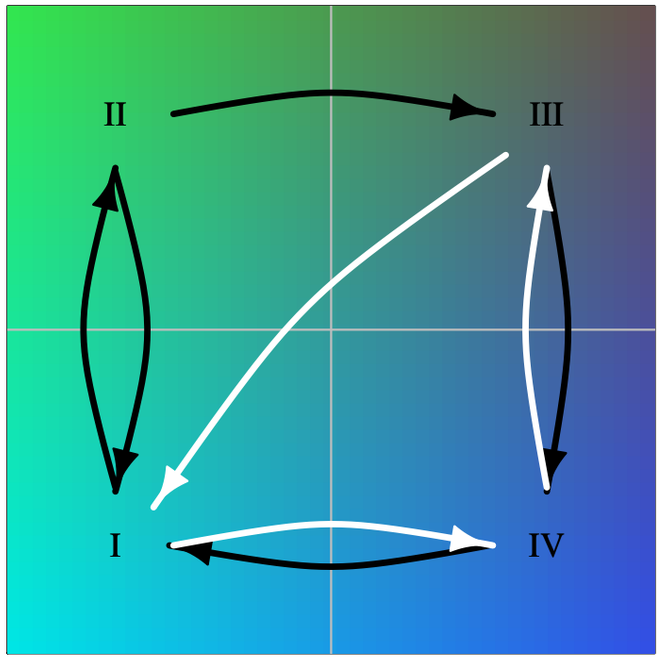
Linking evolutionary and ecological theory illuminate non-equilibrium biodiversity

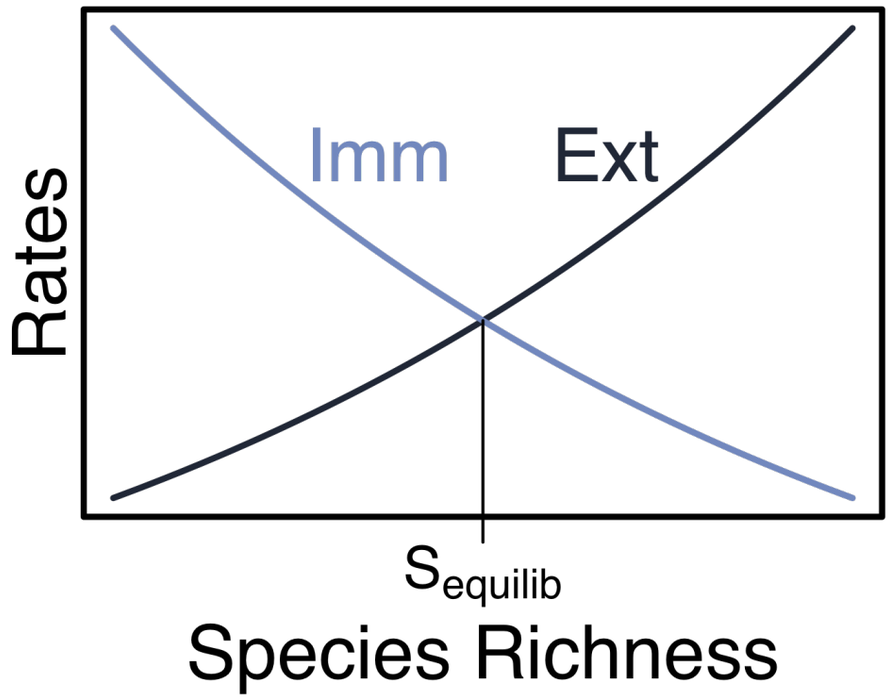


Andy Rominger[1*] & Isaac Overcast[2]

[1]Santa Fe Institute • [2]City College of New York • [*]ajrominger.github.io

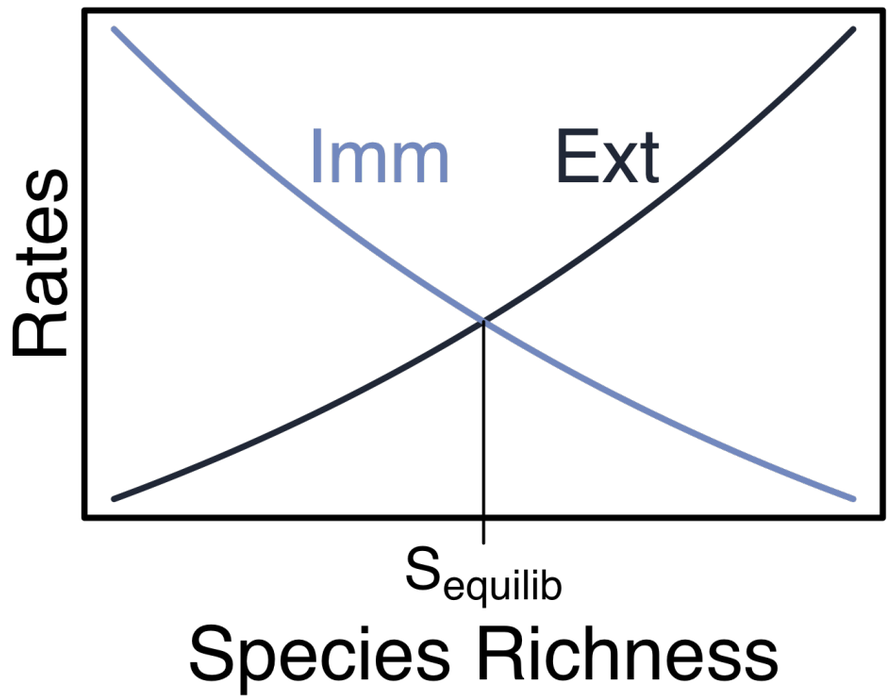
Gordon Research Seminar • 22 July 2018

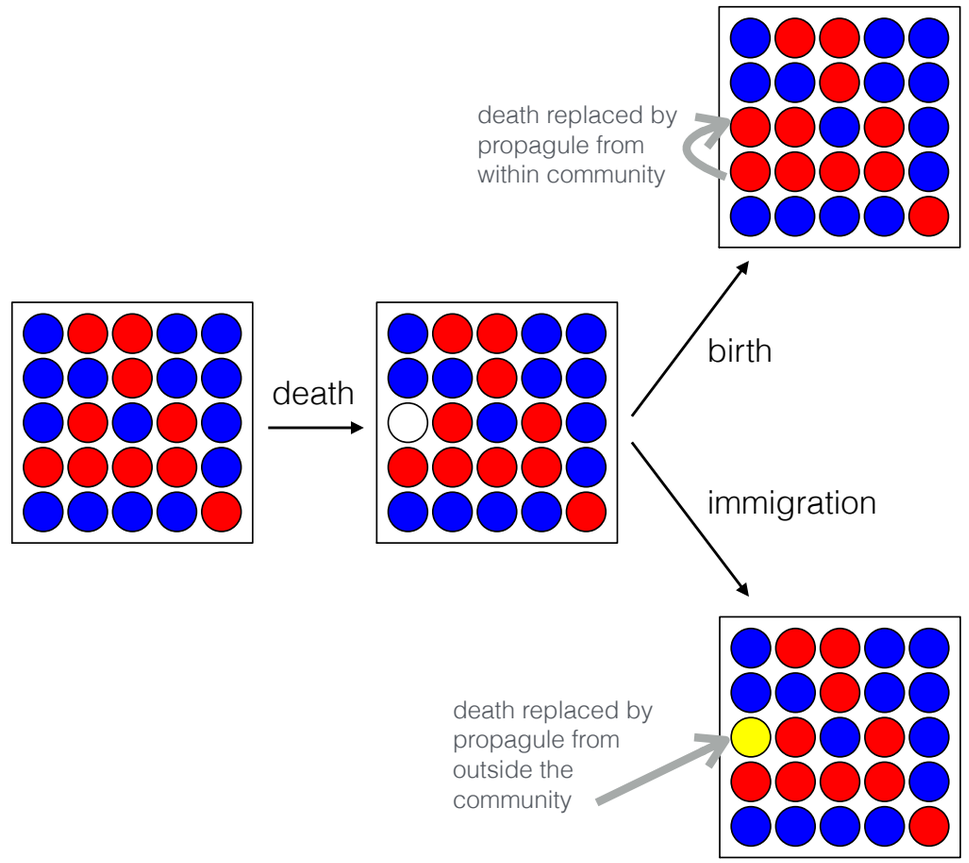
Equilibrium theories have a long history in biodiversity



MacArthur & Wilson (1967)

