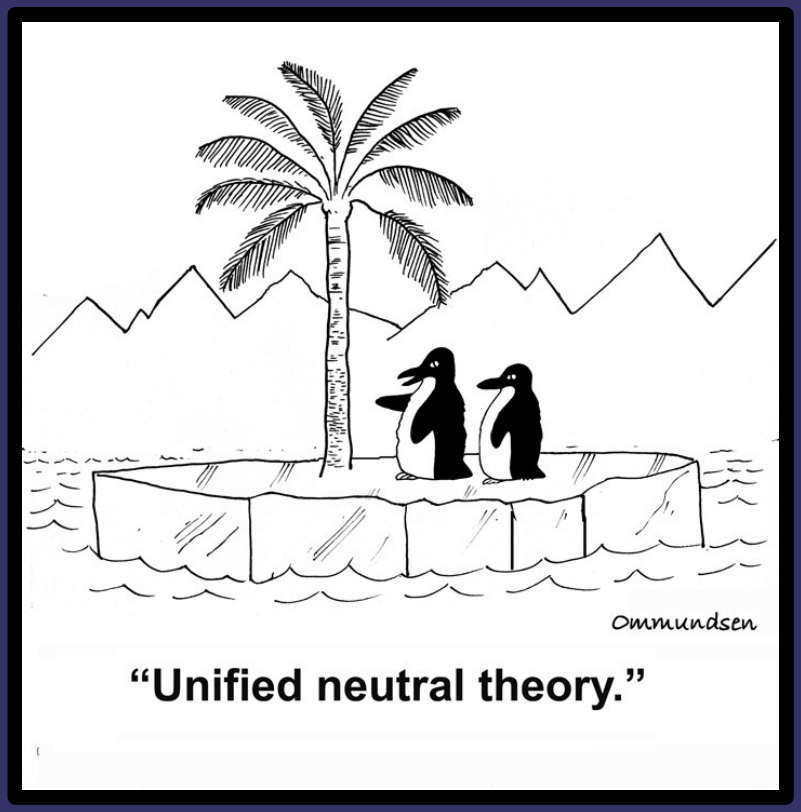
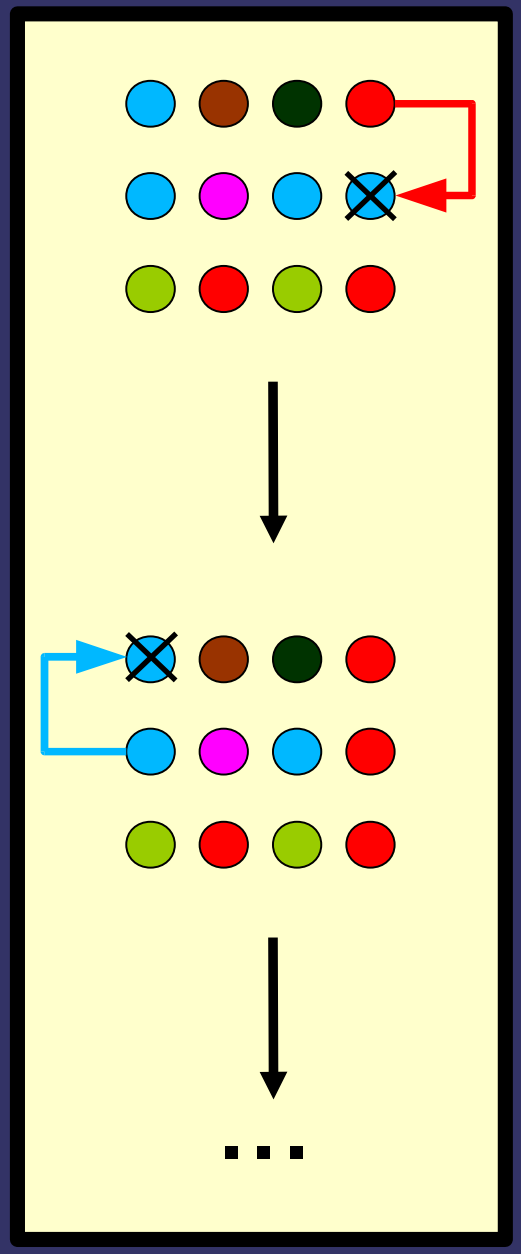
Modelos de Dinâmica Neutra de Comunidades



