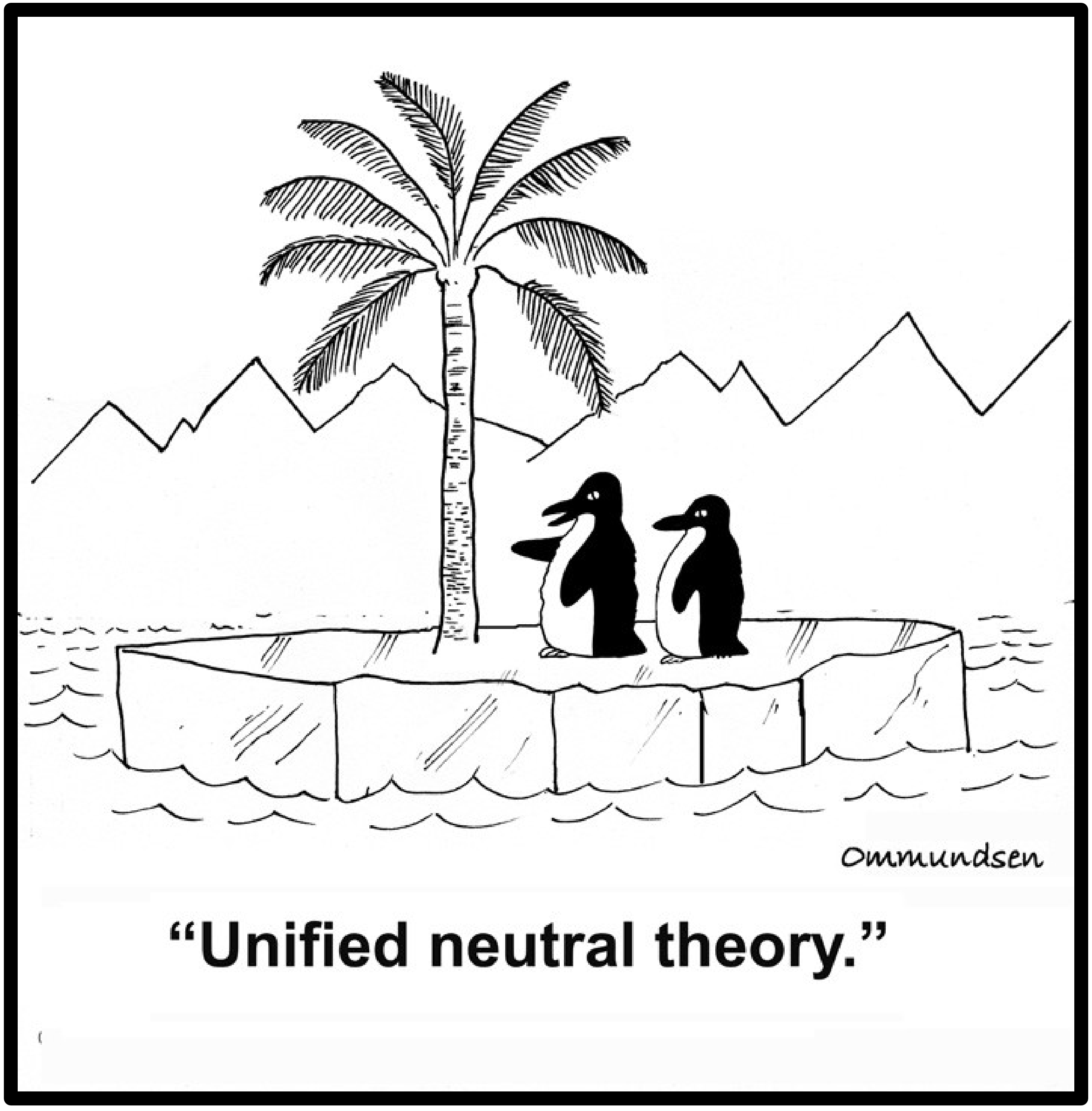
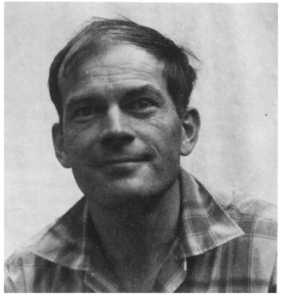
Deriva e Dispersão



A perguntas essenciais

- Riqueza
  - Por que algumas comunidades têm mais espécies do que outras?
- Composição
  - Por que comunidades têm conjuntos diferentes de espécies?
- Abundância
  - Por que as espécies nas comunidades têm tamanhos populacionais diferentes?

Respostas: Nicho



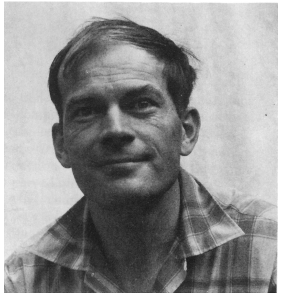
- Riqueza
  - Saturação em pontos diferentes
- Composição
  - Interações determinam: exclusão de espécies similares, coexistência mediada por predação, etc
- Abundância
  - Tamanhos populacionais regulados por interações

As cunhas de Darwin

"Nature may be compared to a surface covered with ten-thousand sharp wedges, many of the same shape & many of different shapes representing different species, all packed closely together & all driven in by incessant blows: the blows being far severer at one time than at another; sometimes a wedge of one form & sometimes another being struck; the one driven deeply in forcing out others; with the jar and shock often transmitted very far to other wedges in many lines of direction: beneath the surface we may suppose that there lies a hard layer, fluctuating in its level, & which may represent the minimum amount of food required by each living being, & which layer will be impenetrable by the sharpest wedge."

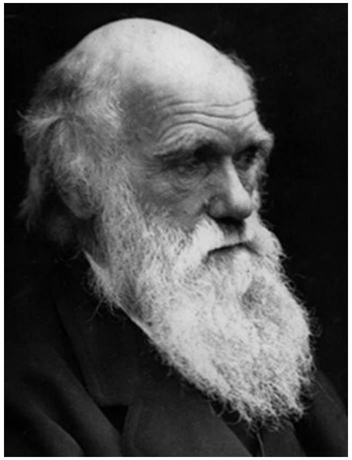
Lotka

Volterra



MacArthur

Hutchinson



http://edhui.wordpress.com/2009/02/07/darwin/

EDOs ou ODEs

$$\frac{dN_1}{dt} = rN_1 \frac{N_1 + \alpha N_2}{K_1}$$

Velocidade

Lotka-Volterra generalizada

$$\frac{dN_1}{dt} = r N_1 \frac{N_1 + \alpha N_2 + \beta N_3 + \ldots}{K_1}$$

$$\frac{dN_i}{dt} = r N_i \left(1 + \sum \alpha_{ij} N_j\right)$$

O demônio de Laplace

Marquês Pierre-Simon Laplace
(1749-1827)