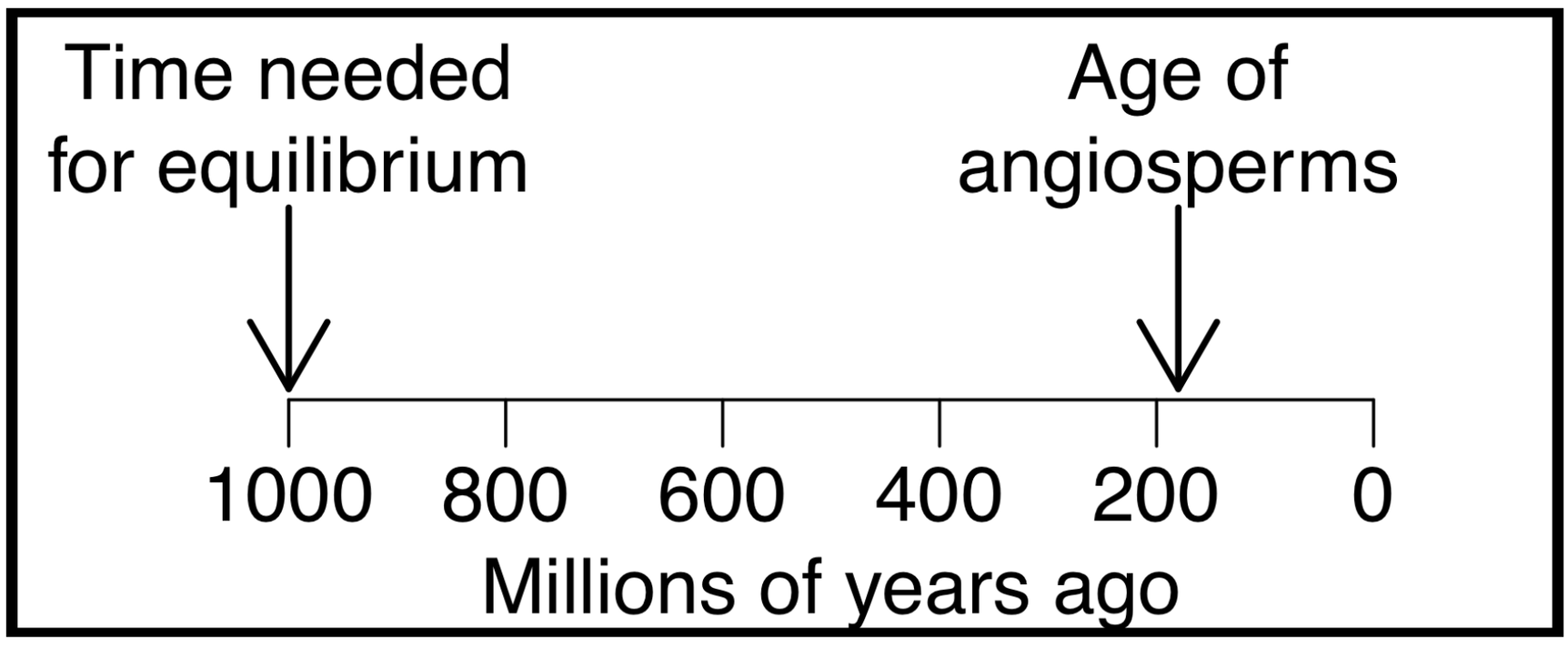
Equilibrium theories have a long history in biodiversity





MacArthur & Wilson (1967); Hubbell (2001)

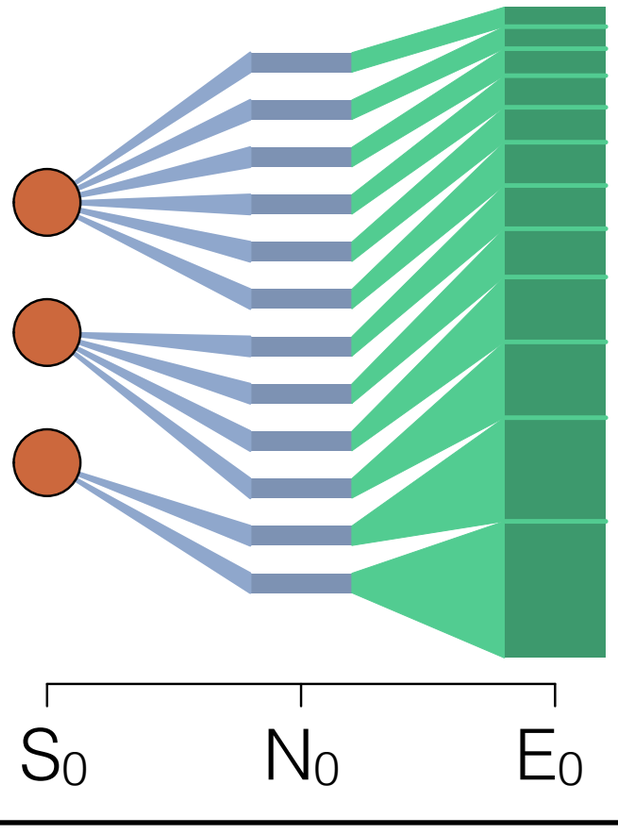
Historical perspectives demonstrate that equilibrium is often violated



Nee (2005) *Funct. Ecol.* 19: 173—176.

Departures from theory highlight non-equilibrium

Unbiased, null allocation

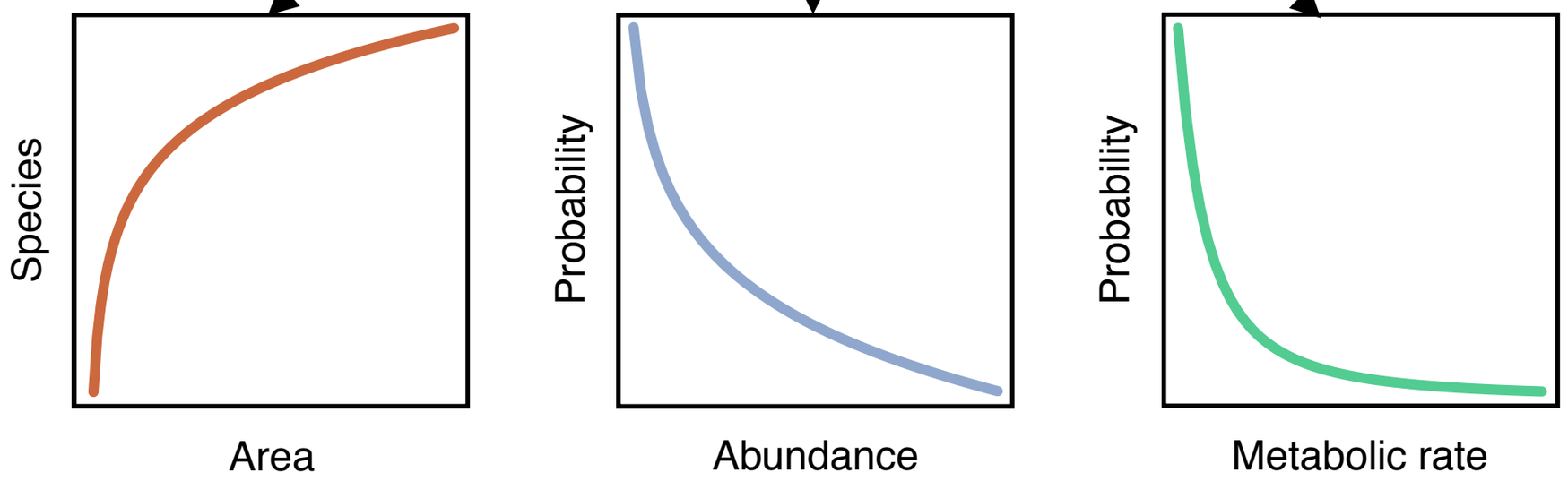


Harte (2011)

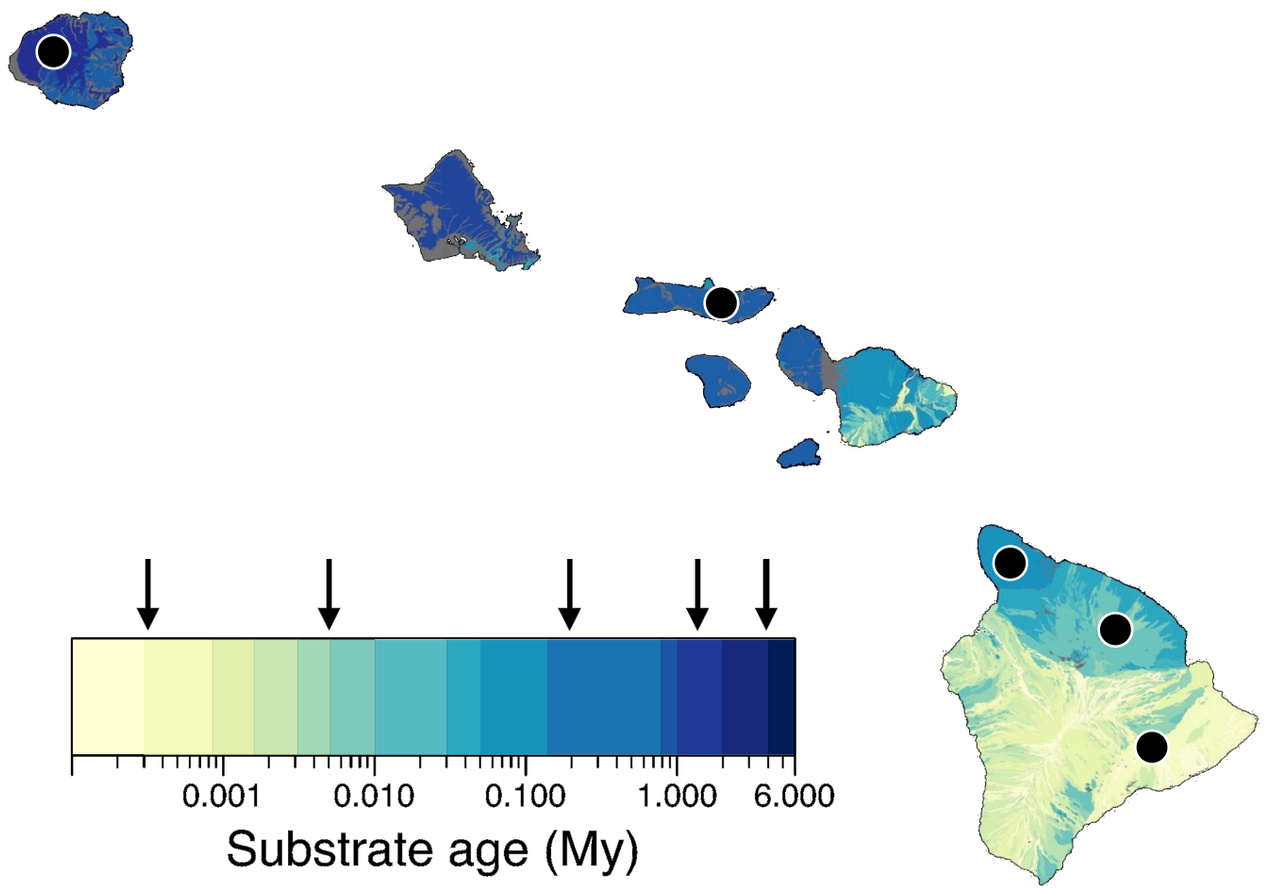
Joint probability of abundance (n) and metabolic rate (ε)