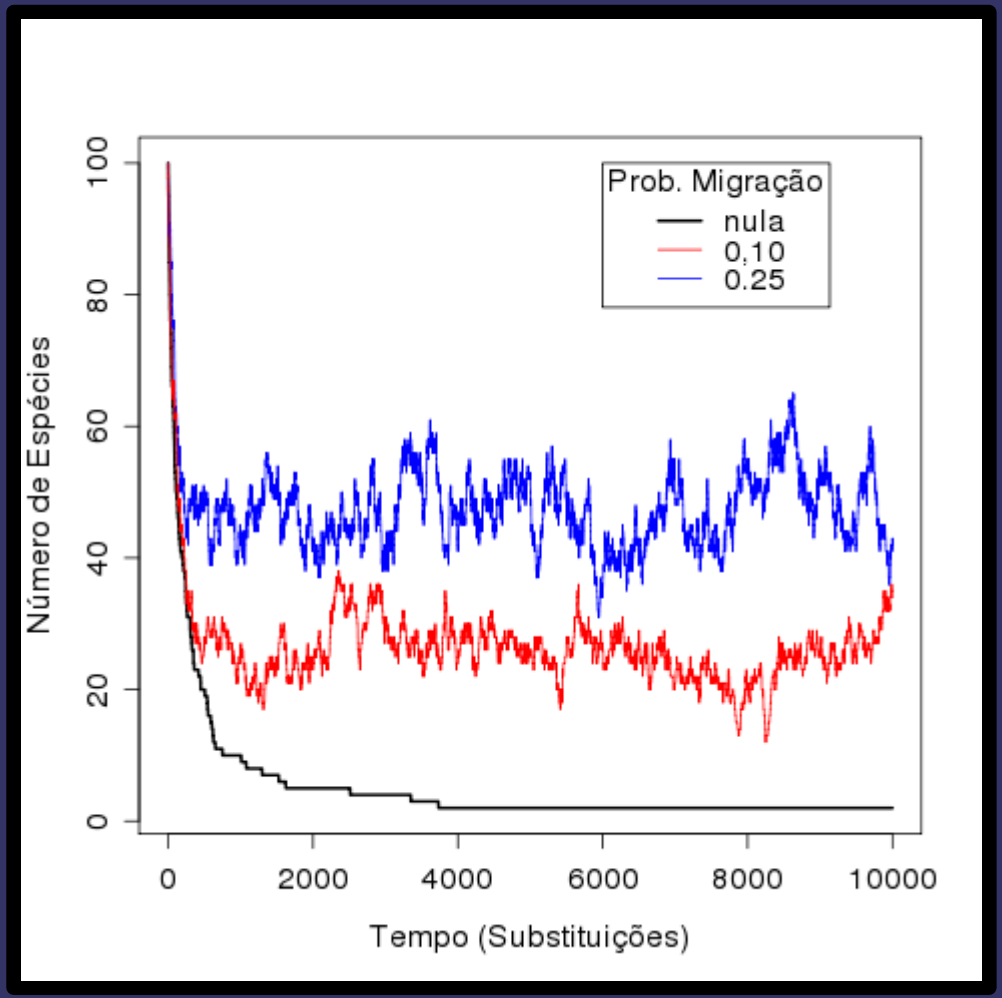
Dinâmica Aleatória de Mortes e Nascimentos



- Indivíduos pertencem a n classes diferentes.
- Intervalos de tempo pequenos: N muda por perda ou acréscimo de **um** indivíduo.
- Em média perdas igualam acréscimos (E[r]=0)
- Há três transições possíveis, dado o intervalo pequeno de tempo:
  - $N_{t+dt} = N_t$
  - $N_{t+dt} = N_t + 1$
  - $N_{t+dt} = N_t - 1$
- **Neutralidade**: as probabilidades destas transições são iguais para todas as classes.

Kendall, 1948. Ann. Math. Statist.
Caswell, 1976. Ecol. Monogr.

