Evolution of Physiological Tactics

Contents

The Evolution of the resistance and tolerance to stress

Set up: Why we need to understand how organisms cope with stress.

Inform whether they are resilient or susceptible to environmental change.

Offsets from ancestral environmental conditions creates mismatches between organism and environment.

Environments can perturb animals, reducing fitness. Specifically, stress damages macromolecules, disrupting cellular activity.

Problem or Need Statement:

The way we refer to how organisms cope with stress severely impacts our understanding of the physiological and molecular strategies/tactics of stress hardiness.

For example: thermal tolerance refers to the ability of an organisms to withstand both low and high temperatures. However, coping with stress can involve not only tolerance mechanisms, but also resistance.

The field would benefit from the herbivore damage literature.

Tolerance - physiological changes in response to environmental perturbations that maintains fitness.

Resistance - physiological mechanisms that reduces damage from environmental perturbations.

A big problem in transcriptomic studies: cant tell the difference between resistance vs tolerance – need reaction norm approach

Types of Perturbations: Press vs Pulse (Edward Bender 1980)

Press perturbations is consistent damage.

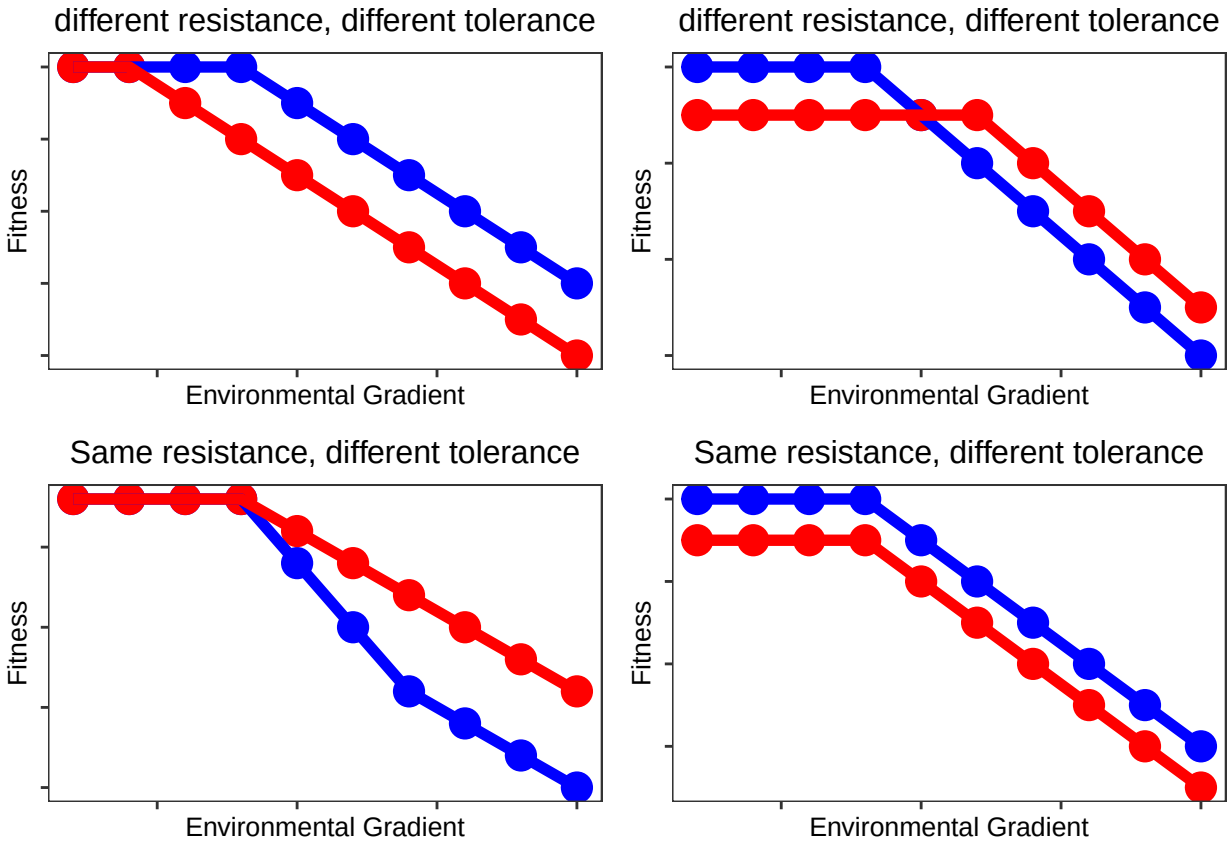
- thermal damage - slow ramping
- performance under herbivore damage
- performance under parasite load

Pulse perturbation is intermittant damage.

- thermal shock, rapid cold/heat treatment - lends itself to investigating recovery mechanisms
- initial herbivore damage
- initial parasite infection

Note: There can be things in between pulse and press: intermediate heat ramping protocols. The central read out for heat damage is proteome stability.

Types of patterns to expect from data, pulse or press



Evolutionary tactics for stress resistance

Selection favors stress resistance mechanisms when stress is constant throughout a lifetime.

Cost- allocation cost whereby investing in defenses or elevating stress resistant mechanisms comes at the cost of other life history traits such as growth.

Benefit - Takes more stress to disrupt biological activity

Tactics

- High baseline ("Front loading") investment in protective molecules.

Evolutionary tactics for stress tolerance

Selection favors stress tolerance mechanisms when stress is variable within a lifetime.

Cost- costs energy to turn on a response

Benefit- the response enables the organism to cope with the environmental condition

Tactics

- When perturbed, increase magnitude of protective molecules.

Molecular level :

Phenotype: environmental limits (thermal limits, drought limits,)

Resistance - Environmental range where key macromolecules do not change

Tolerance - Environmental range wherw macromolecules changing during and after

So should we be thinking about what a particular molecule is doing for the organism? THe molecule itself is resistant or tolerant?

Is this just understanding phenotypic plasticity of a given molecule?