$$R(n,\varepsilon) = \frac{1}{Z} e^{-\lambda_1 n} e^{-\lambda_2 n\varepsilon}$$

λ_1 and λ_2 are Lagrange multipliers from constrained entropy maximization

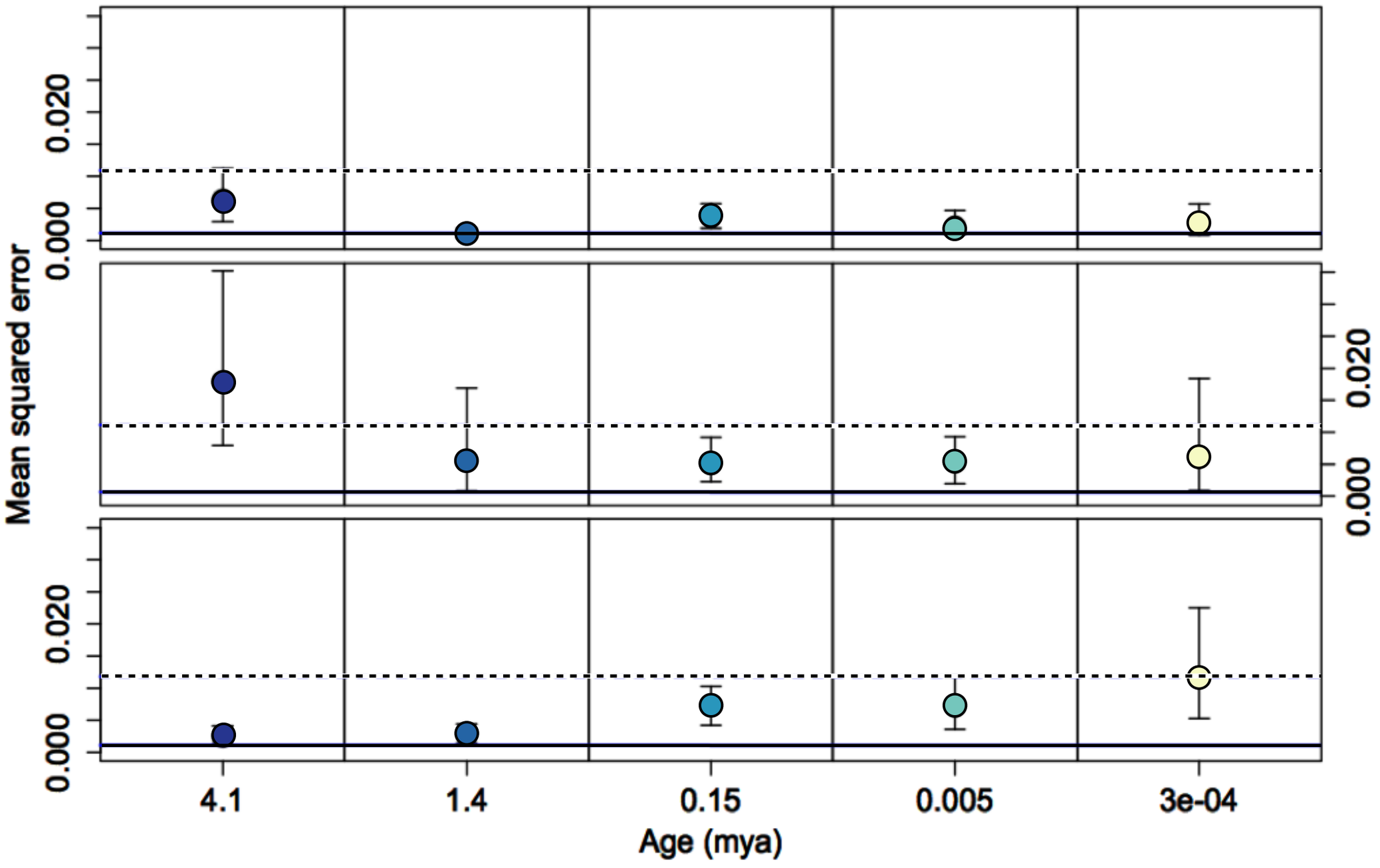


Departures from theory highlight non-equilibrium

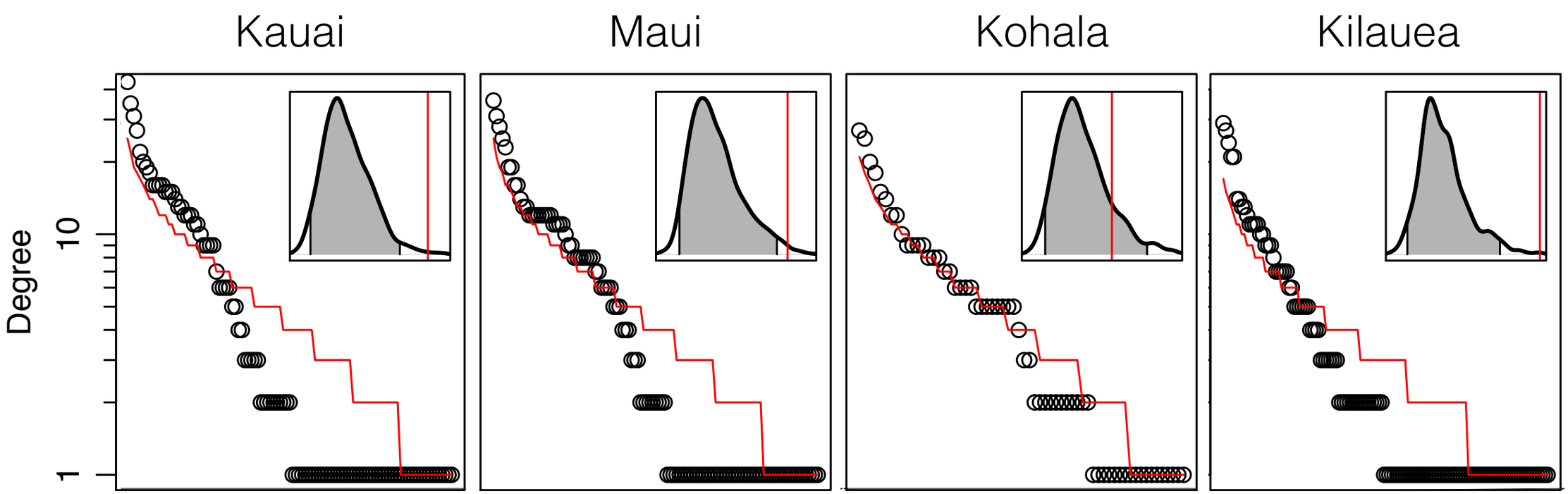


Data from Gruner (2007) Biol. J. Linn. Soc. 90: 551—570

