

INTRODUÇÃO À MACROEVOLUÇÃO: EVOLUÇÃO DE FENÓTIPOS ACIMA DO NÍVEL DE ESPÉCIES

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diogoprovete.weebly.com

Cronograma do curso

- 4 partes
- 1 parte da manhã: o que é evolução, diferença entre micro- e macroevolução, exemplos de processos (4 processos), níveis de seleção (multi-level selection theory), maneiras de unificar micro e macroevolução por meio de genética quantitativa, idéia de “progresso”, convergência vs. contingência como processos geradores de diversidade, modos de especiação, quem estuda macroevolução geralmente é paleontólogo, mas agora isso está mudando porque 1) cada vez mais incluído na ecologia e biogeografia, por conta dos métodos, e porque 2) especiação pode ocorrer em curtos períodos de tempo (Finches Science paper)

Cronograma do curso

■ Parte da manhã

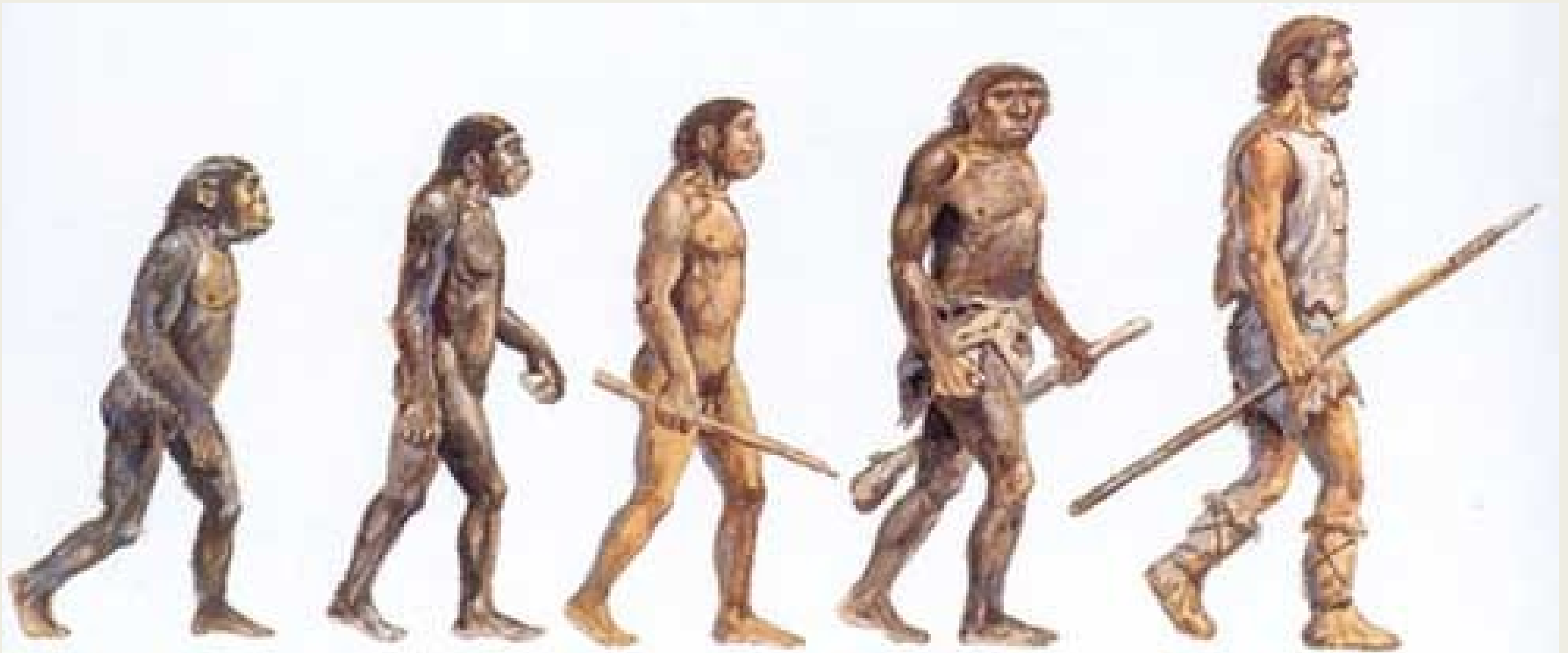
- *O que é evolução, diferença entre micro- e macroevolução*
- *Falar que normalmente macroevolução é estudada nas disciplinas de paleontologia e zoologia de invertebrados e vertebrados, do que em disciplina de genética e evolução*
- *Falar que isso é resultado de uma longa tradição “neontologistas” vs. Paleontologistas que legava somente aos paleontólogos o estudo de macroevolução porque ela só ocorria ao longo do tempo geológico*
- *No entanto isso tem mudado com o advento de novos métodos analíticos e disponibilidade de dados*
- *Além disso, temos evidência hoje de que pode haver especiação em curtos períodos de tempo (exemplos Darwin finches – 2 gerações)*

Cronograma do curso

■ Parte da tarde

- *Alguns trabalhos que foram ou estão sendo realizados no nosso laboratório envolvendo*
- *macroevolução de ecolocalização em morcegos em escala global,*
- *padrões de diversificação de formato de corpo de girinos neotropicais,*
- *evolução da relação alométrica entre vocalização e tamanho de corpo em anfíbios anuros do mundo,*
- *evolução da diurnalidade em mamíferos no mundo.*
- *evolução da coloração interna (melanina) de anfíbios anuros neotropicais,*
- *evolução da osmoregulação e tendência à terrestrialidade em caranguejos chama-maré (Uca).*

O que é evolução?