Uma Dinâmica de Não-equilíbrio

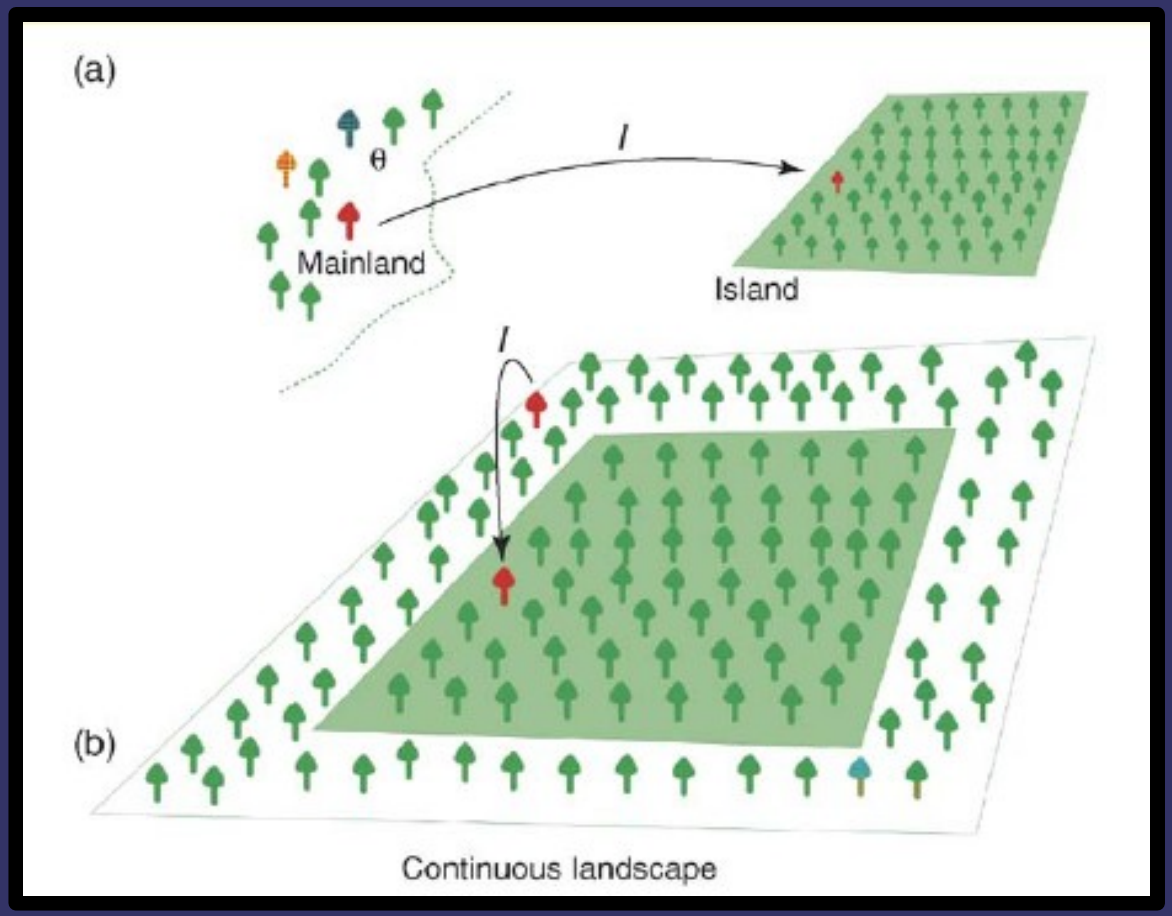


Simulação em R de dinâmica neutra com e sem entrada de migrantes no sistema.

Pacote *untb* de Robin Hankin.

Ver Hankin 2007. Journal of Statistical Software.

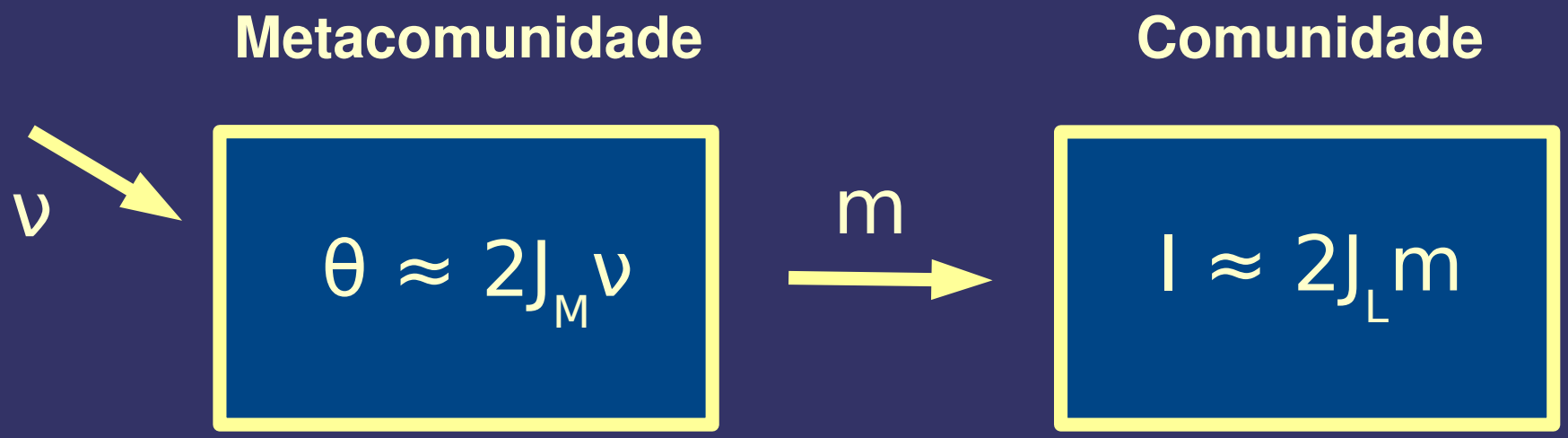
Teoria Neutra Unificada da Biodiversidade