“Se houvesse um intelecto que num dado momento conhecesse todas as forças que colocam a natureza em movimento, e todas as posições de seus elementos, e que também fosse vasto o suficiente para submeter essses dados à análise, ***ele poderia abranger numa única fórmula*** *os movimentos dos maiores copros celestes e do mais ínfimo átomo, e para ele nada seria incerto, e passado e futuro seriam o mesmo que o presente a seus olhos.”*

THE THEORY OF

Island Biogeography

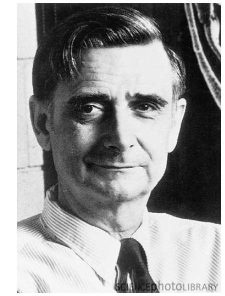
ROBERT H. MAC ARTHUR AND

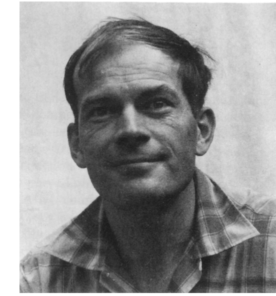
EDWARD O. WILSON

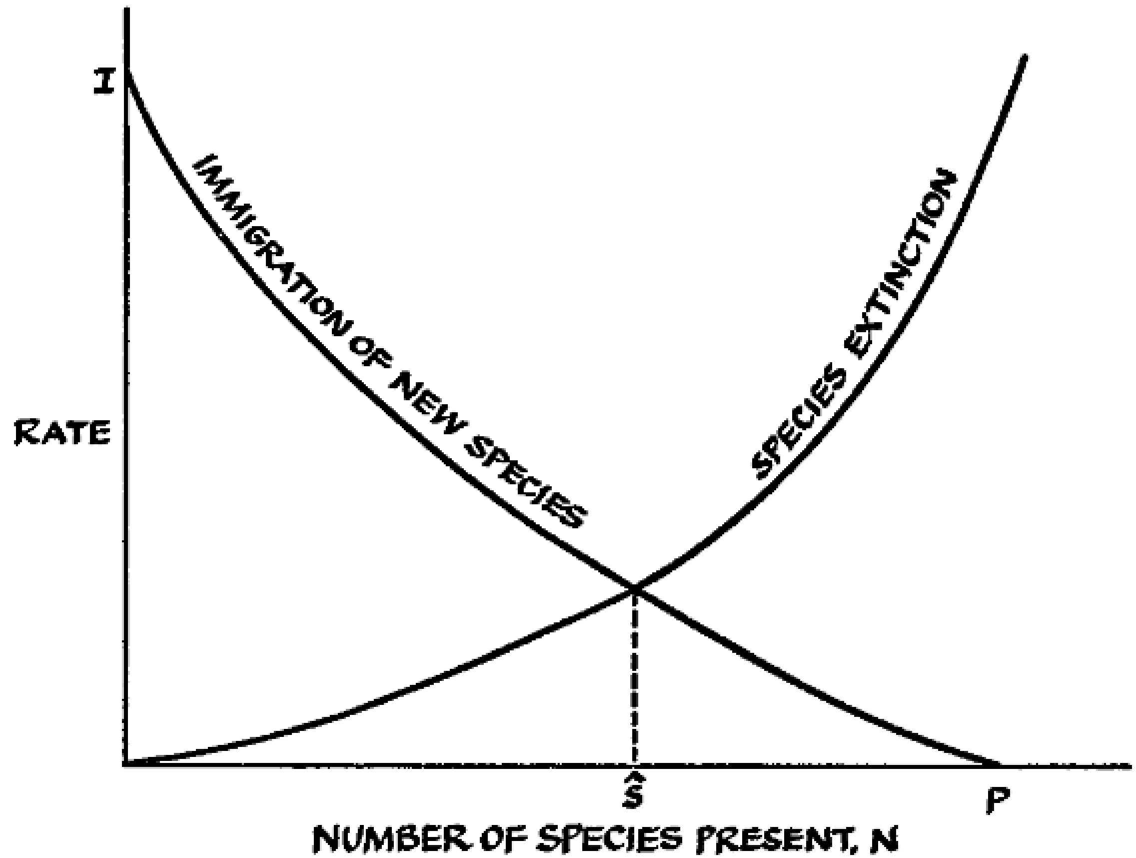