Departures from theory highlight non-equilibrium

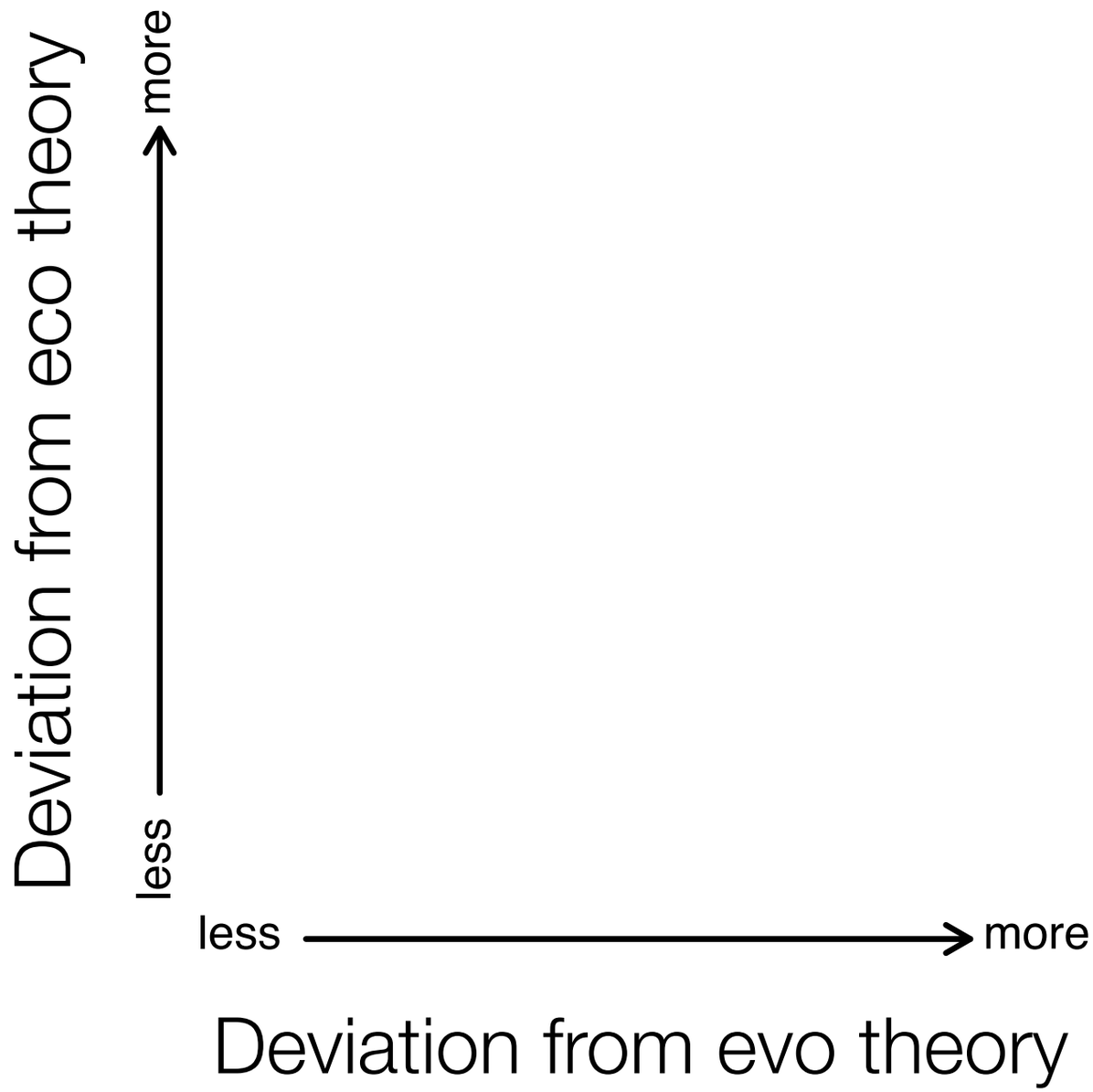


Departures from theory highlight non-equilibrium

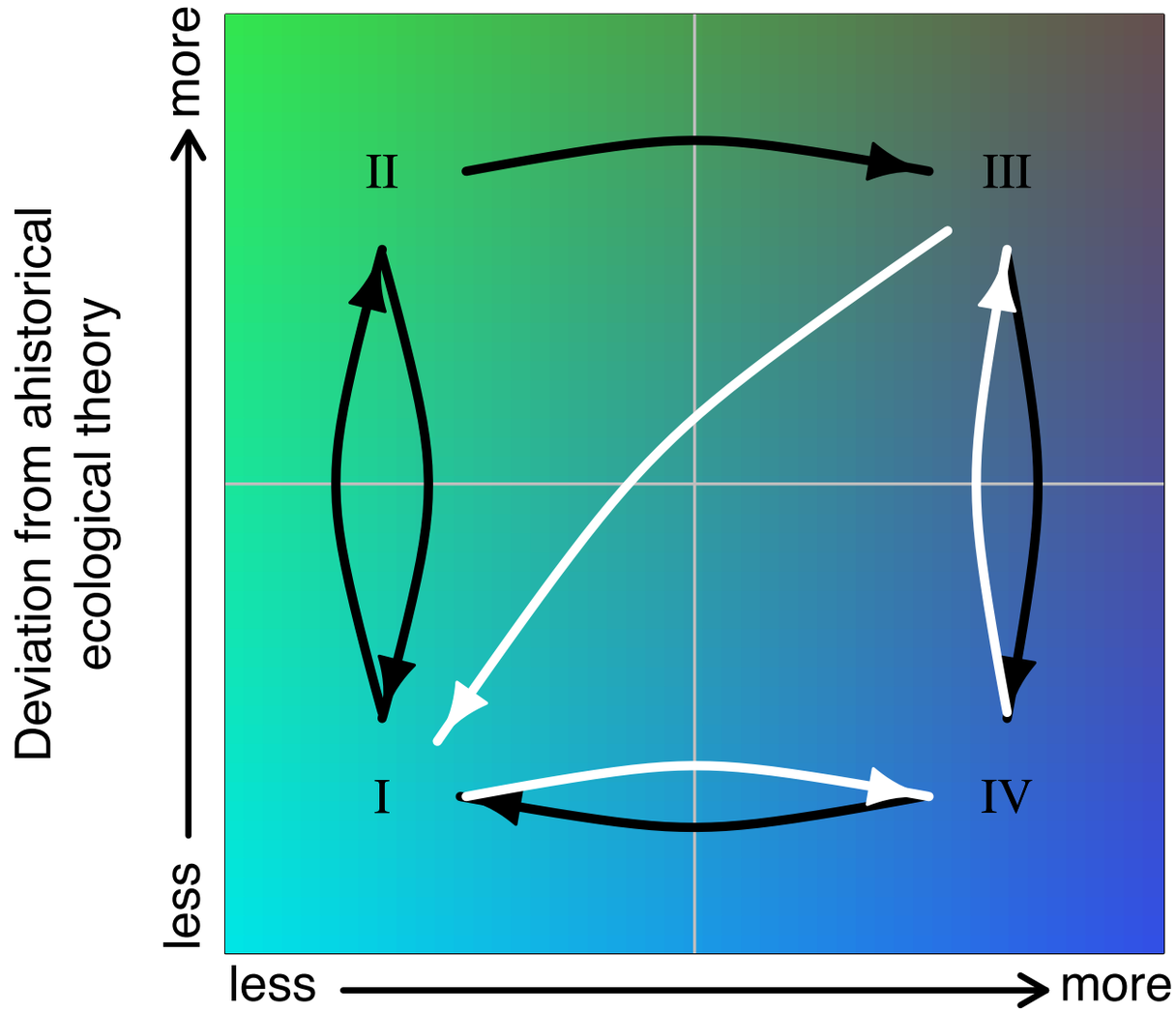


Rominger et al. (2016) *Global Ecol. Biolgeo.* 25: 769—780

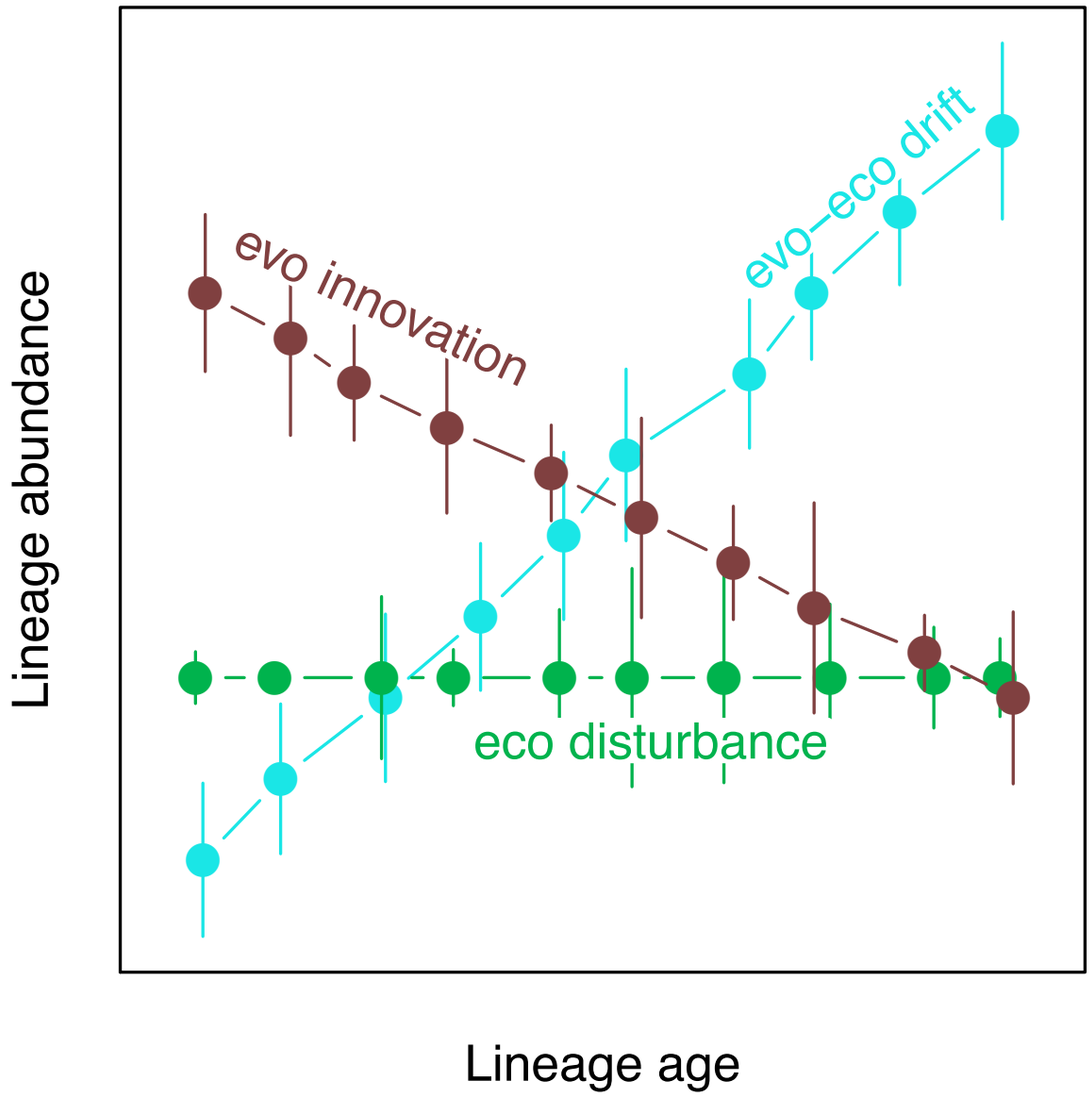
Combining evo and eco theories capture non-equilibrium