- J_M : tamanho da metacomunidade
- ν : taxa de especiação
- J_L : tamanho da comunidade
- m : taxa de migração
- $I \approx 2J_L m$
- $\theta \approx 2J_M \nu$

Alonso et al. 2006. TREE

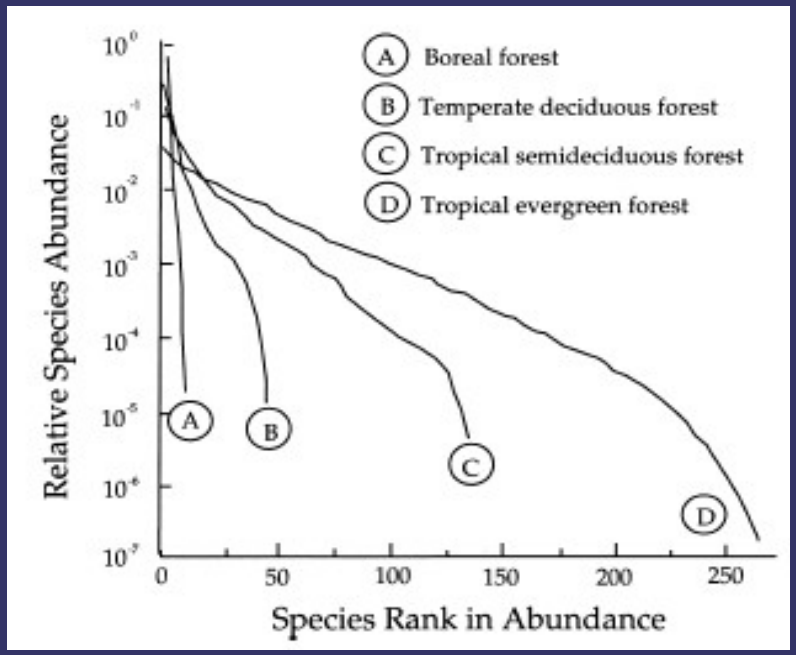
Escala Local e Regional

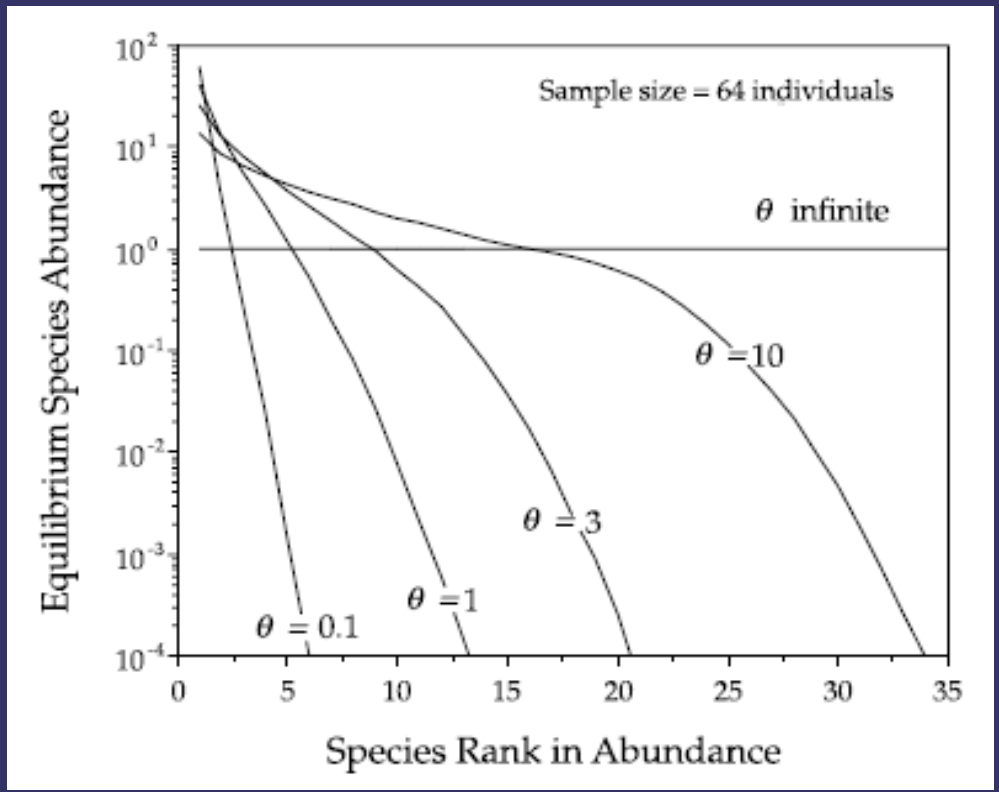


Dinâmica neutra estabilizada por entrada de espécies no sistema por especiação.