Australopithecus



Homo habilis



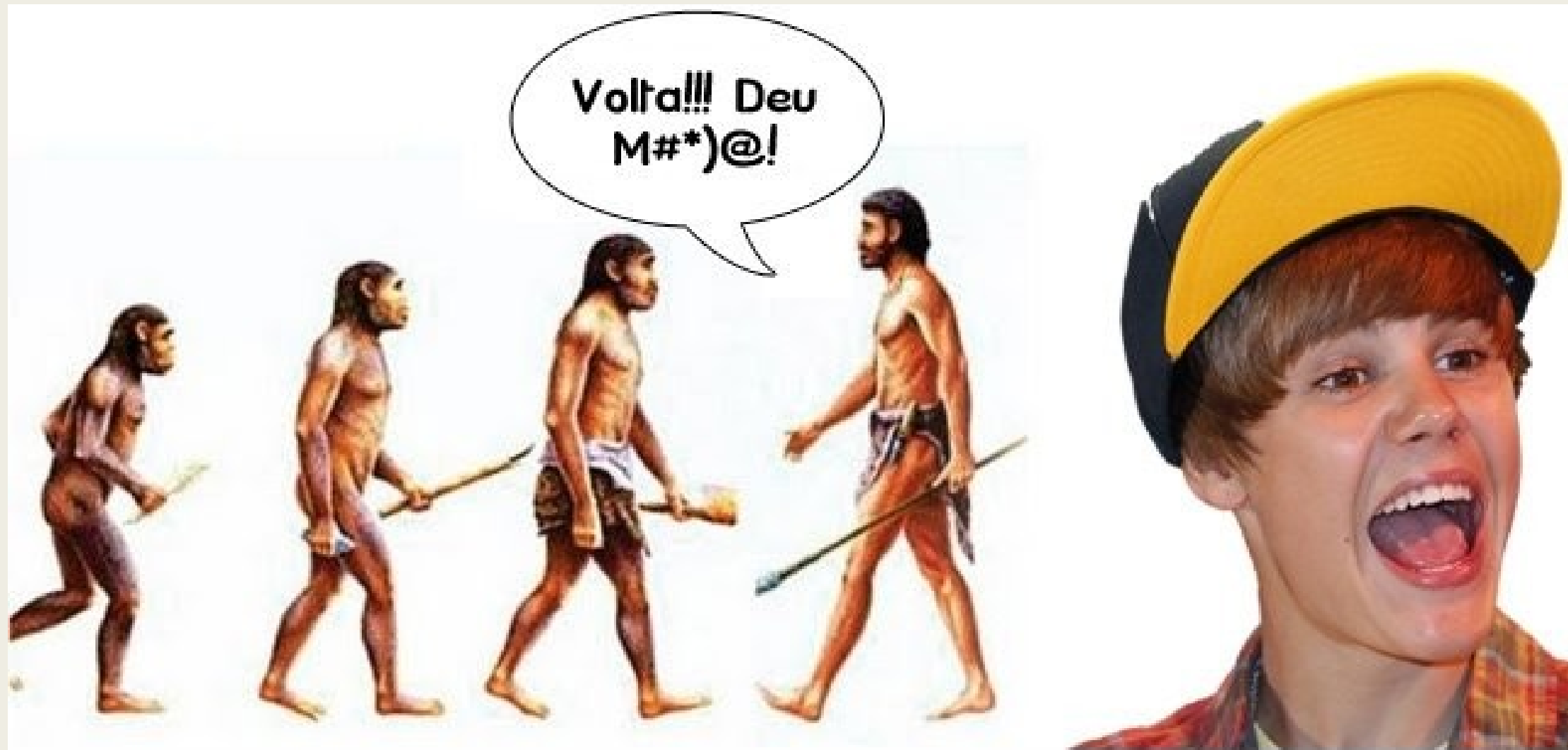
Homo erectus



*Homo sapiens
neanderthalensis*



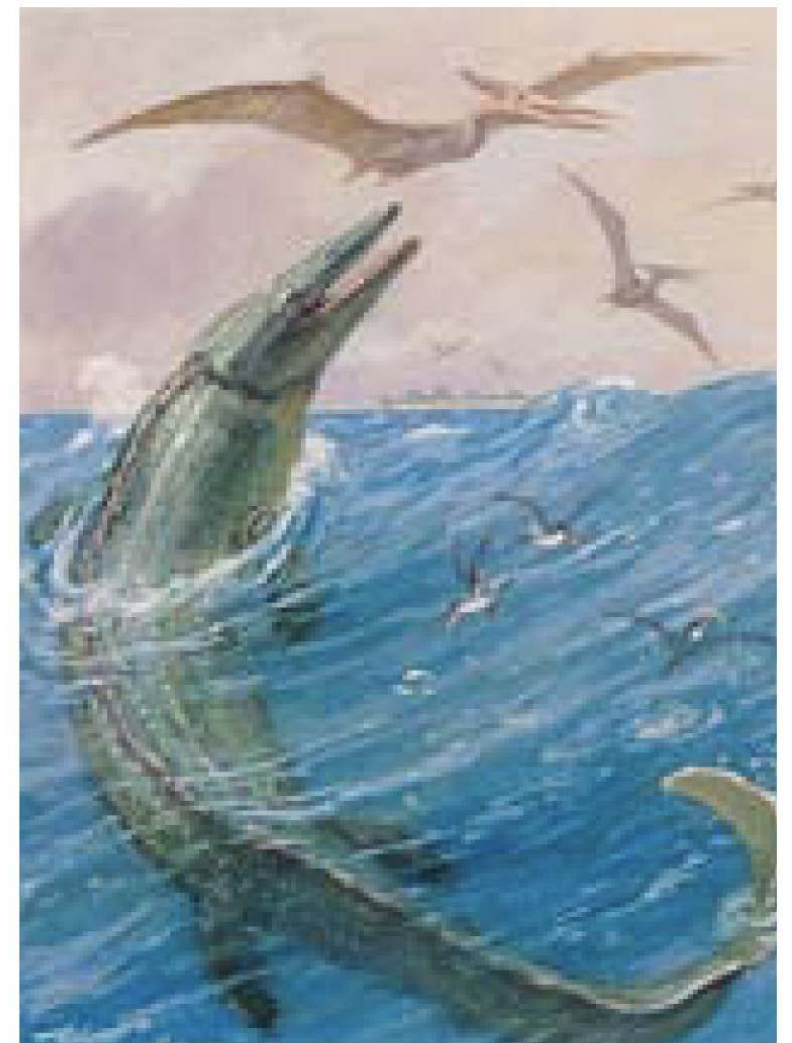
*Homo sapiens
sapiens*



Volta!!! Deu
M#*)@!

*Mudança da frequência gênica
ao longo das gerações*

Idéia de “progresso” embutida
nesta representação



CLASSICAL REPRESENTATIONS OF LIFE'S HISTORY reveal the severe biases of viewing evolution as embodying a central principle of progress and complexification. In these paintings by Charles R. Knight from a 1942 issue of *National Geographic*, the first panel shows invertebrates of the Burgess Shale. But as soon as fishes evolve, no subsequent scene ever shows

another invertebrate, although they did not go away or stop evolving. When land vertebrates arise (*panel 2*), we never see another fish, even though return of land vertebrate lineages to the sea may be depicted (*panel 3*). The sequence always ends with mammals—even though fishes, invertebrates and reptiles are still thriving—and, of course, humans.

NOTES AND COMMENTARY

**On the Darwinian View
of Progress**

AMARTYA SEN

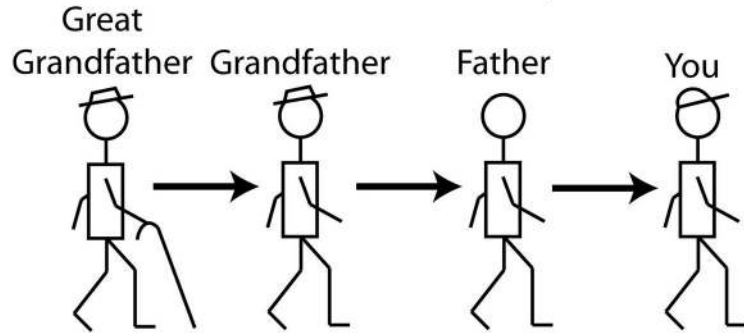
POPULATION AND DEVELOPMENT REVIEW 19, NO. 1 (MARCH 1993)

*ISSN 2079-0864, Biology Bulletin Reviews, 2011, Vol. 1, No. 3, pp. 199–206. © Pleiades Publishing, Ltd., 2011.
Original Russian Text © N.N. Iordansky, 2010, published in Zhurnal Obshchei Biologii, 2010, Vol. 71, No. 6, pp. 488–496.*