PRINCETON, NEW JERSEY

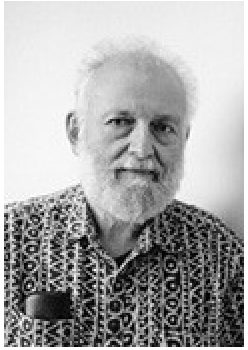
PRINCETON UNIVERSITY PRESS

1967

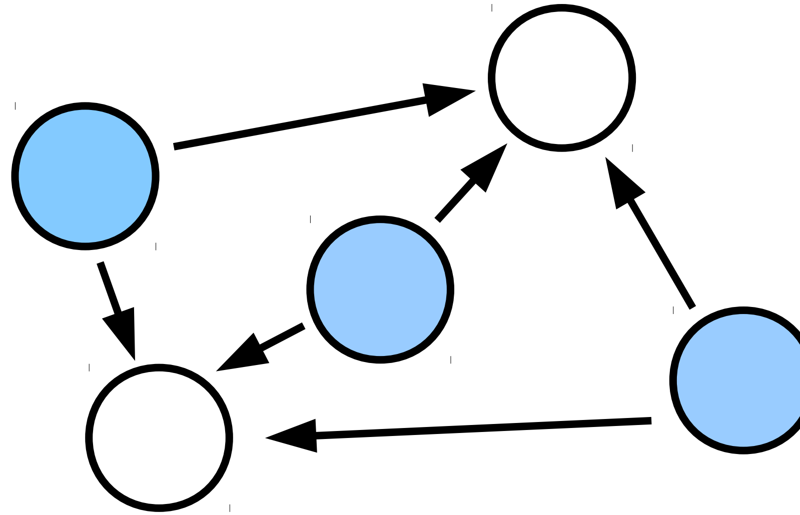








Metapopulações



$$\frac{df}{dt} = if(1-f) - p_e f$$

$$\hat{f} = 1 - \frac{p_e}{i}$$

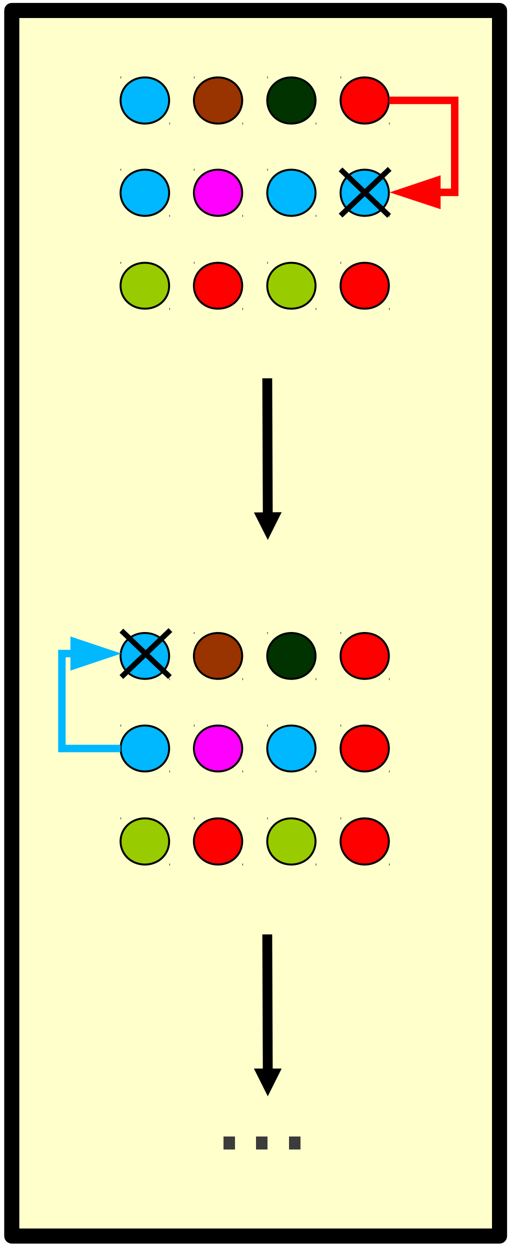
- Infinitas manchas iguais
- Populações chegam a K imediatamente
- Colonização não afeta dinâmicas locais

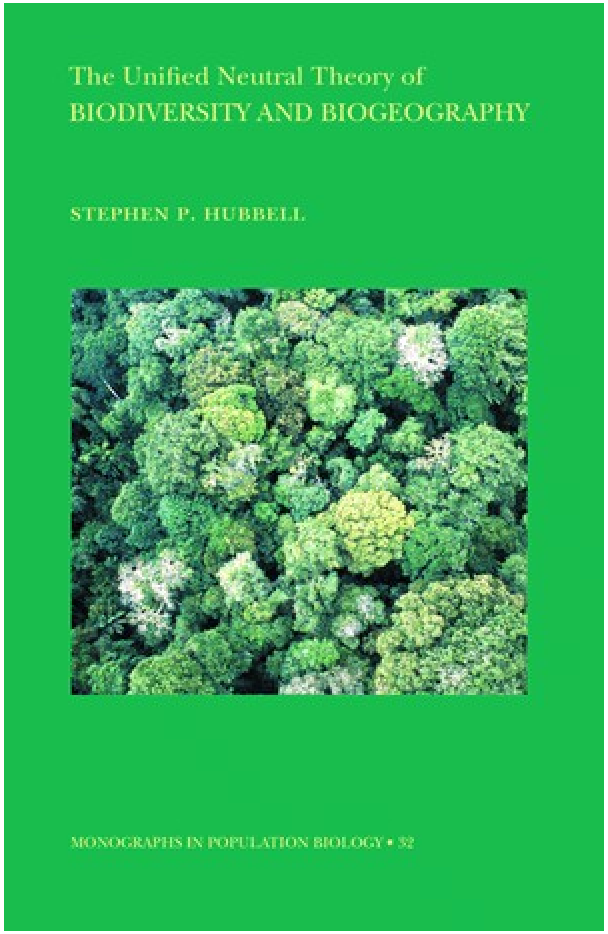
Mesmas perguntas, outras respostas

- Riqueza
  - Balanço entre migração e extinção
- Composição
  - Equilíbrio dinâmico: sorteios de um mesmo pool (deriva)
- Abundância
  - Não contemplada