Dinâmica neutra estabilizada por entrada de espécies no sistema por migração.

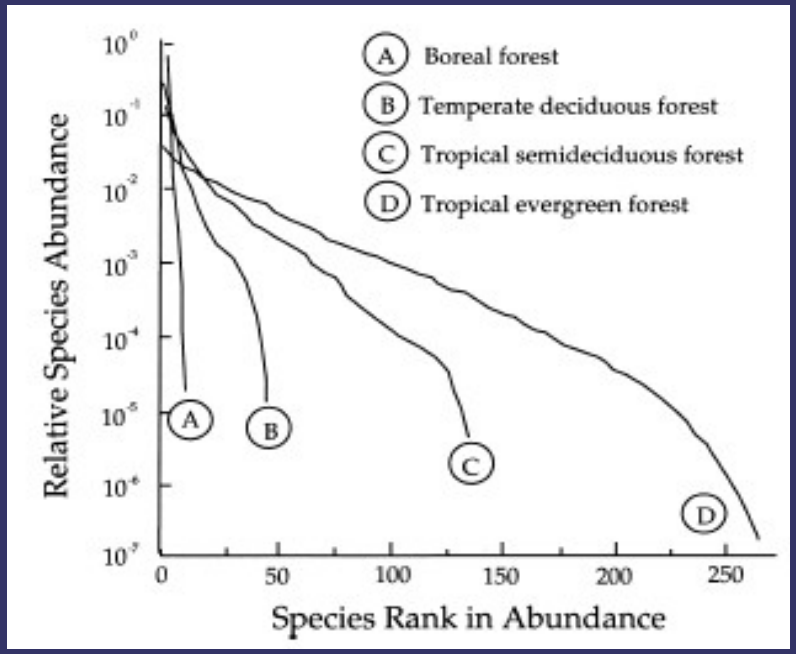
Previsões do Modelo

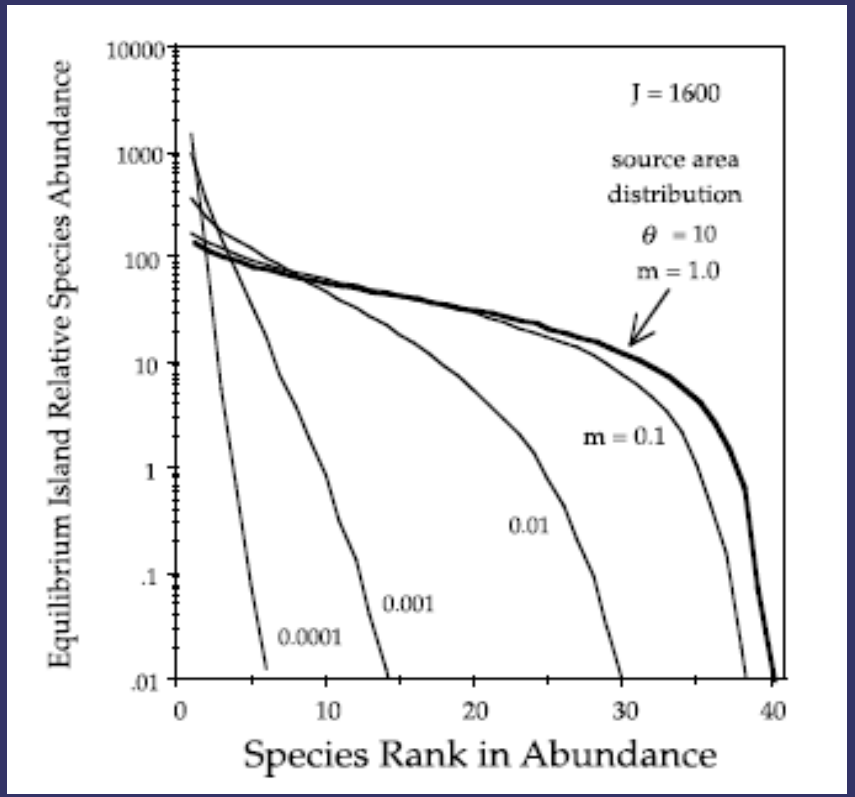




Hubbell, S.P. (2001). The Unified Neutral Theory of Biodiversity and Biogeography. Princenton Univ. Press.

