



Variation in host-plant quality and herbivore population dynamics:

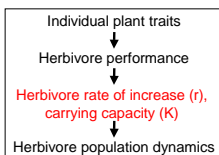
An unnatural history of herbivore population dynamic parameters

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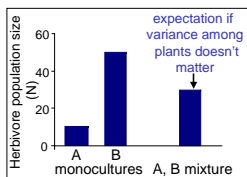


Introduction

The effect of plants on herbivore populations is mediated by herbivore population dynamic parameters, which may vary among plant genotypes (Underwood and Rausher 2002).



If variance among plants in r and K does **not** affect herbivore population size (N), N on a mixture of plant genotypes should be the average of N on monocultures of each of the genotypes in the mixture.

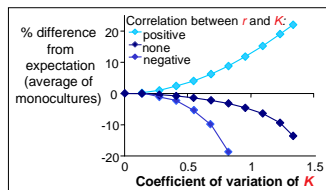


I used a simulation model of the effect of variance in herbivore population dynamic parameters among plants to ask if variance in r and K affect herbivore population size (Underwood 2004).

$$\frac{dn_i}{dt} = r_i n_i \left(1 - \frac{n_i}{K_i}\right) - n_i m - \frac{1}{j} \sum_{j=1}^j n_i m$$

The model shows that

- the amount of variance in herbivore r and K in a plant population can affect herbivore population size and
- the effect of variance depends on the correlation between r and K



An analytical version of this model (M. Donahue, et al. in prep.) shows more generally that the covariance between r and K influences the effect of variance in population dynamic parameters on population size.

$$\frac{d\bar{N}}{dt} = \bar{r}\bar{N}\left(1 - \frac{\bar{N}}{\bar{K}}\right) + \frac{\bar{r}}{\bar{K}}\bar{N}^2 \text{cov}\left(K, \frac{1}{K}\right) - \bar{N}^2 \text{cov}\left(r, \frac{1}{K}\right) - \bar{N} \text{cov}\left(\frac{r}{K}, N\right)$$

Questions

Because the relationship between growth rate and carrying capacity is important for understanding population dynamics in a heterogeneous environment (such as an herbivore population living on a population of genetically variable plants), I wanted to ask

- How much variation in r and K is there among genotypes within a plant species?
- What is the correlation between r and K ?

What is the expected correlation between r and K ?

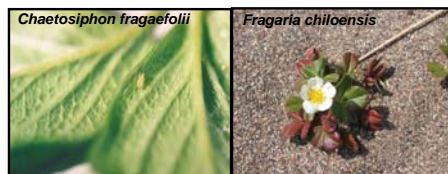
If r and K are properties of a genotype, population, or species....

r and K should have a negative correlation (assuming tradeoff between per-capita recruitment at low and high density)

If r and K are properties of the environment (i.e. the plant)...

the expectation is unclear

A little data



Methods

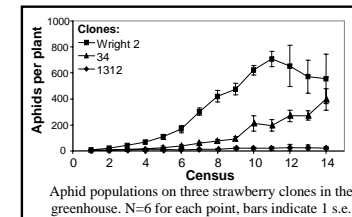
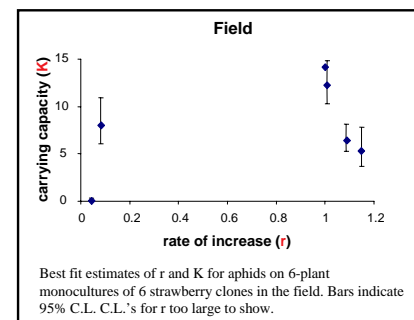
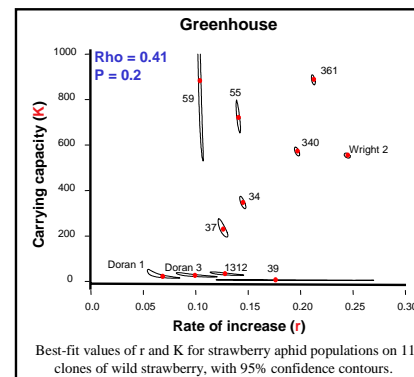
I measured r and K for a specialist aphid on clones of wild strawberry in the greenhouse and field as follows:

- Collected clones of strawberry from the field and USDA germplasm collection.
- Grew 6 replicates of each plant clone in the greenhouse
- Confined adult aphids on individual plants in mesh bags
- Counted aphids on each plant over 14 censuses
- Fit logistic model to aphid census data, using maximum likelihood to estimate r and K on each plant clone.
- Counted aphids on monocultures of six of the clones in the field at Bodega Marine Reserve, CA.

Results

In the greenhouse and field....

- Population dynamic parameters do vary among strawberry genotypes.
- But there is no correlation between r and K across strawberry genotypes.



Conclusions

- The effect of environmental heterogeneity on population dynamics depends in part on the amount of variation in, and correlation between, r and K
- Aphid population dynamic parameters can vary significantly among genotypes of wild strawberry
- There is no significant correlation between aphid r and K across genotypes of a species of wild strawberry.

New questions

- A mechanistic question:
 - What plant traits might affect r and K and what correlation might those traits predict?
- A natural history question:
 - What are the distributions of, and correlations between, herbivore r and K within natural plant populations?

Acknowledgments

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Literature cited

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 Underwood, N. 2004. Variance and skew of the distribution of plant quality influence herbivore population dynamics. Ecology 85(3):686-693
 Donahue, M. et al. in preparation.

For further information

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