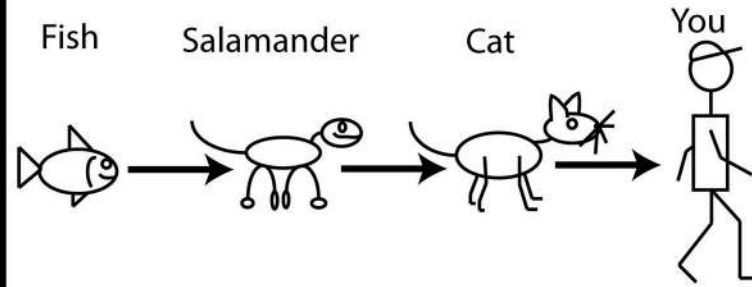
Charles Darwin and the Problem of Evolutionary Progress

N. N. Iordansky

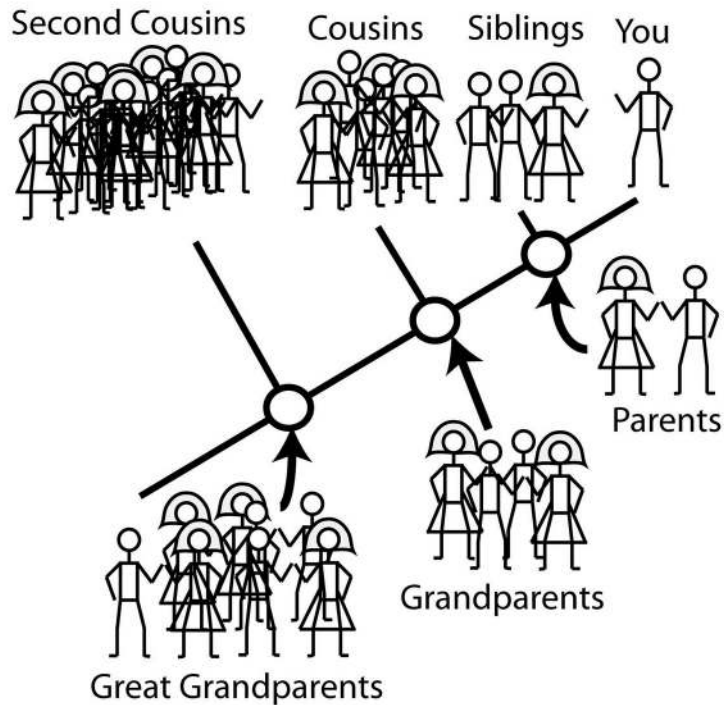
This is NOT Your Family Tree



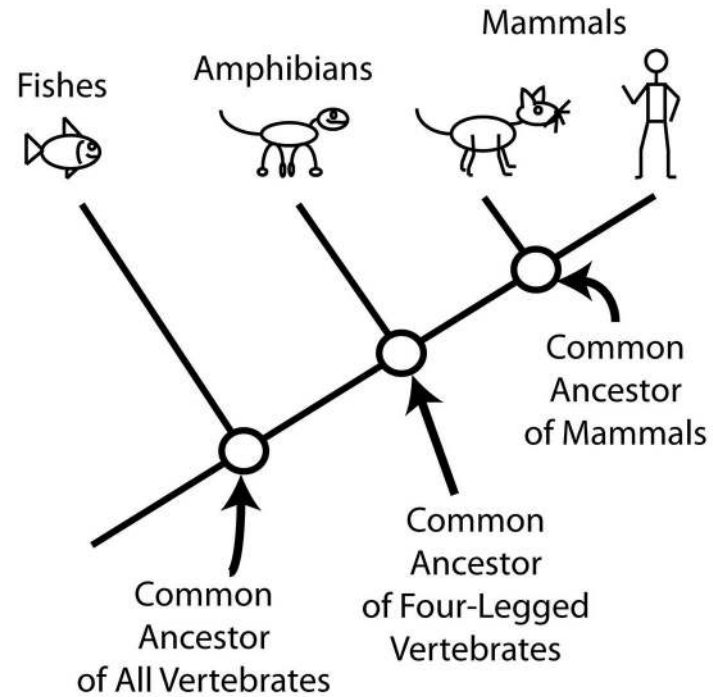
This is NOT Evolution



This is Your Family Tree

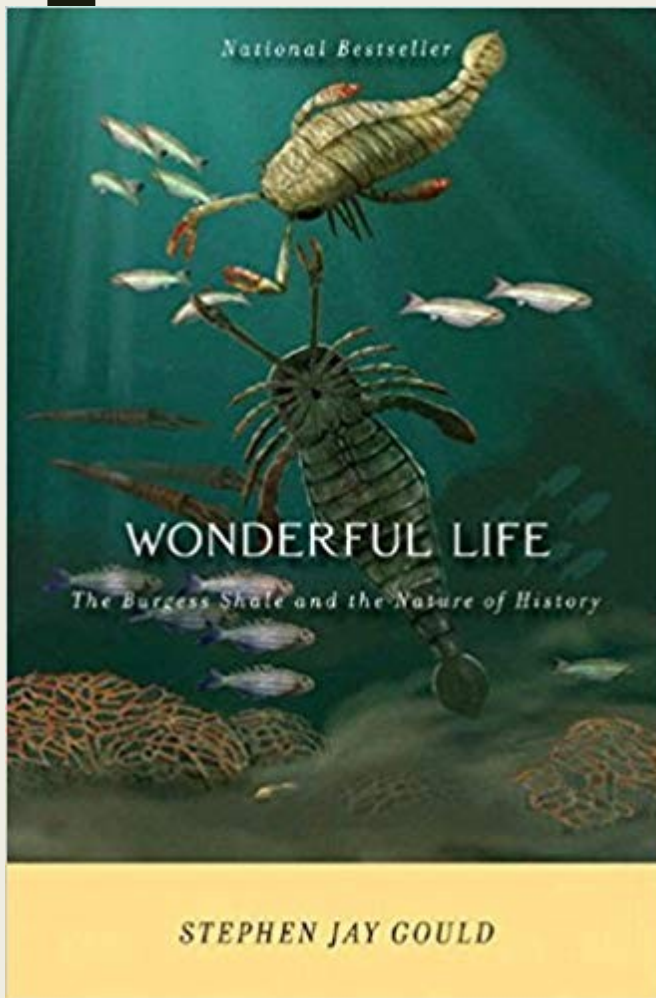


This is Evolution

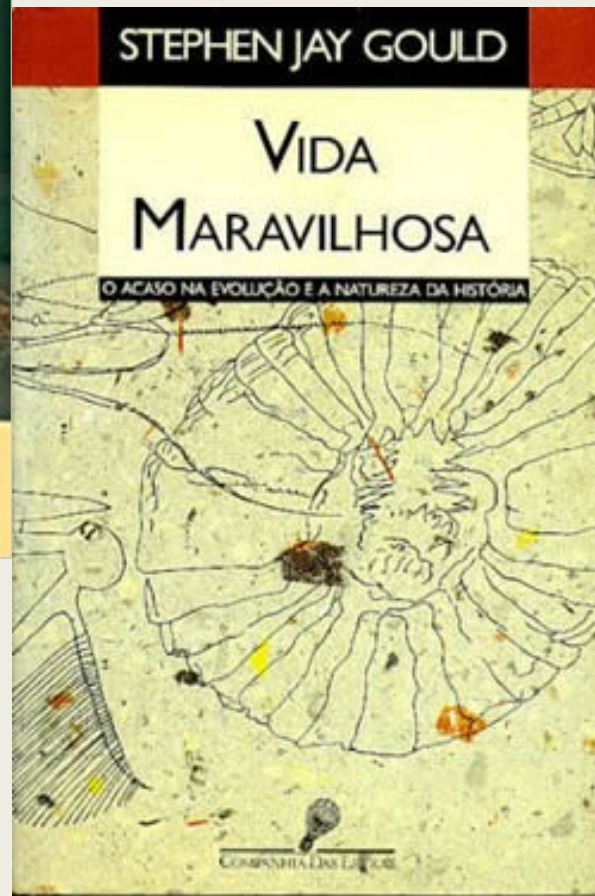


Debate contingência vs. predictabilidade

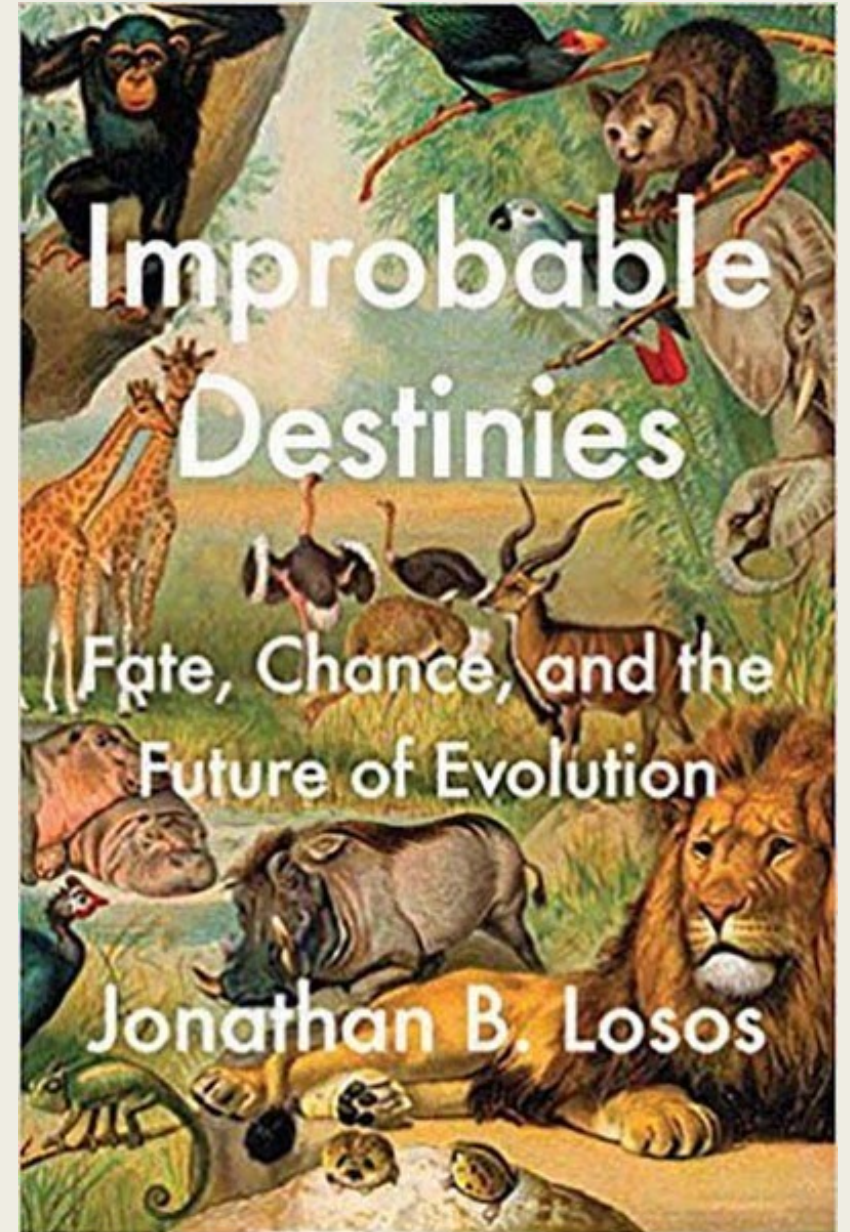
- Convergência é algo pervasivo na natureza
 - *Ambiente determina características das espécies*
 - *Portanto, espera-se encontrar espécies com características similares em ambientes similares*
 - *Uma derivação lógica disto é que podemos prever como organismos vão evoluir se soubermos que tipo de ambiente temos*
- Evolução não pode ser predita porque depende de processos aleatórios em nível de população e catástrofes podem causar extinções aleatórias