Previsões do Modelo





Hubbell, S.P. (2001). The Unified Neutral Theory of Biodiversity and Biogeography. Princenton Univ. Press.

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	$\theta \approx 2J_M\nu$	$\theta \approx 4\,N\mu$
Fundamental dispersal number	$I \approx 2J_L m$	$\theta \approx 4\,Nm$
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

Alonso et al. 2006. TREE.

Teoria Neutra da Evolução Molecular

Evolutionary Rate at the Molecular Level

by
MOTOO KIMURA

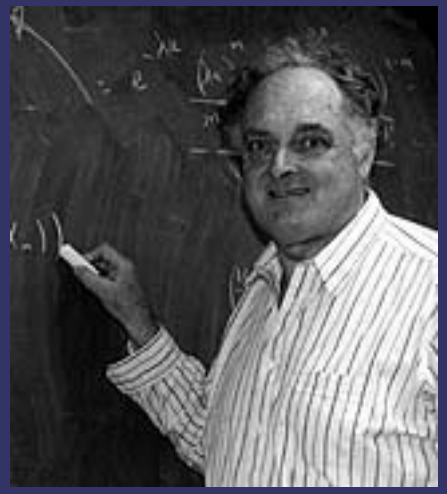
National Institute of Genetics,
Mishima, Japan

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

A Fórmula de Amostragem de Ewens



Warren Ewens

THEORETICAL POPULATION BIOLOGY 3, 87–112 (1972)

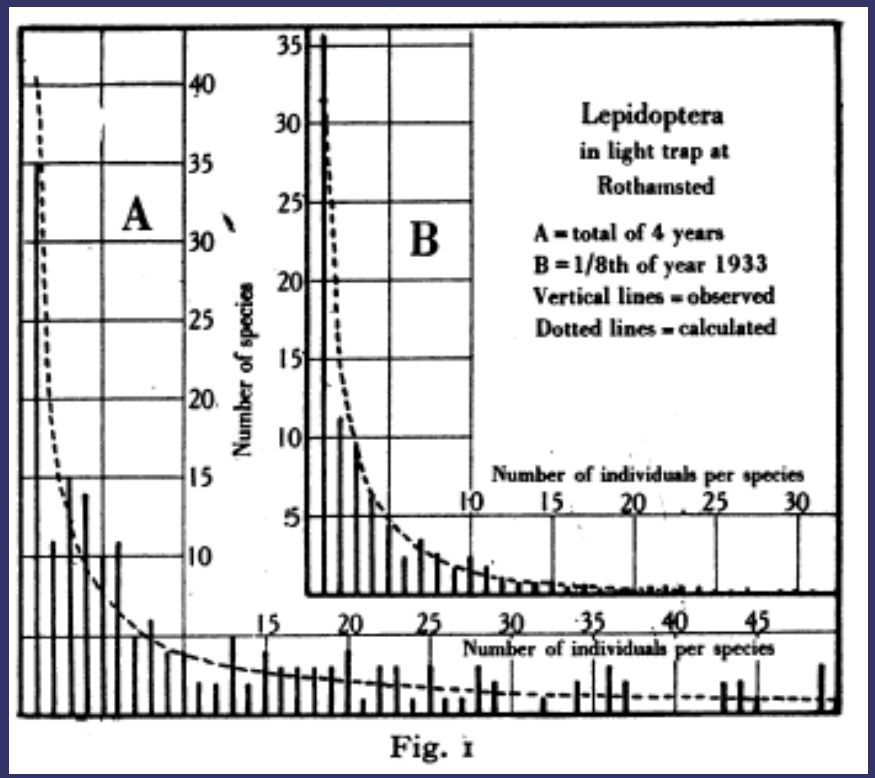
The Sampling Theory of Selectively Neutral Alleles*

W. J. EWENS†

Department of Zoology, University of Texas at Austin, Austin, Texas, 78712

Teoria da Amostragem em Ecologia

Sir Ronald Fisher
1890-1962



Distribuição de Série Logarítmica

Journal of Animal Ecology, 1943

Uma Profusão de Modelos

TABLE 1. A summary of 10 versions of the neutral model.