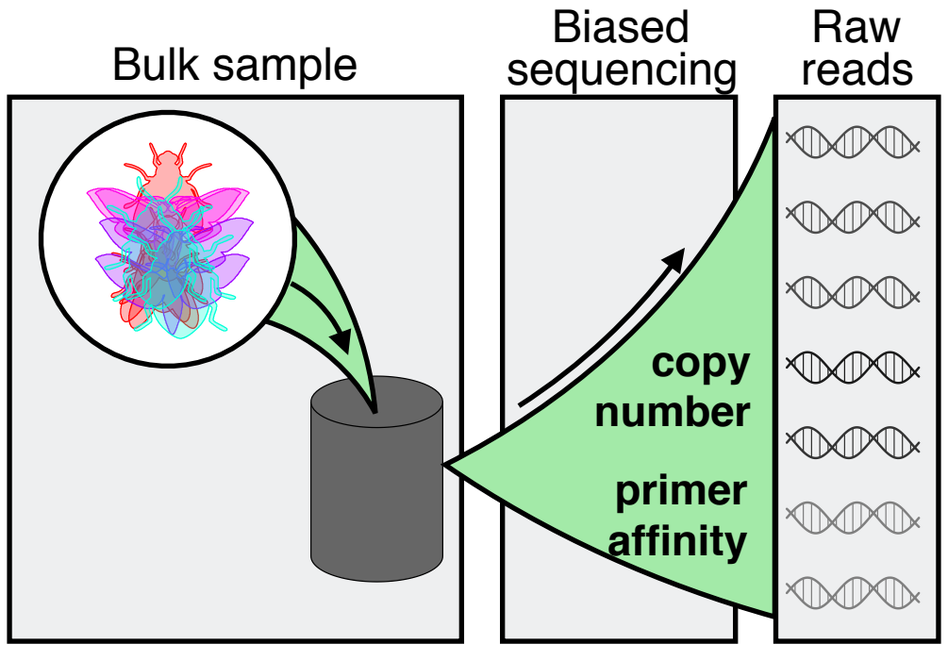
Combining evo and eco theories capture non-equilibrium



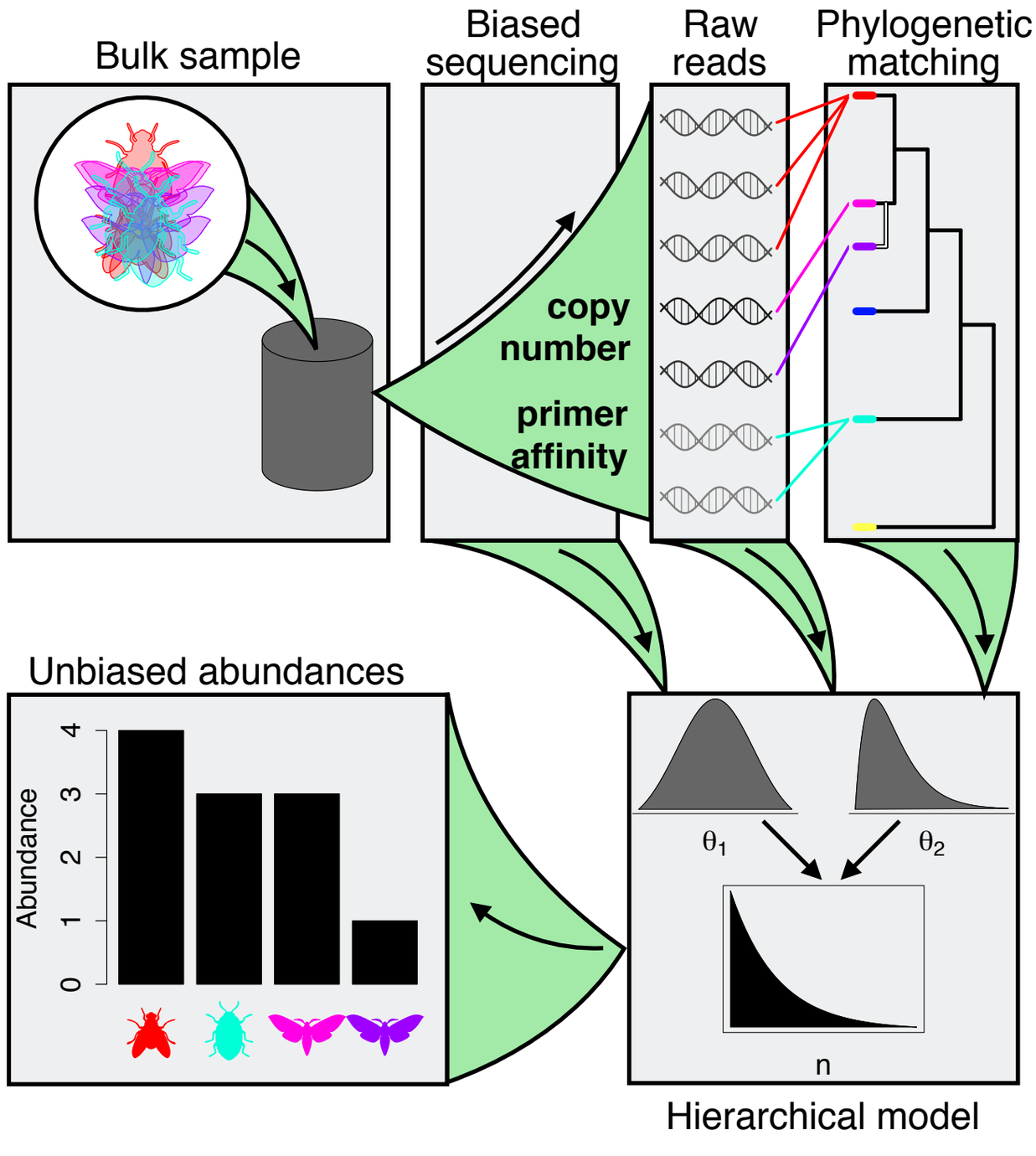
Combining evo and eco theories capture non-equilibrium