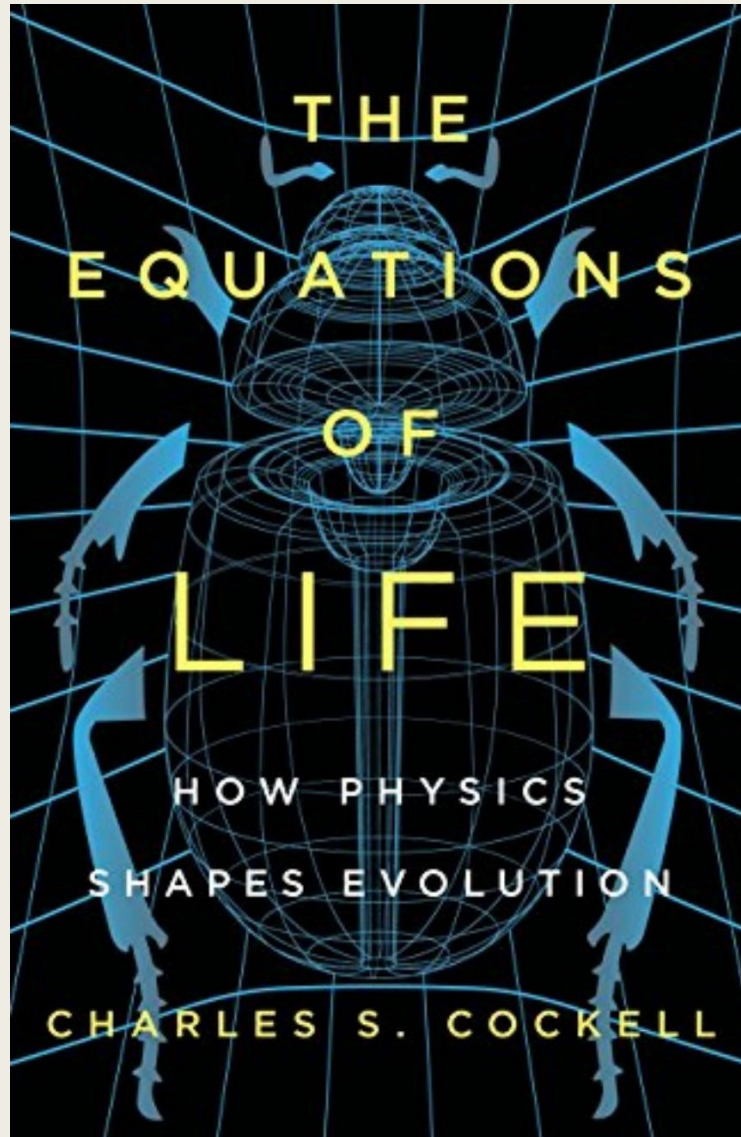
1990



Fora de



2017

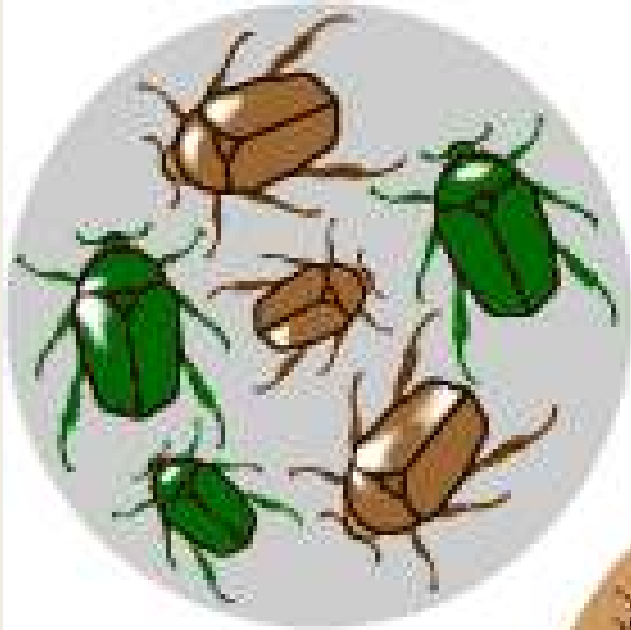


2018

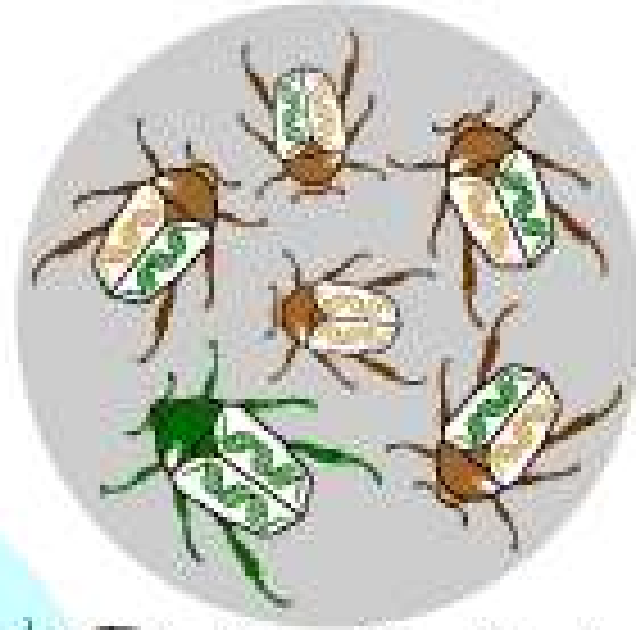
- Vida é restrita por leis físicas
- Em algum aspecto, a evolução da vida pode ser predita, porque deve obedecer às leis físicas
- Otimização do *fitness* não é algo absoluto

Evolução

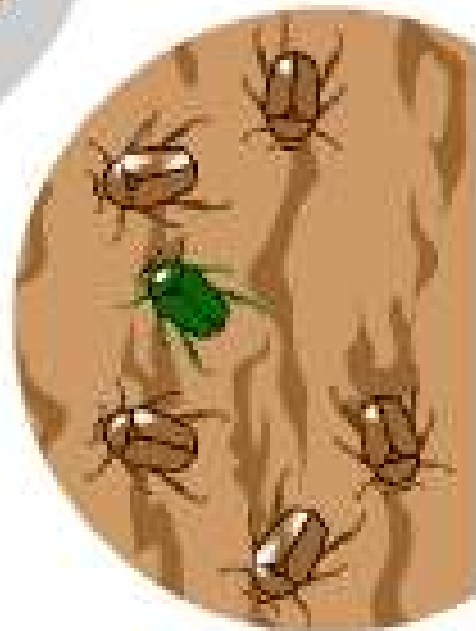
- Para ocorrer evolução deve haver:
- 1) variação em atributos fenotípicos e/ou alelos
- 2) Essa variação deve ser herdável
- 3) A frequência com que atributos fenotípicos estão distribuídos na população deve afetar o desempenho (*fitness*) dos indivíduos



Variação



Hereditariedade



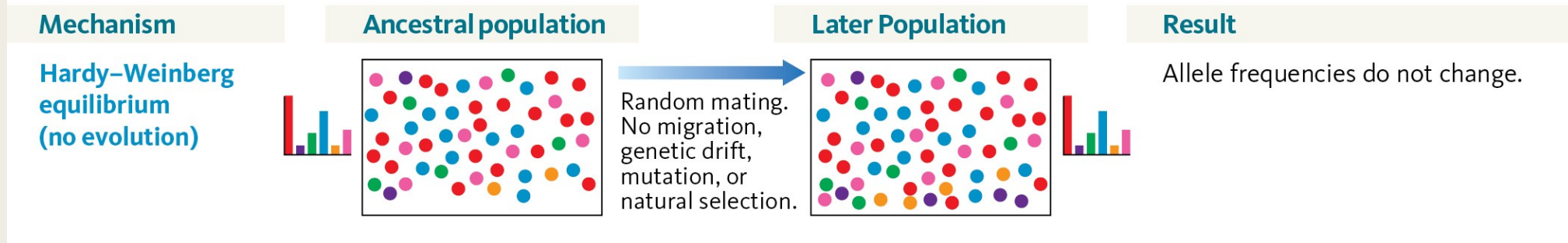
Reprodução diferencial



Níveis de organização e evolução

Micro vs. Macroevolução

Mechanisms of Evolution: Altering Allele Frequencies

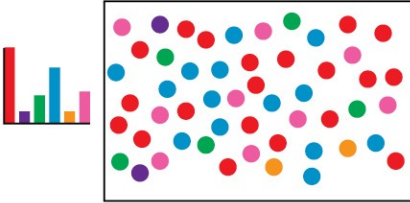
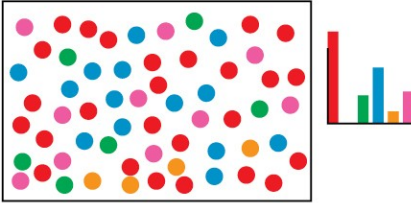
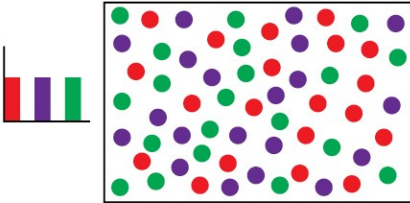
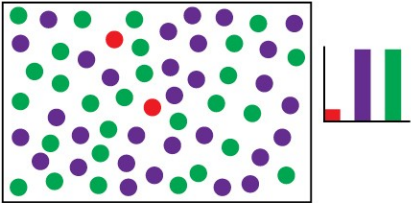
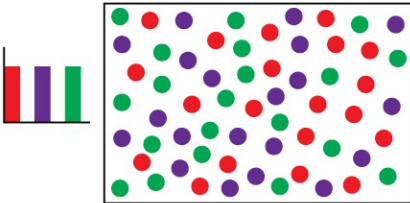
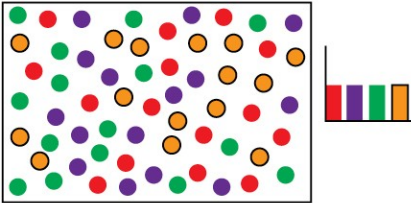
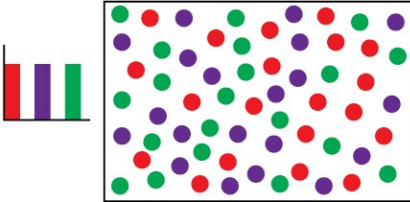
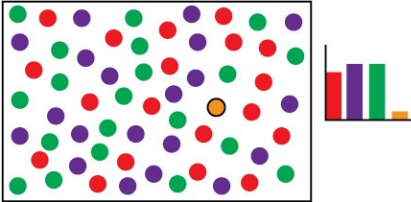