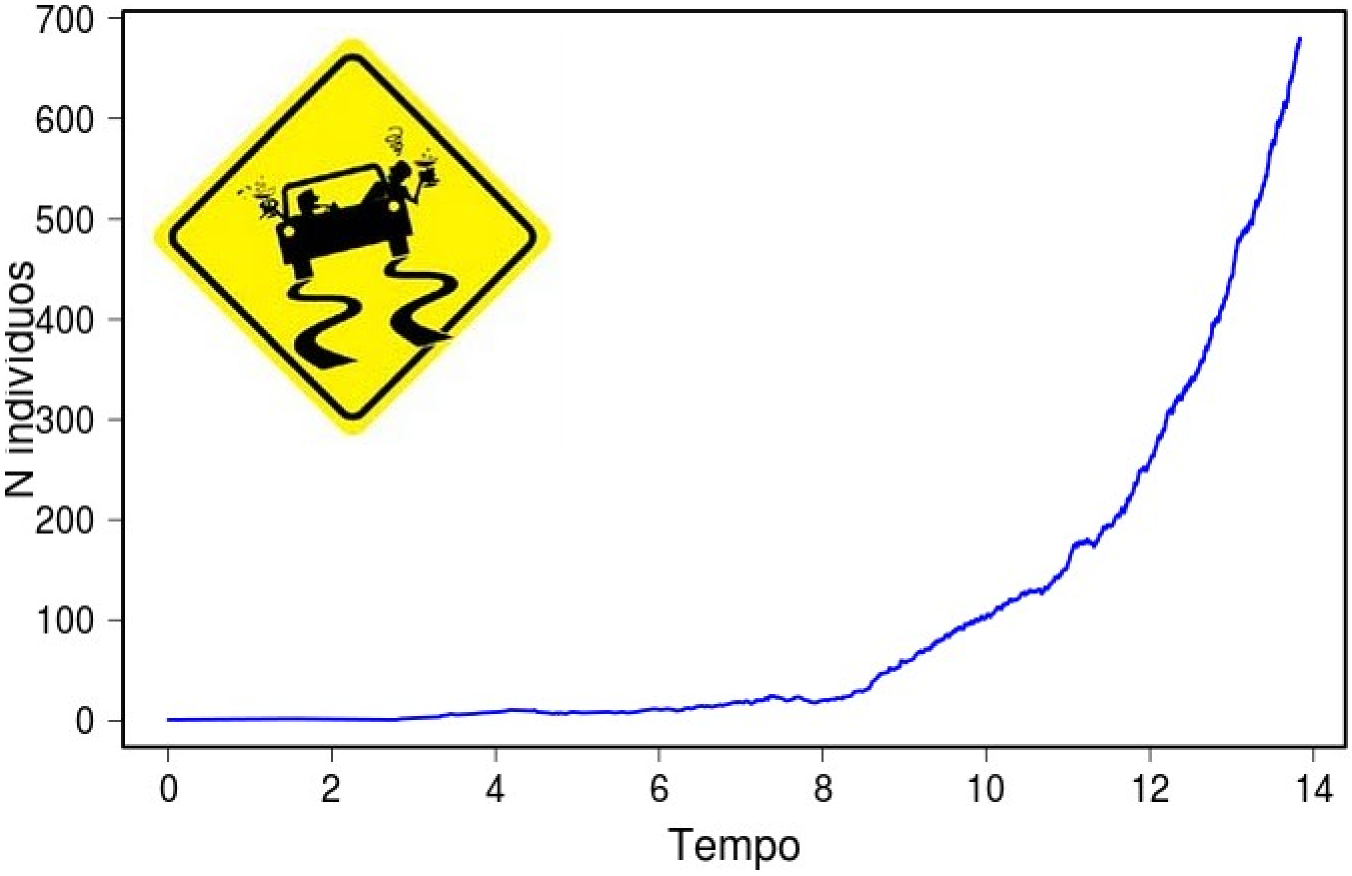
Deriva

- Neutralidade
- Estocasticidade

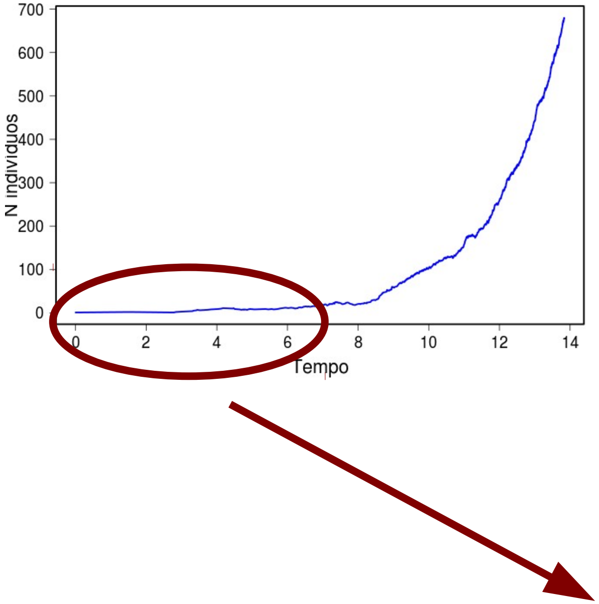


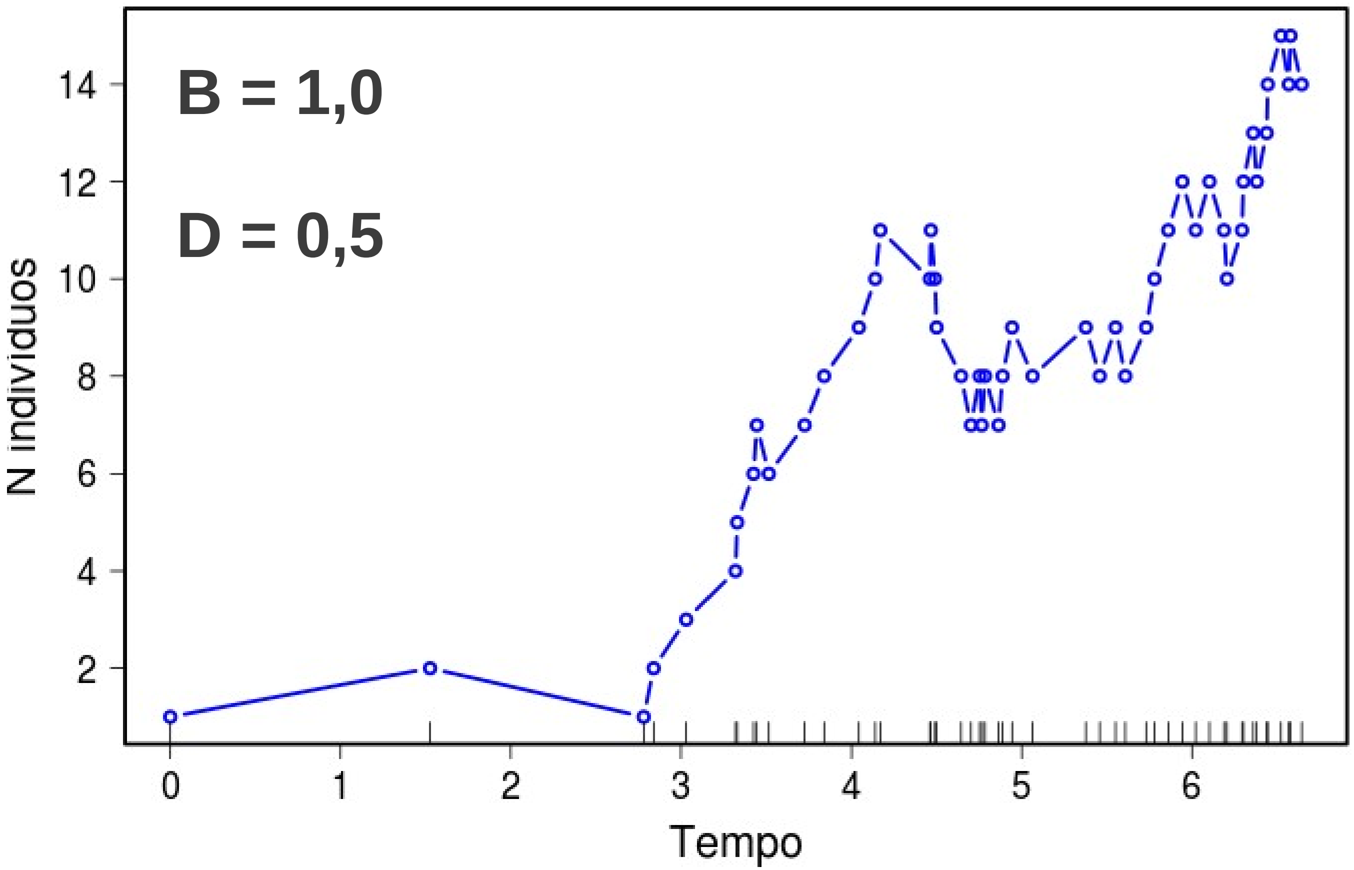


Dinâmicas estocásticas