Reference	Has metacommunity model?	Spatially explicit metacommunity?	Constant local population (zero-sum)?	Finite metapopulation?
Caswell (1976)	no†	NA	yes/no‡	NA
Hubbell (1979), Hubbell and Foster (1986)	no†	NA	yes	NA
Hubbell (2001)	yes	no	yes	yes
Bell (2000)	yes	no	yes§	yes
Bell (2001, 2003)	yes	yes	yes§	yes
Volkov et al. (2003)	yes	no	yes	no
McKane et al. (2000), Vallade and Houchmandzadeh (2003), McKane et al. (2004)	yes	no	yes	yes¶
Etienne and Olff (2004)	yes	no	yes	yes
He (2005)	yes	no	yes	no
Etienne (2005)	yes	no	yes	yes

McGill et al. 2006. Ecology

Neutralismo x Selecionismo

Non-Darwinian Evolution

Most evolutionary change in proteins may be due to neutral mutations and genetic drift.

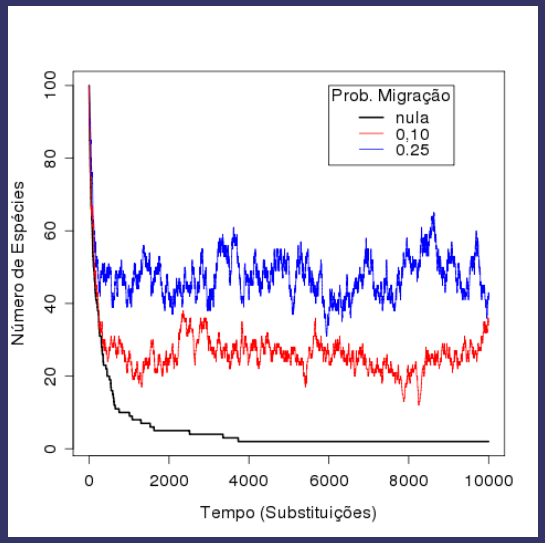
Jack Lester King and Thomas H. Jukes

16 MAY 1969

From these considerations it is not difficult to conclude that the stream of spontaneous alterations in DNA, continuously fed into the genetic pool, should include far more acceptable changes that are neutral than changes that are adaptive. Protein molecules

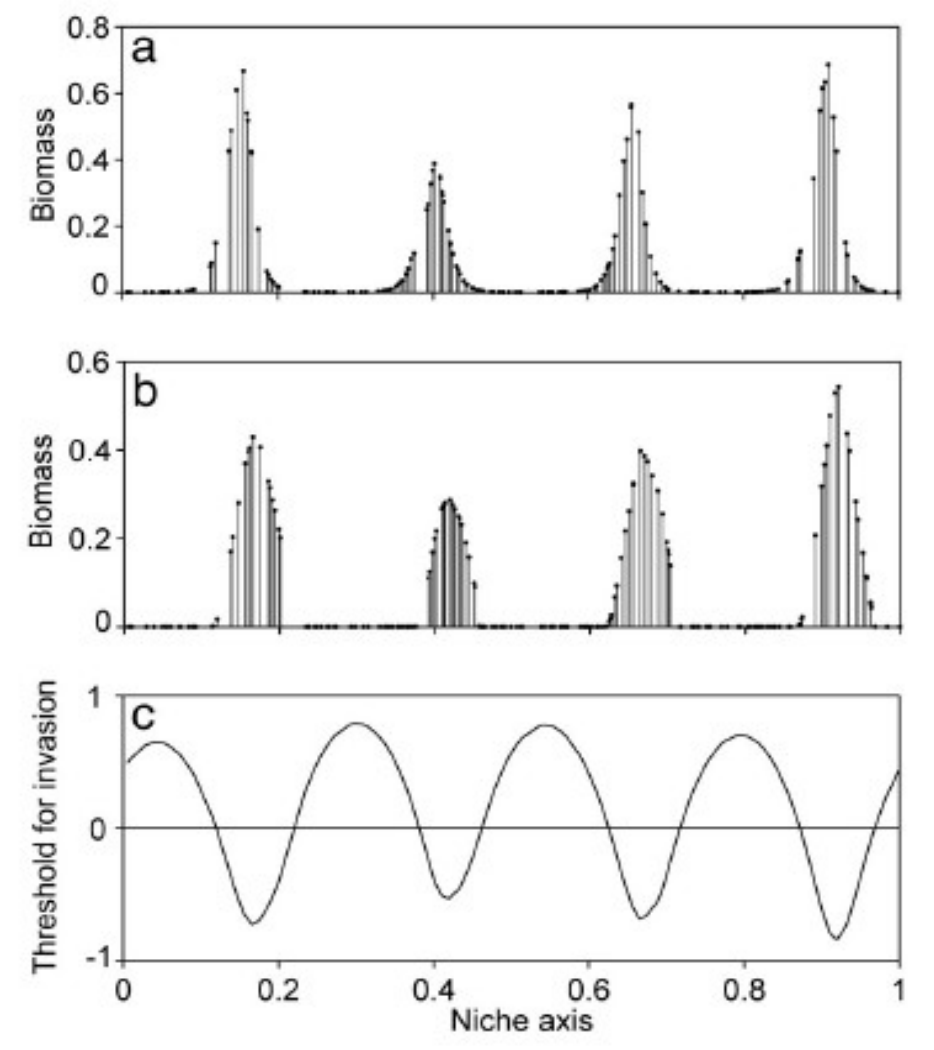
Science, 1969

Um Nicho para a Neutralidade



Adler et al. 2007 Ecology Letters.