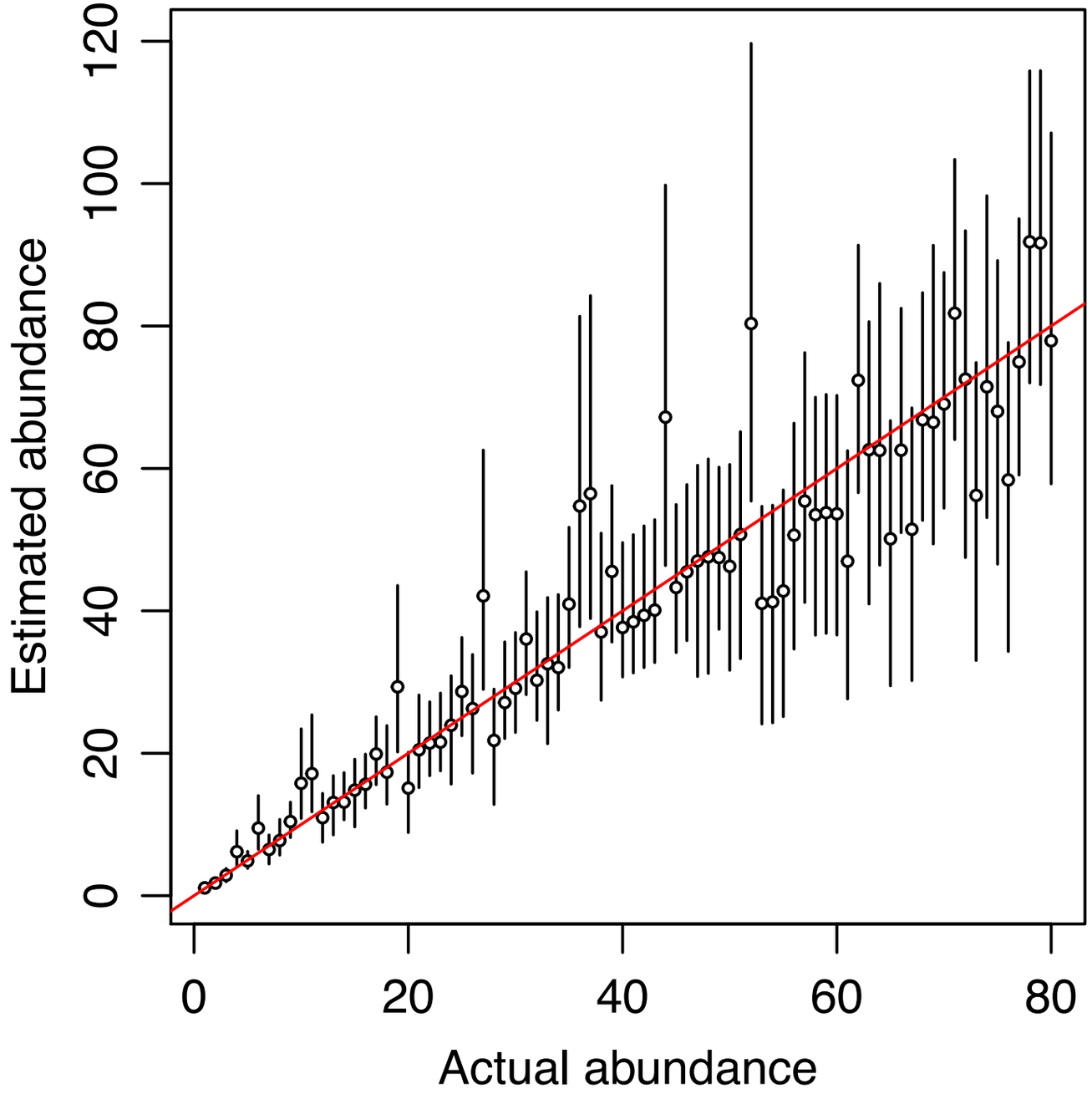
Metabarcoding (if done right) unlocks evo-eco data



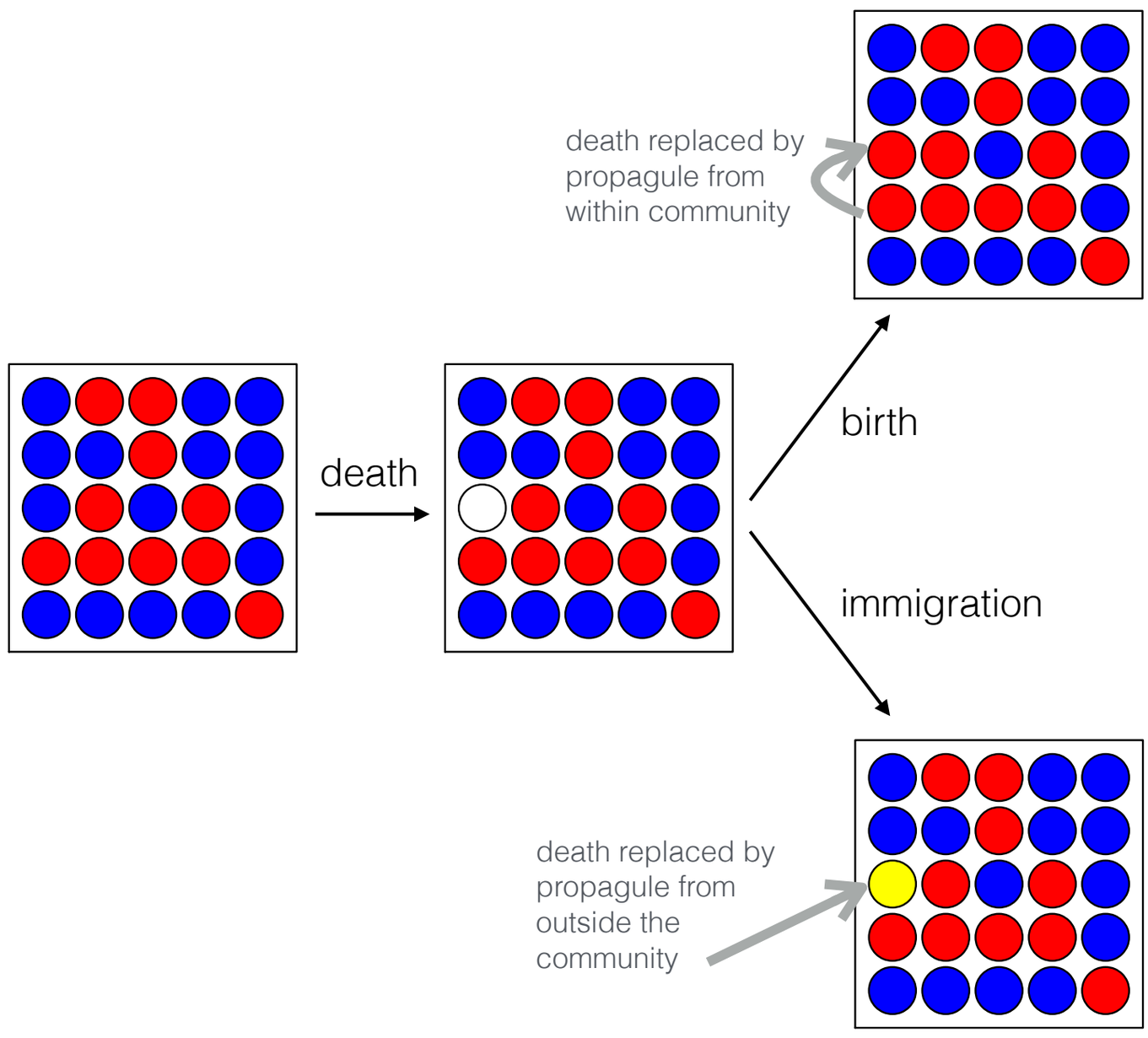
Metabarcoding (if done right) unlocks evo-eco data



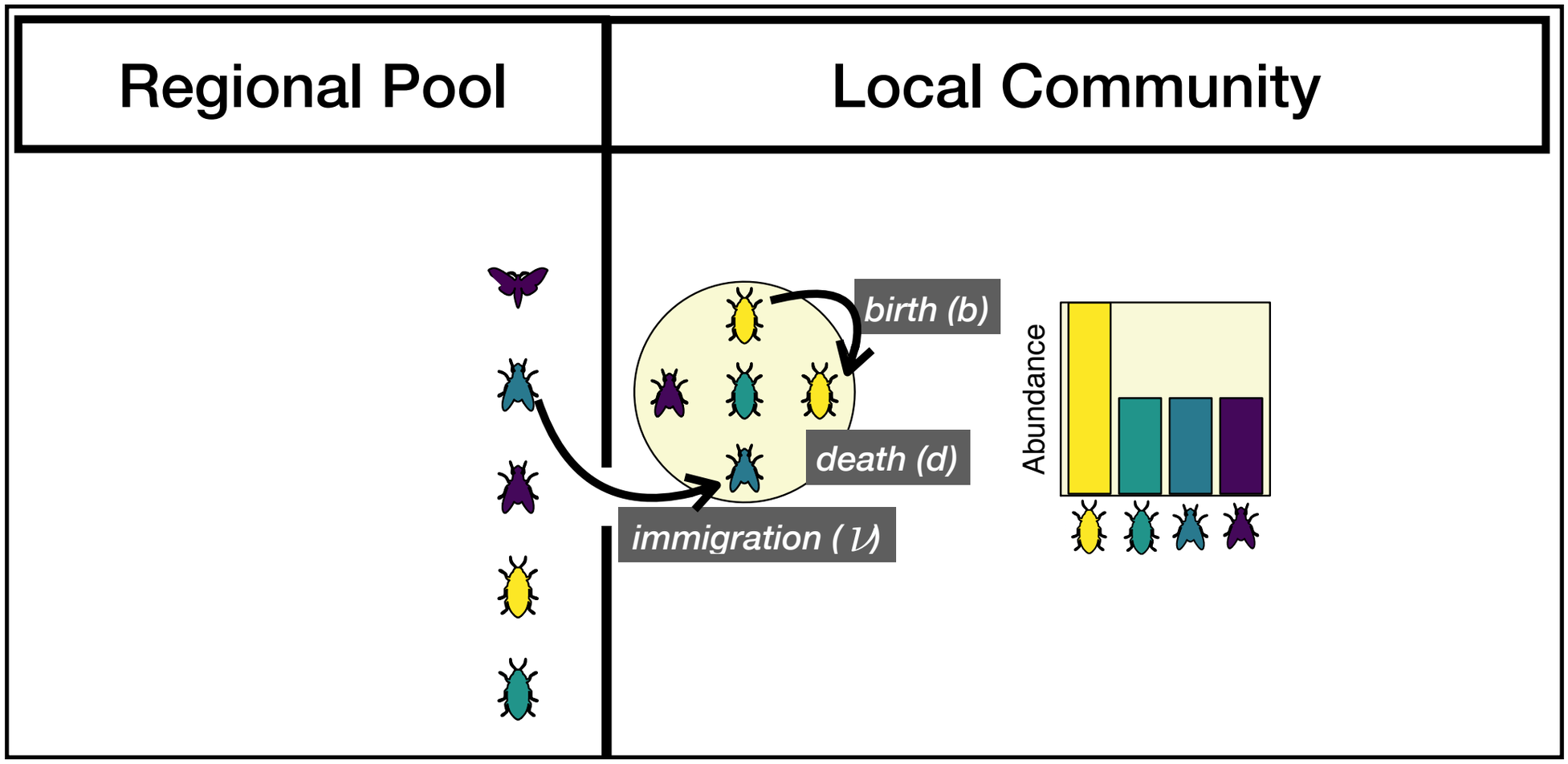
Metabarcoding (if done right) unlocks evo-eco data