Modelo nulo da
genética de populações
e evolução



Prediz a frequência alélica
numa população na
ausência de seleção,
migração, mutação, e deriva

Mechanisms of Evolution: Altering Allele Frequencies

| Mechanism | Ancestral population | Later Population | Result |
|------------------------------|--|--|--|
| Drift |  | <p>Imperfect sampling causes some alleles to be underrepresented relative to others.</p>  | Purple allele is lost. |
| Natural selection |  | <p>Environmental factors are unfavorable for red alleles</p>  | Red allele becomes less common. |
| Migration (gene flow) |  | <p>Individuals with a new allele enter the population.</p>  | Allele that enters becomes more common. |
| Mutation |  | <p>A red allele becomes an orange allele.</p>  | New genetic variant appears in the population. |

Mechanisms of Evolution: Altering Allele Frequencies

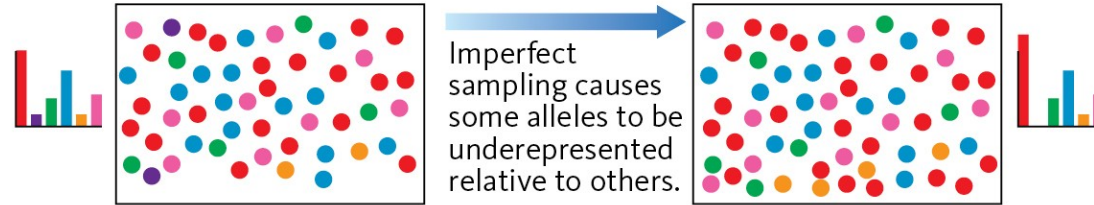
Mechanism

Ancestral population

Later Population

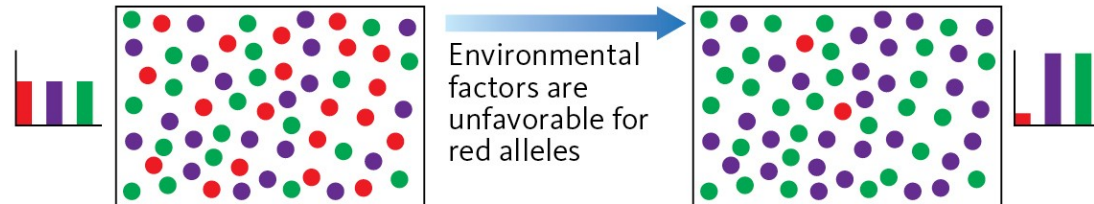
Result

Drift



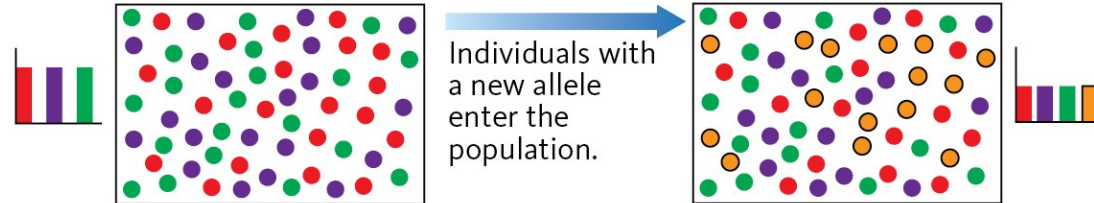
Purple allele is lost.

Natural selection



Red allele becomes less common.

Migration (gene flow)



Allele that enters becomes more common.

Mutation



New genetic variant appears in the population.