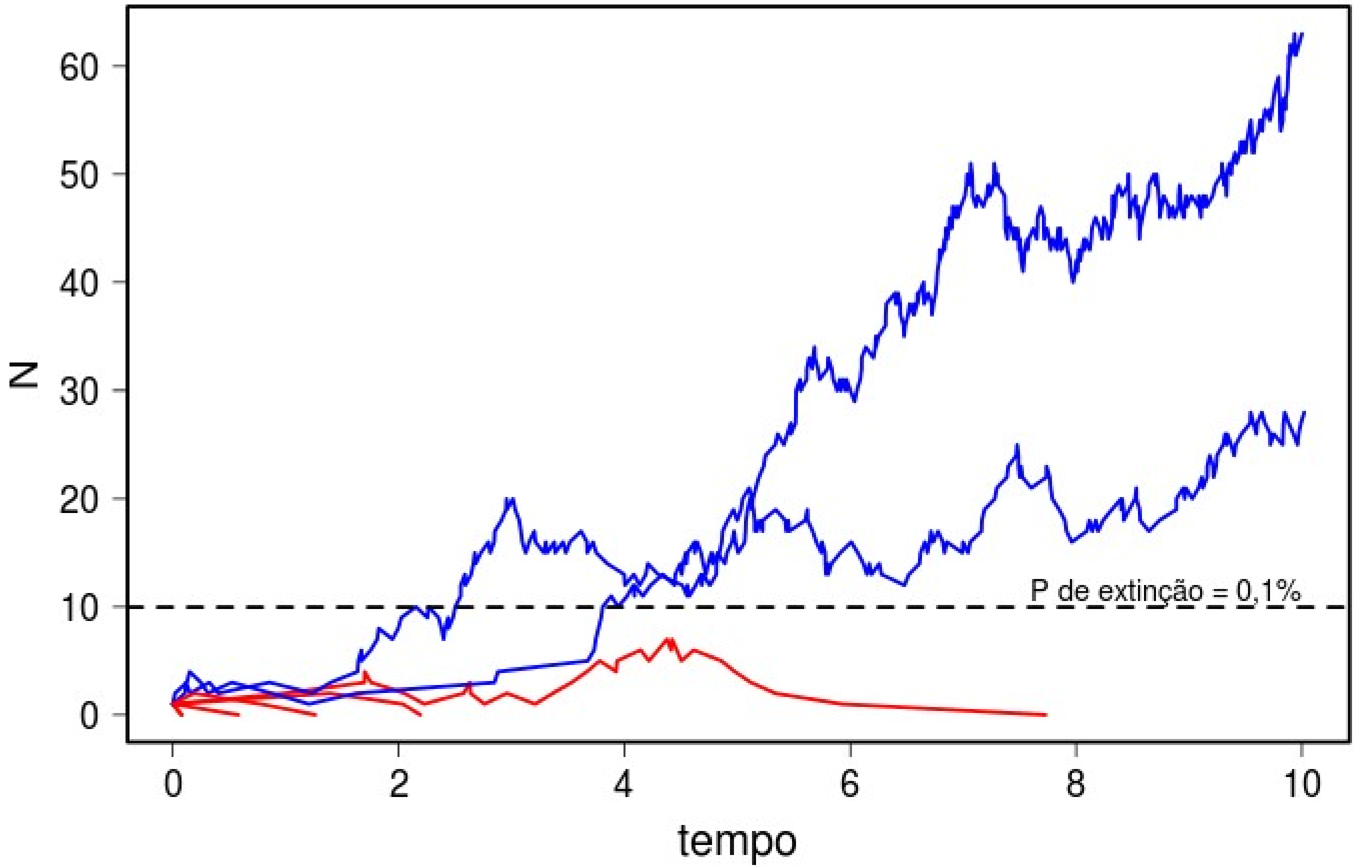


Processo de nascimentos e mortes



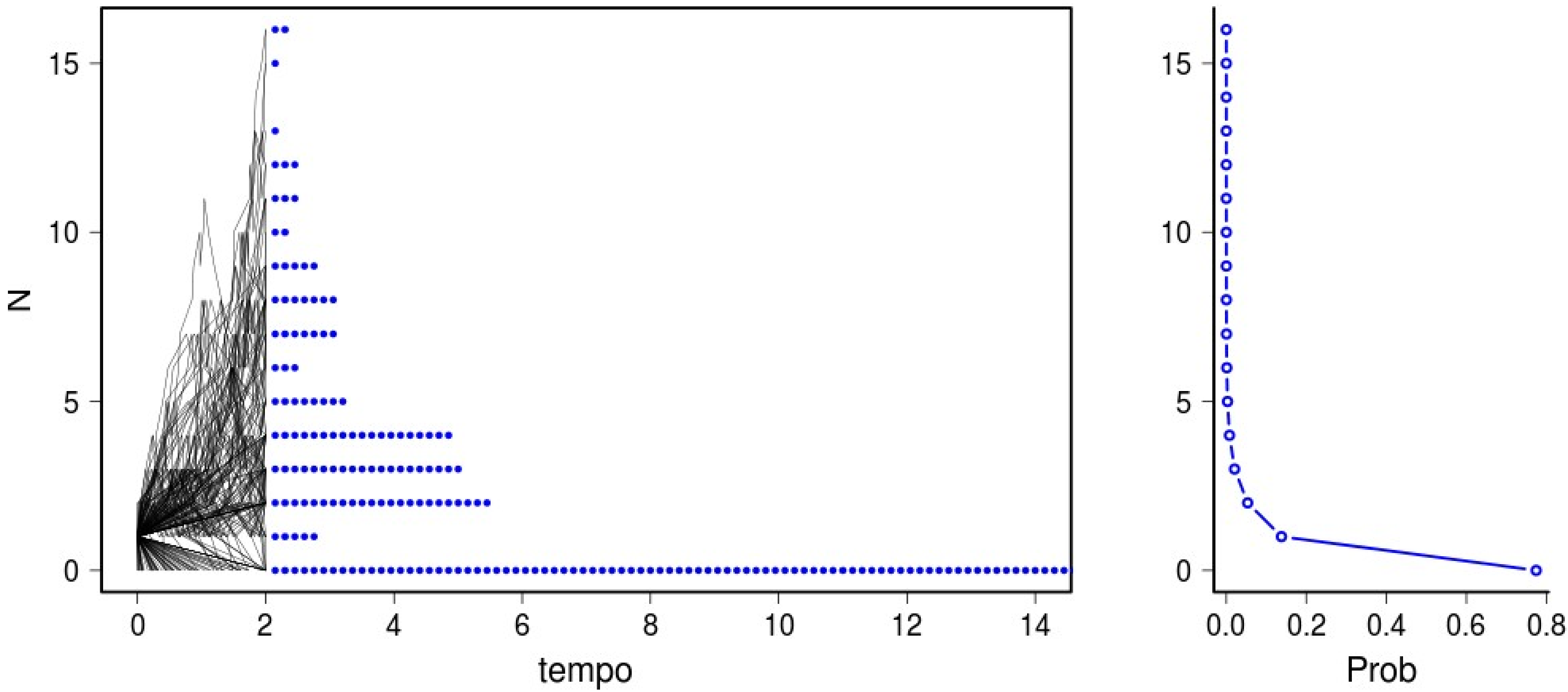


Dançando à beira do abismo



Probabilidade de extinção sempre maior que zero!