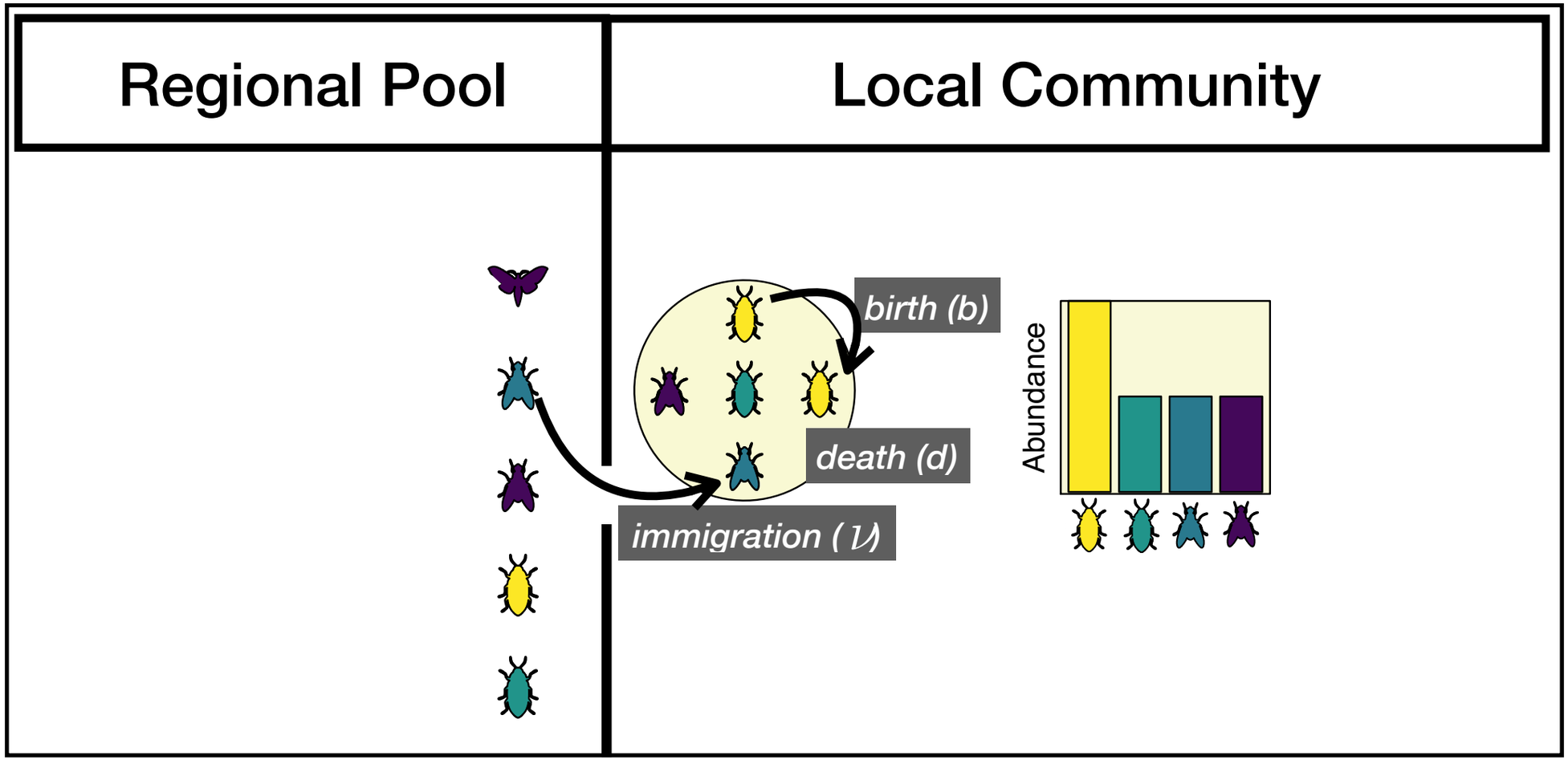


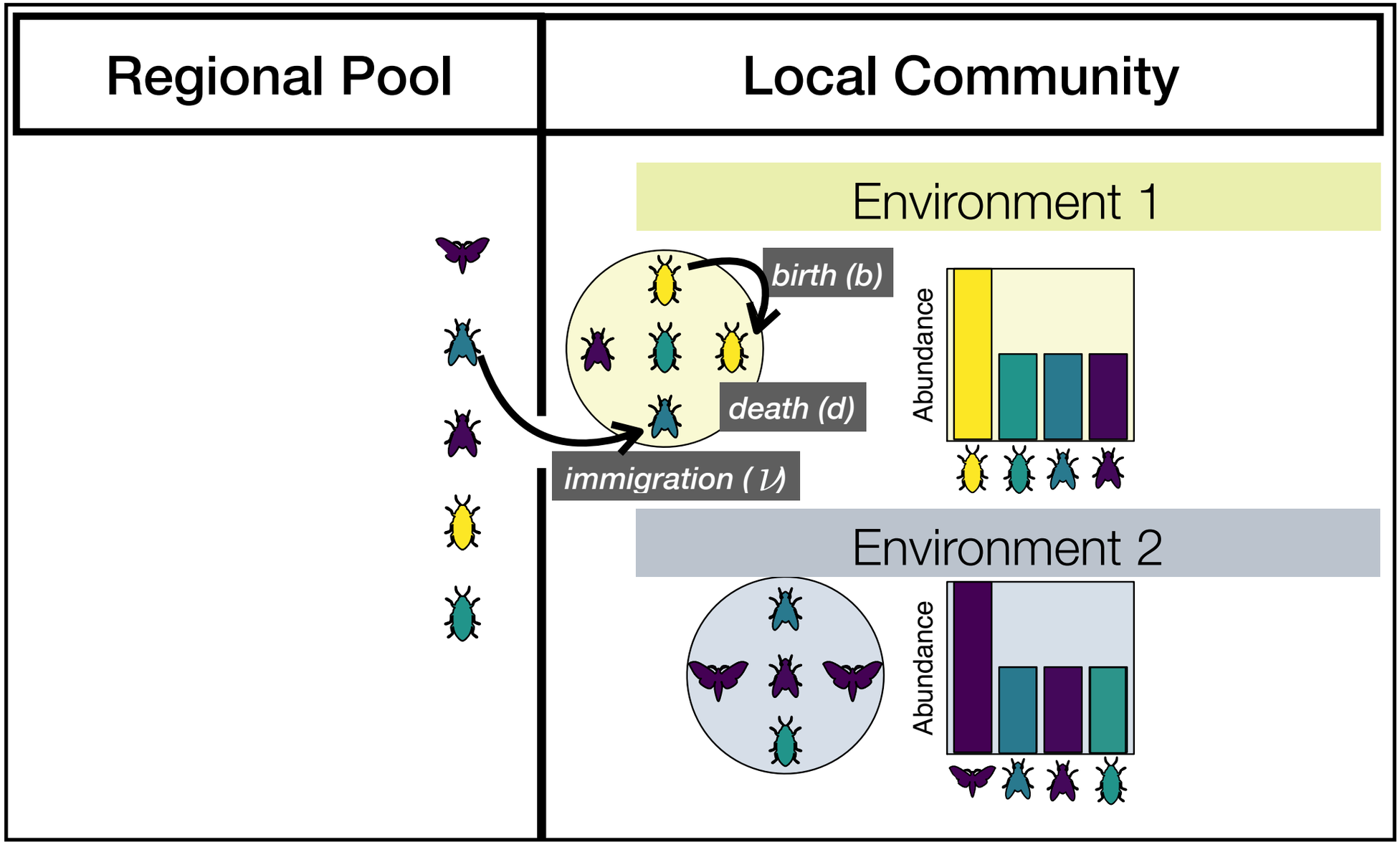
Mechanistic evo-eco theory reveals cause of non-equilibrium

