimate
2016 - year of planting - possibility of transplant effect
Overall - 2016 fitness are low.
Note: gradients smooth - reflecting minimal diff across groups

$\boxed{2017}$ - Curvature of landscapes change in 2017, w/ steeper gradients among groups

- Pattern is consistent
- Peak in 2017 (but just GL-Alvar)

$\boxed{2018}$ - Peak of fitness landscape broadened - now all 3 regions occupy some portion of the fitness peak.

- MB-Alvar may be catching up to GL-alvar
- GL-Alvar is still increasing.
- Prairie is also slowly catching up.

How do these tie into plasticity? & h^2 gen. variation

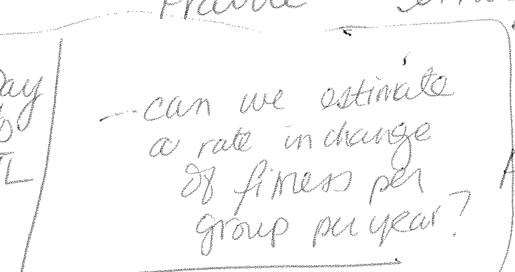
---

r vs. K strategy.

~~gen variatio~~ heritable gen variation for timing

Alvars - time emergence, grow like hell
Prairie - emergence & timing m
less heritable gen. var for timing.

Day to TL



- can we estimate a rate in change of fitness per group per year?

Day to Germ

Alvars - extreme environment, predictability
predictability selects for adaptive plasticity
Expectations for the evol^n of adaptive plasticity
(i) cues is reliable
(ii) environments vary

For Fitness landscape
→ is genetic canalization occurring?
→ given that MBA + PRA are catching up (diff. genotypes) are beginning to hit same fitness peak as GLA perhaps this may indicate genetic canalization

For fitness landscape → can we evaluate the occupancy of the peak?

→ 2018 - fitness landscape is not symmetrical - but becoming more oblong → so is capturing more variation in the distance to garden but is NOT changing in the timing of emergence that it's capturing
[x-axis is expanding, y-axis not so much!]

AND → emergence is one of more heritable traits so movement off the fitness peak for a genetically constrained trait has a heavy cost to fitness. (impact)

Broad theme: Testing ~~f~~for the evol^{n} of adaptive plasticity in heterogeneous environments.

Important references:
Acasuso-Rivero et al. 2019.

Discussion

P1 - Summary

- Evol^{n} of adaptive plasticity in response to varying environments w/ reliable cues. [overview sentence]
- ? Heritable gen. var imp. in predictable extreme environments (abiot) whereas plastic responses appear more prevalent for life history timing transitions in unpredictable environments.
- If emergence has strong genetic basis (high h^2) but environment in decreasingly predictable than there in ↑ likelihood of ~~mal~~ reduced fitness (or a fitness cost).
- ~~Proximity~~ Fitness can be maximized through a combination of heritable gen. variance + plasticity ~~in phenology~~.
- Indiv. can maximize proximity to fitness optimum by matching appropriate comb. of heritable + plastic traits given the degree environmental predictability

P2 - Gen. variance for phenological + life history traits

- Discuss variation in h^2 in early vs. late phenological transitions [compare w/in]
- 1st. Compare h^2 for phenological traits + those related to fitness (life history)
  - ↳ bring in discussion of the correlation btwn phenological traits + shift btwn regions [correlation figure]

2ND. Compare h^2 w/in early v late phenology
early v. late life history

~~B~~ P3 - Aster fitness discussion

- GL-Alvar always have higher fitness
  ↳ explained by shunting of resources to reproduction early in a perennial.
  caveat: escape from native stressful envir
- Y2 → Y3 GL-Alvars exhibit ~~orders of m~~ roughly double fitness estimates relative to Prairie

→ (1) Distinct regional fitness trajectory ~~across~~ across regions.

- MB alvar → catching up in Y3.
- Prairie exhibit slowest rate of increase
  → Discuss dist. of genetic variation & likelihood (or lack) of gene flow btwn Prairie ↔ GLAlvar & Prairie-MBA

P4 → Fitness landscapes

- Cooberation btwn fitness optimum & fitness estimates for GLA.
  → Prairie individuals that come ~~from~~ are geographically distant are closer to fitness optimum

major point: Distance from garden does not predict optimum
  → However, the fitness in Y1 is relatively flat
- This changes in Y2 where the landscape becomes steeper (greater diff. in isoclines) & the shape of the optimum is changing. The optimum now includes the MB alvars.

- Finally in Y3 again more oblong → x-axis captures more, but y-axis still limited

P5

-Wrapper summary (see Intro to Disc.) → ~~As~~ emergence is a heritable trait the genetic constraints of the heritable trait may impede indiv. ability to traverse trait space to achieve fitness optimum

P5 - Conclusion section.

- Geographic proximity does not necessarily predict fitness.
- Early <u>heritable</u> life history traits determine the degree to which indiv. exhibit a match or mismatch w/ later life history traits & their environment.
- These heritable traits may make it challenging to traverse ~~of~~ a fitness landscape.

- Within the context of climate change where we expect ↑ extremes, ↓ predictability we may expect ...?

Introduction

[Compensatory plasticity]

P1 Requirements for the evol^n of adaptive plasticy (in the context of climate change)

P2 • Importance of phenology (timing of life history events [Function value trait paper → Mason ref.] & consequences of mismatch (↓ fitness)

P3 Can plasticity in late life events compensate for genetically-determined mismatches btwn environ. & earlier life history events?

P4 This is our system, this is what we did.

P5 Sppecifically, we ask:

(i) Across a continuum of life history events is there variance in the heritability of life history traits? (higher h^2 than later)

↳ Are there fitness consequences to this?

(ii) Does the heritabsity of phenology & life history events affect the ability to traverse the fitness landscape & proximity to the fitness optimum?