Coexistência por Excesso de Similaridade



Arranjo instável, após 1000 gerações

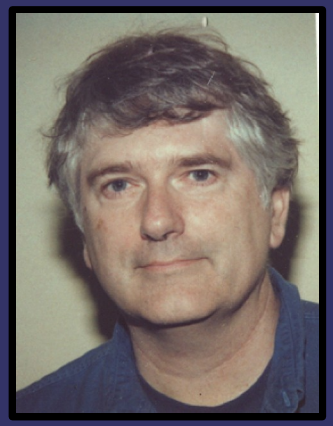
Arranjo estável, com pequena compensação por competição intraespecífica

Invasibilidade do eixo de nicho

Schefer & Van Nes 2006. PNAS

Os Méritos de Hubbell

- Teoria que propõe ligações explícitas entre escalas por meio das dinâmicas de processos evolutivos e ecológicos.
- Tem estimulado a pesquisa em:
  - Dinâmicas de não equilíbrio
  - Estabilização x diversificação
  - Modelos mínimos em ecologia
  - Teorias de amostragem
  - SADs
  - ...



Stephen Hubbell

A fina arte de fazer pensar

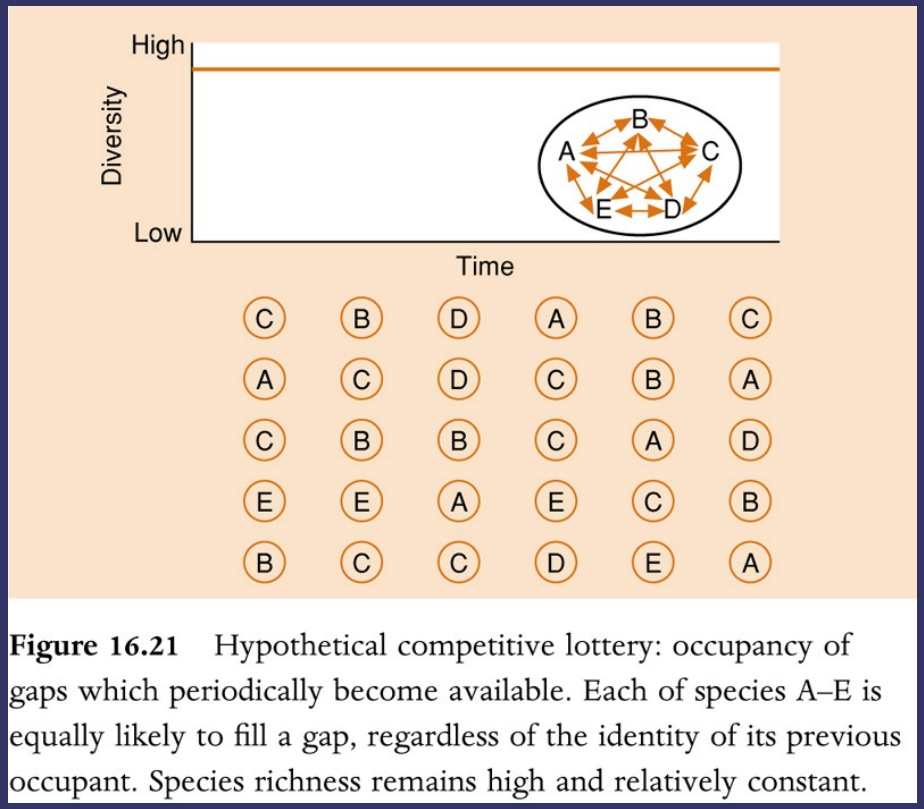


Figure 16.21 Hypothetical competitive lottery: occupancy of gaps which periodically become available. Each of species A–E is equally likely to fill a gap, regardless of the identity of its previous occupant. Species richness remains high and relatively constant.

"Tropical forests and reefs are subject to severe disturbances often enough that equilibrium may never be attained."

Science, 1978

"I think it has been cited so often because it presents several possible mechanisms that can produce and maintain high diversity [...]"

Joseph Connell