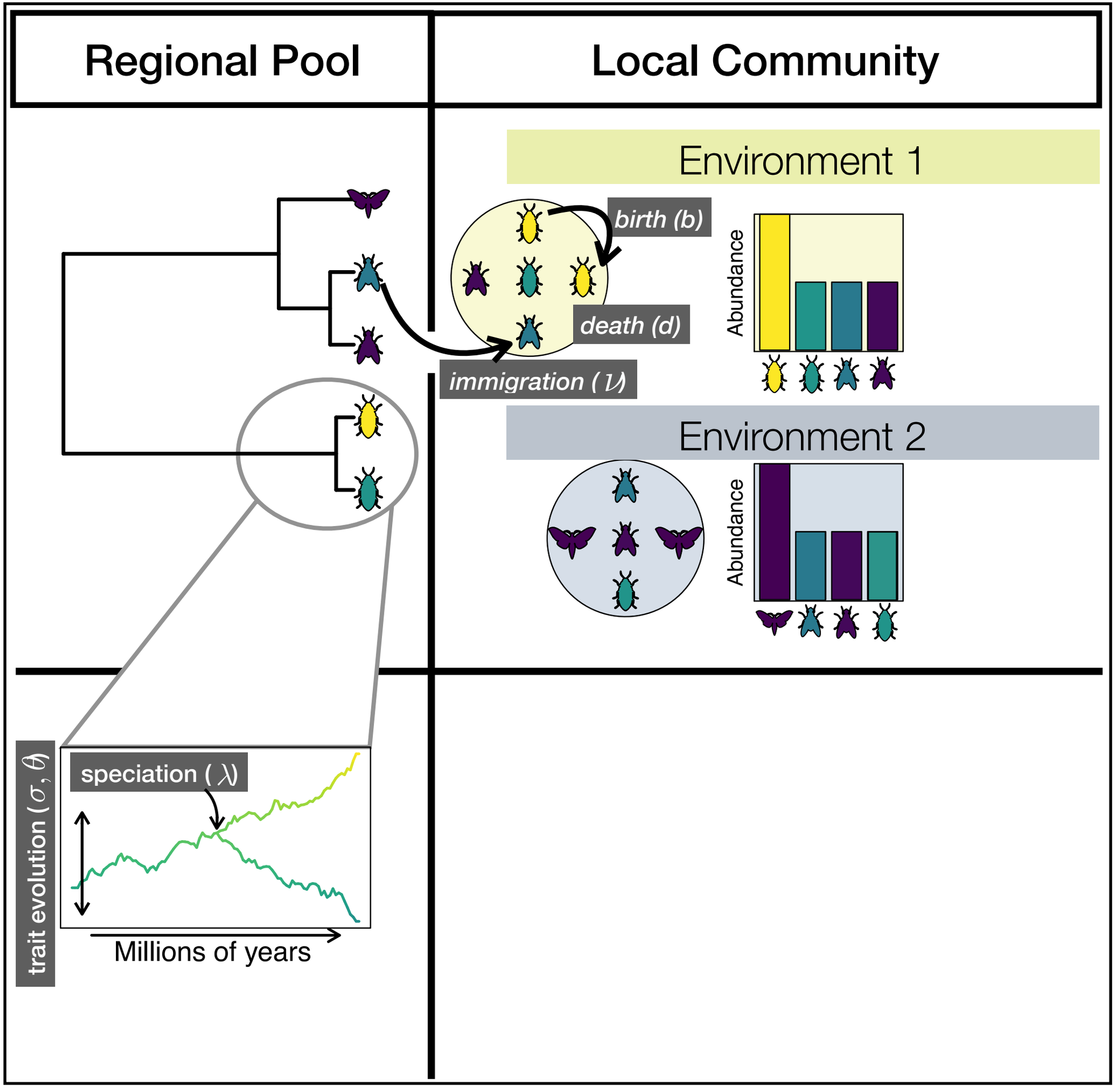


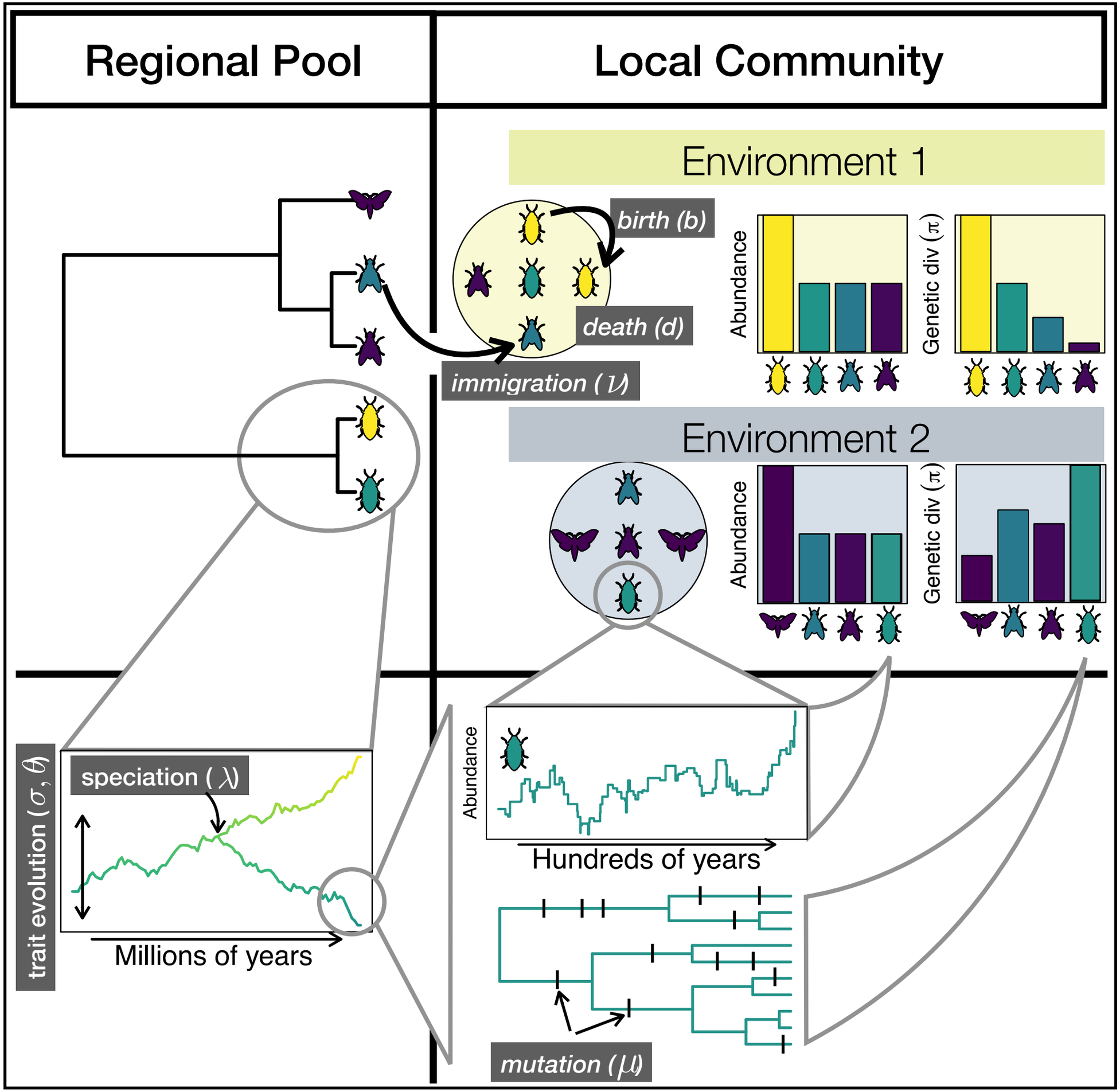
Mechanistic evo-eco theory reveals cause of non-equilibrium




Regional Pool
Local Community
birth (b)
death (d)
immigration (ν)
Abundance


Regional Pool
Local Community
Environment 1
birth (b)
death (d)
immigration (ν)
Abundance
Environment 2
Abundance


Regional Pool
Local Community
Environment 1
birth (b)
death (d)
immigration ($\mathcal{V}$)
Abundance
Environment 2
Abundance
speciation (λ)
trait evolution (σ, θ)
Millions of years


Regional Pool
Local Community
Environment 1
birth (b)
death (d)
immigration ($\mathcal{V}$)
Abundance
Genetic div (π)
Environment 2
Abundance
Genetic div (π)
speciation (λ)
trait evolution (σ, θ)
Millions of years
Abundance
Hundreds of years
mutation (μ)

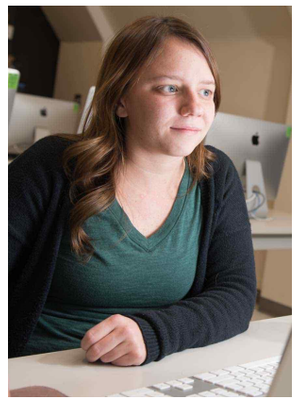
Thanks!

J. Harte

R. Gillespie

D. Gruner

L. Schneider

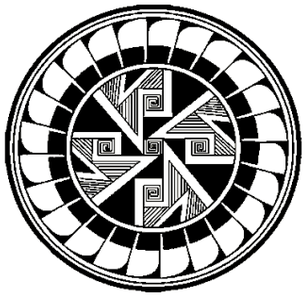


M. Ruffley

J. Chase

M. Hickerson

L. Harmon



When do we need evolution to explain ecology and vice versa?