Generalizando para muitas spp



SADs

Motomura 1932

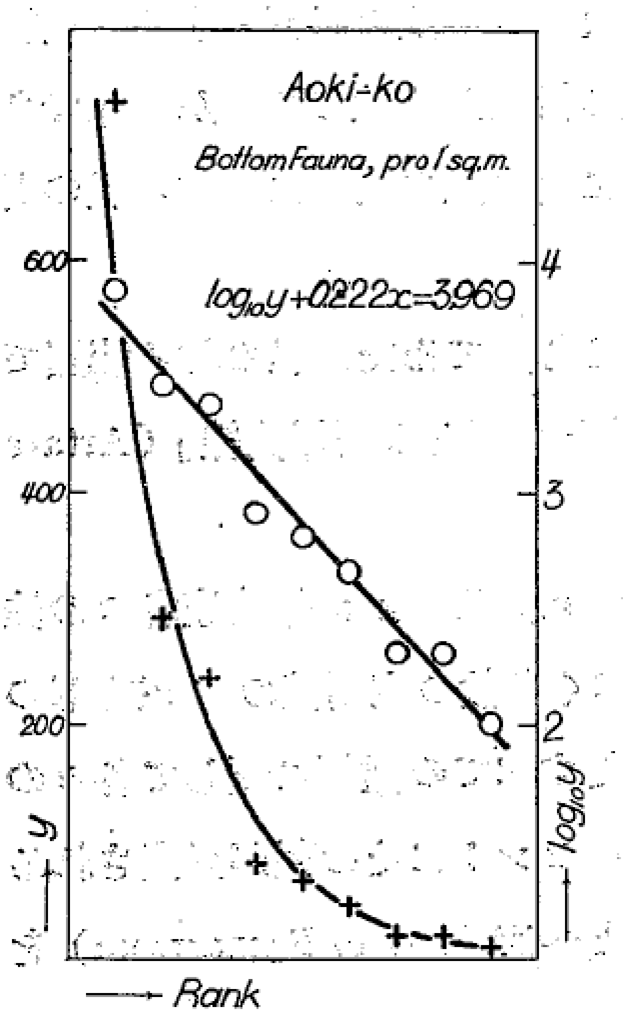
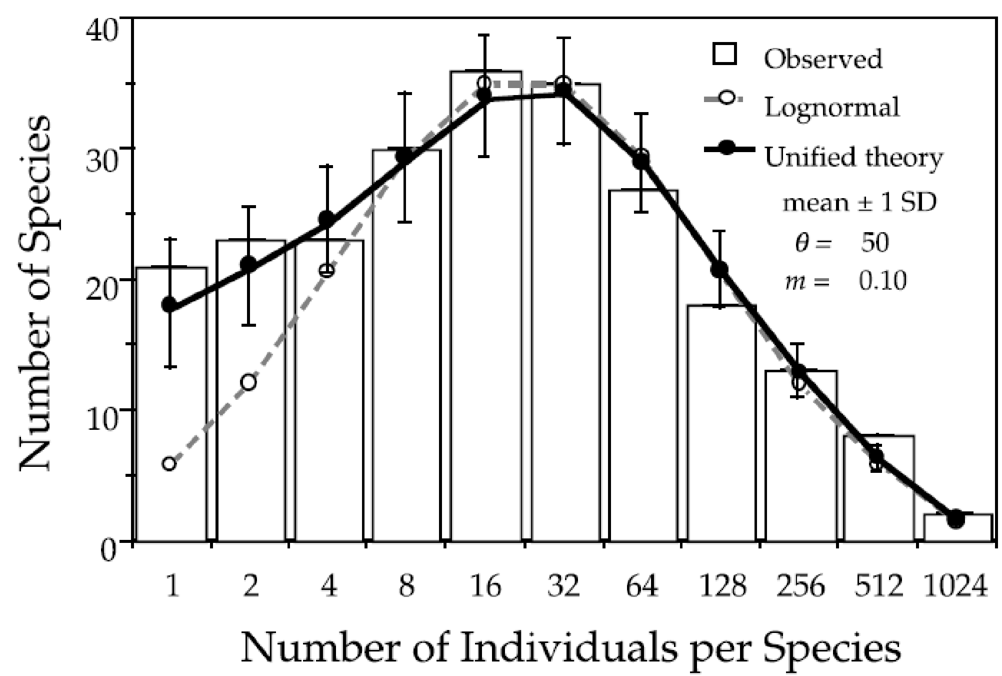


Fig. 1



Hubbell 2001

Teoria neutra da evolução

Evolutionary Rate at the Molecular Level

by
MOTOO KIMURA
National Institute of Genetics,
Mishima, Japan

Calculating the rate of evolution in terms of nucleotide substitutions seems to give a value so high that many of the mutations involved must be neutral ones.

NATURE, VOL. 217, FEBRUARY 17, 1968

Finally, if my chief conclusion is correct, and if the neutral or nearly neutral mutation is being produced in each generation at a much higher rate than has been considered before, then we must recognize the great importance of random genetic drift due to finite population number[23] in forming the genetic structure of biological populations. The significance of random genetic drift has

Motoo Kimura
1924 - 1994

Sobre o ombro de gigantes

Table I. Analogies between community ecology and population genetics

Property	Community ecology	Population genetics
System (size)	Metacommunity (J_M)	Population (N)
Subsystem	Local community	Deme
Neutral system unit	Individual organism	Individual gene
Diversity unit	Species	Allele
Stochastic process	Ecological drift	Genetic drift
Generator of diversity	Speciation (at rate ν)	Mutation (at rate μ)
Fundamental diversity number	$\theta \approx 2J_M\nu$	$\theta \approx 4N\mu$
Fundamental dispersal number	$I \approx 2J_L m$	$\theta \approx 4Nm$
Relative abundance distribution, $\Phi(x)$	$\theta x^{-1}(1-x)^{\theta-1}$	$\theta x^{-1}(1-x)^{\theta-1}$
Time to common ancestor (in small θ approximation)	$-J_M x(1-x)^{-1}\log(x)$	$-N x(1-x)^{-1}\log(x)$
Dispersal	Immigration	Migration

Mesmas perguntas, outras respostas

- Riqueza
  - Balanço entre extinção estocástica e migração/especiação
- Composição
  - Divergência ao acaso (deriva de comunidades)
- Abundância
  - Flutuação estocástica dos tamanhos populacionais