Diminuem
diversidade
genética

Aumentam
diversidade
genética

Mechanisms of Evolution: Altering Allele Frequencies

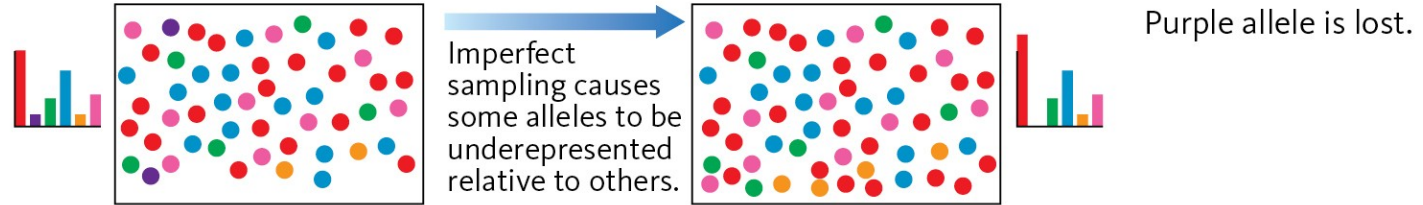
Mechanism

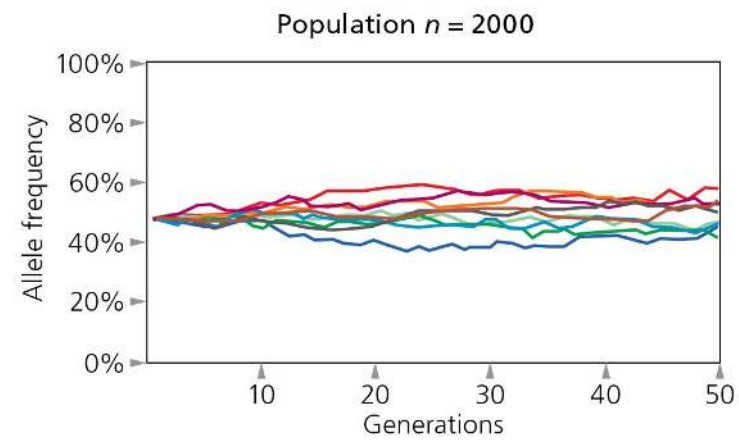
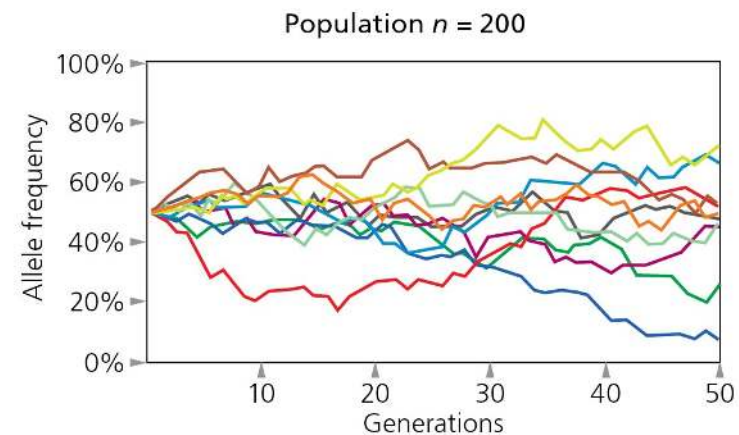
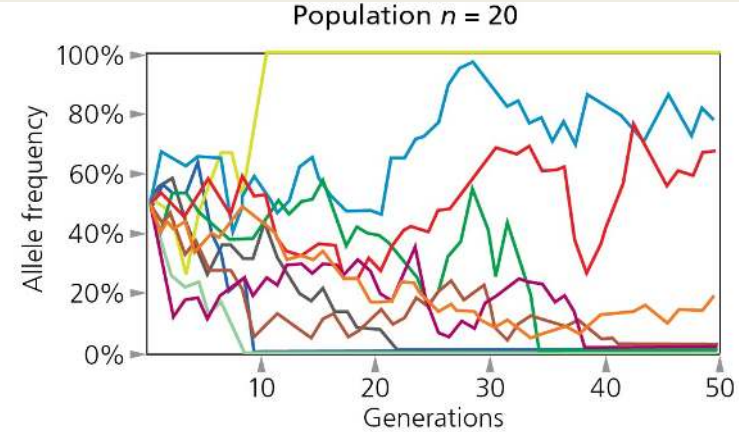
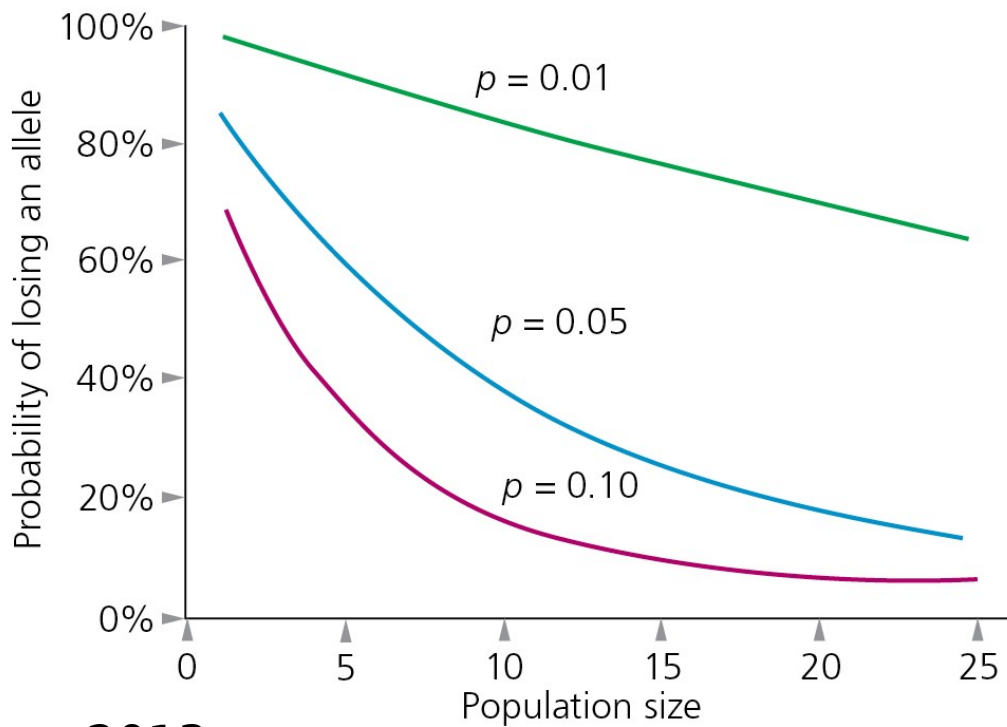
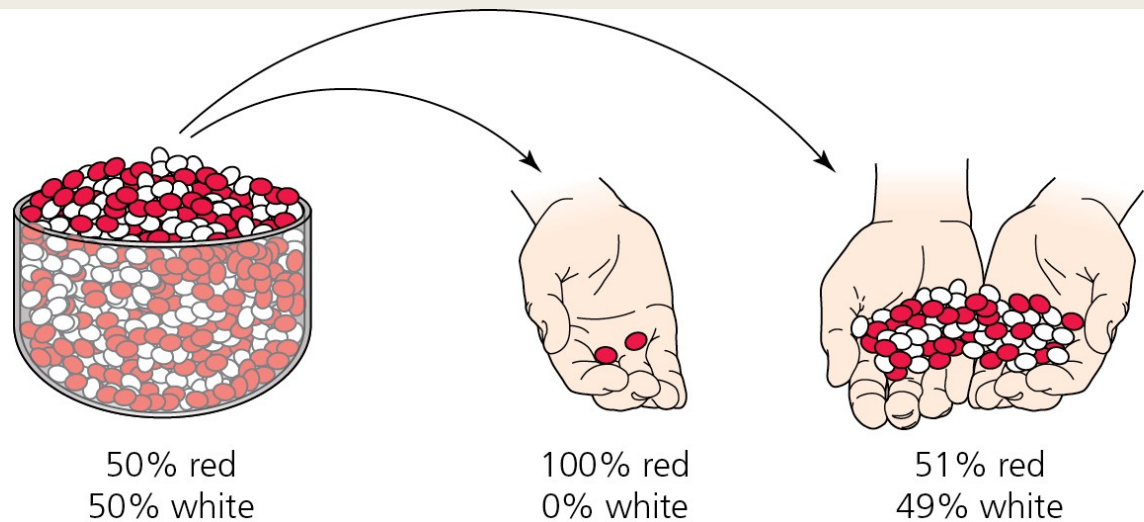
Ancestral population