Dispersão

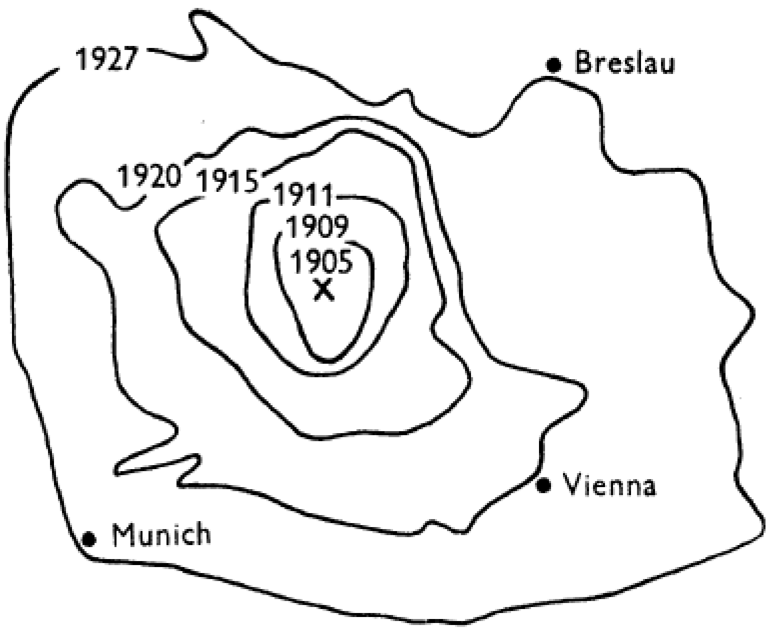
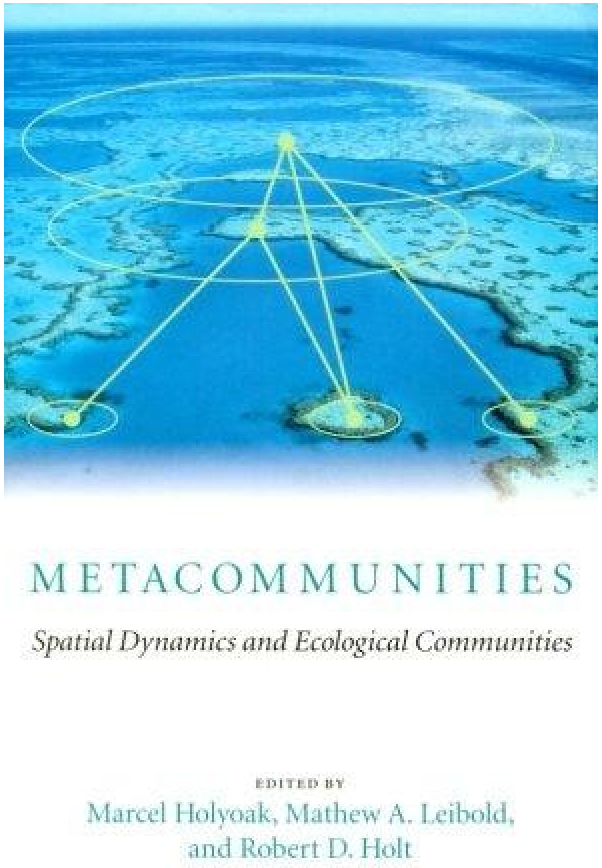


Fig. 1



Reação-difusão

RANDOM DISPERSAL IN THEORETICAL POPULATIONS

By J. G. SKELLAM

Biometrika, Vol. 38, No. 1/2 (Jun., 1951), pp. 196–218

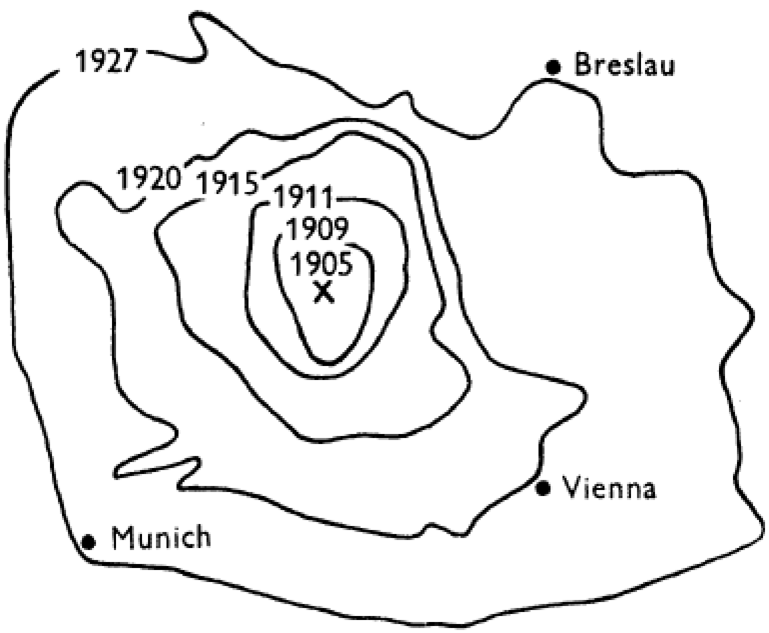
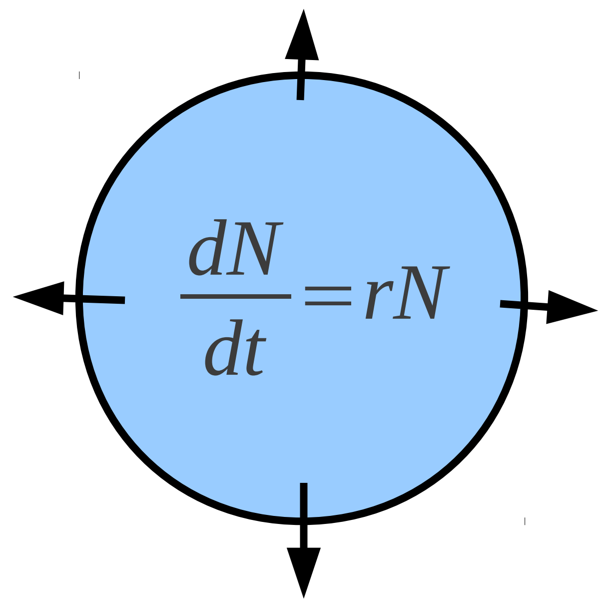
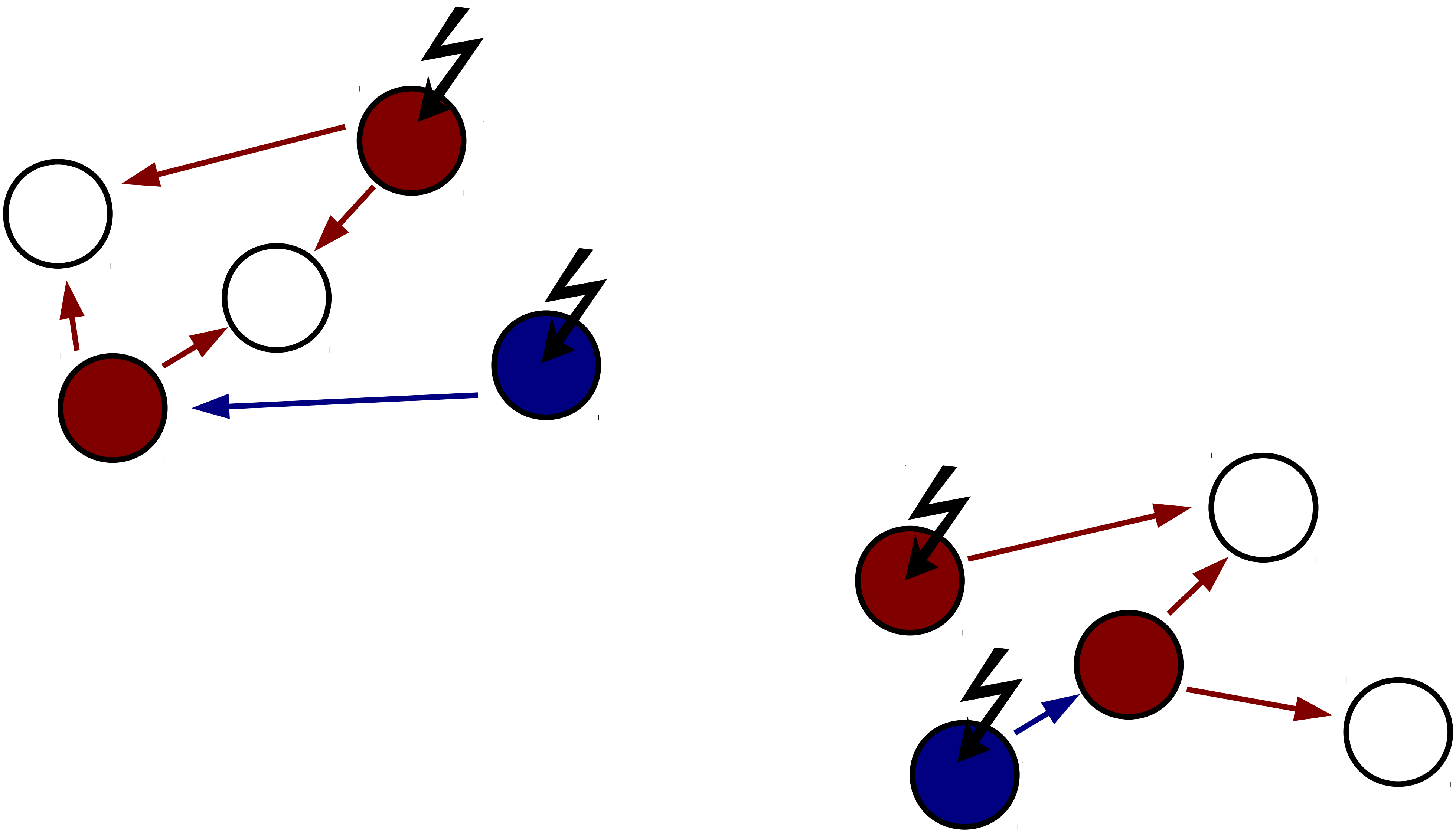


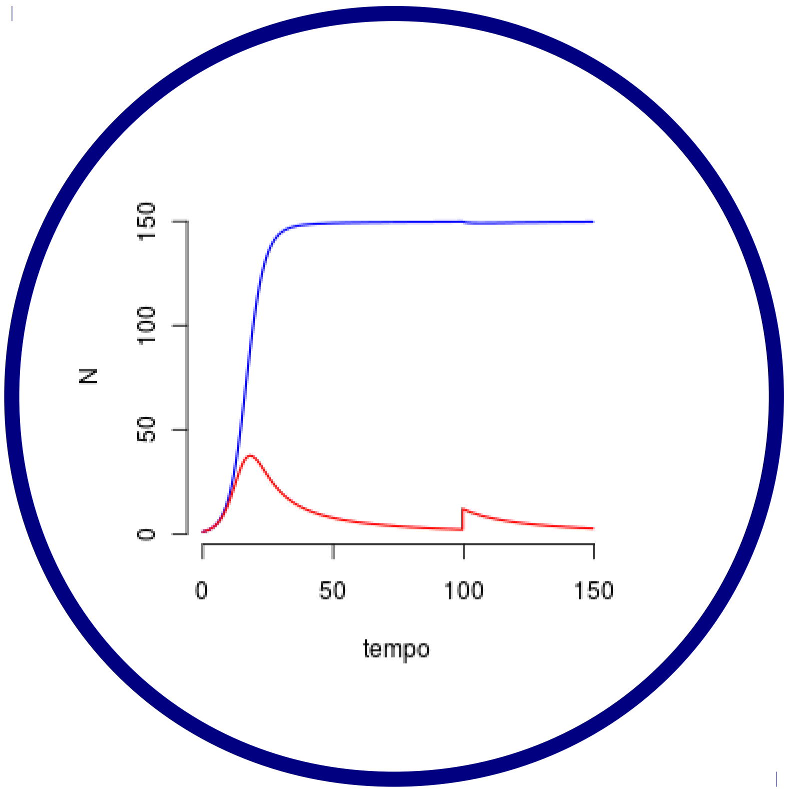
Fig. 1

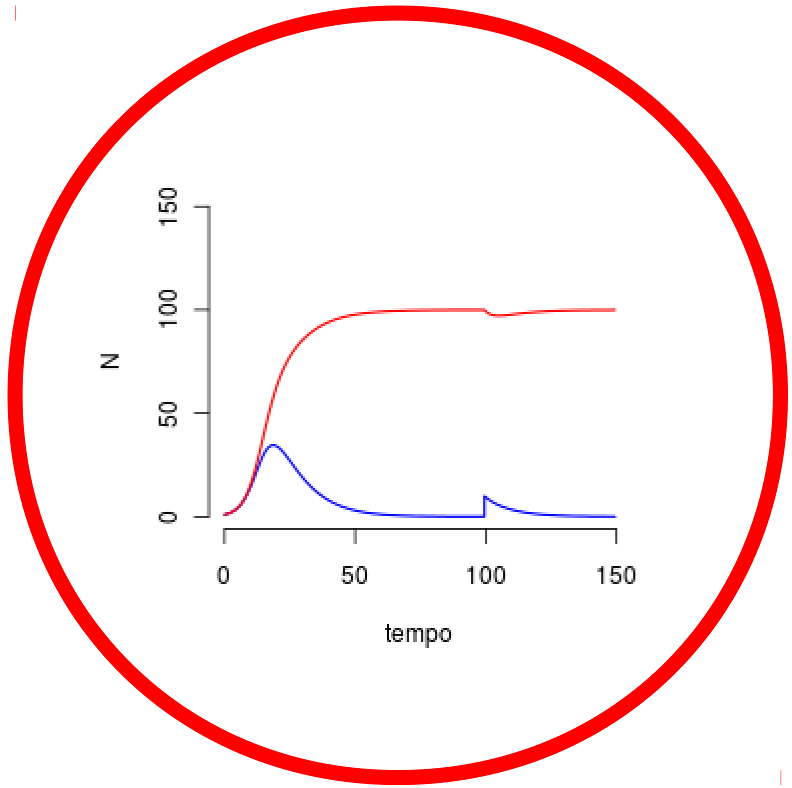


Colonização x Competição



Teorema da coexistência





Metacomunidades

	NICHO	DERIVA	DISPERSÃO	ESPECIAÇÃO
Biogeografia de ilhas		X	X	
Patch dynamics			X	
Mass effects	X		X	
Species sorting	X		X	X
Neutral dynamics		X	X	X