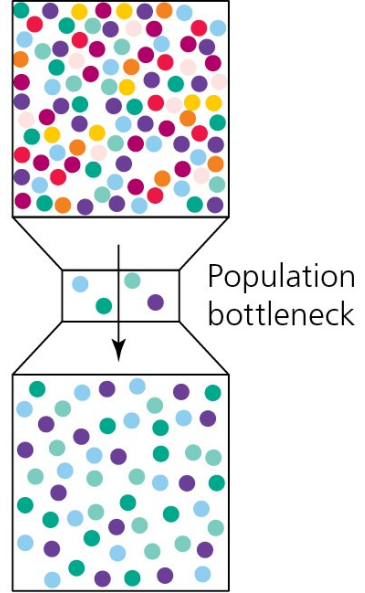
Later Population

Result

Drift

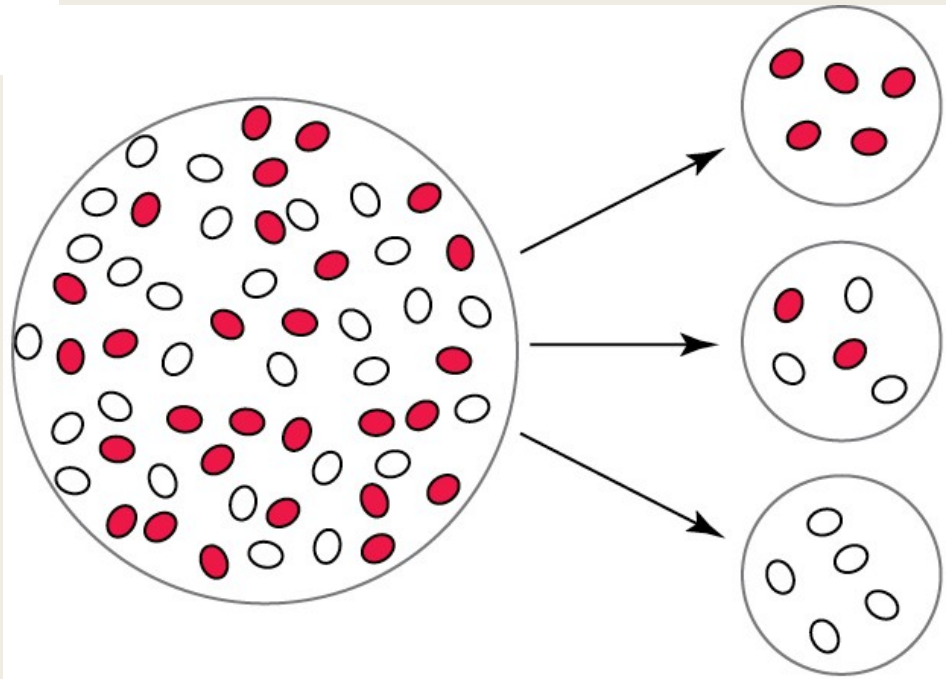






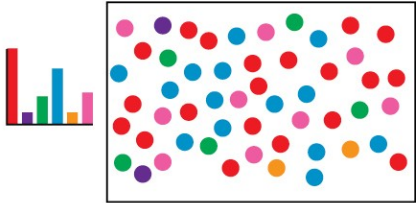
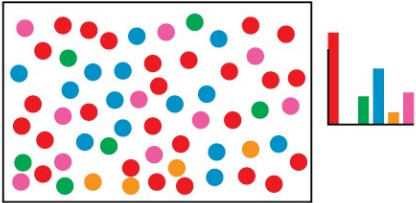
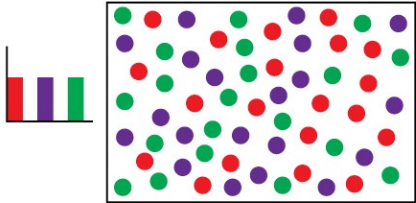
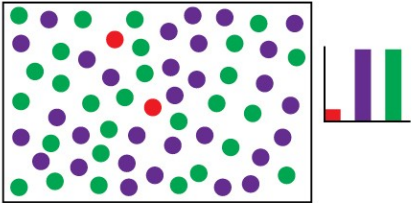
**Efeito gargalo
"bottleneck"**

Efeito do fundador



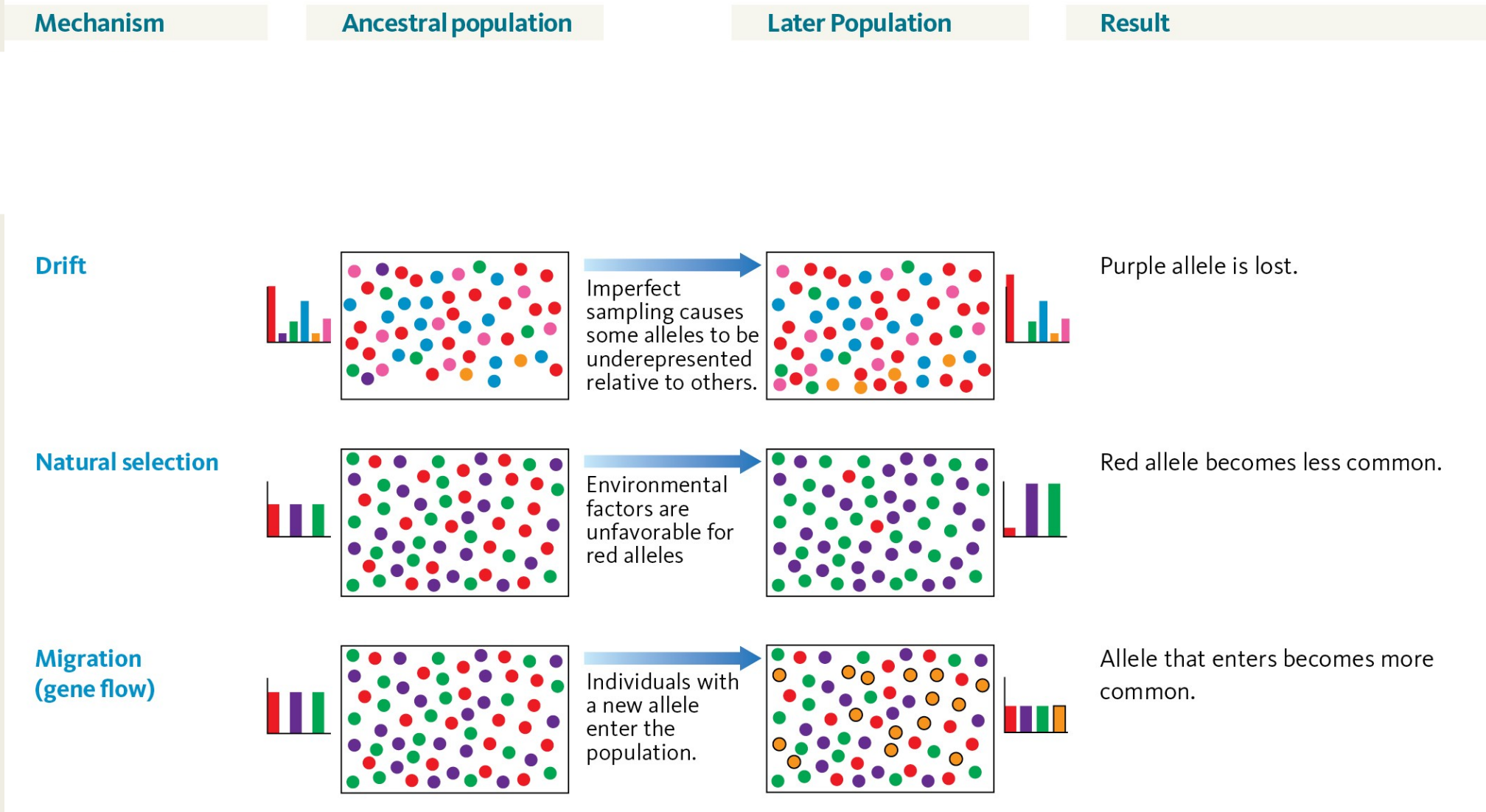
New populations started
by a small number of individuals

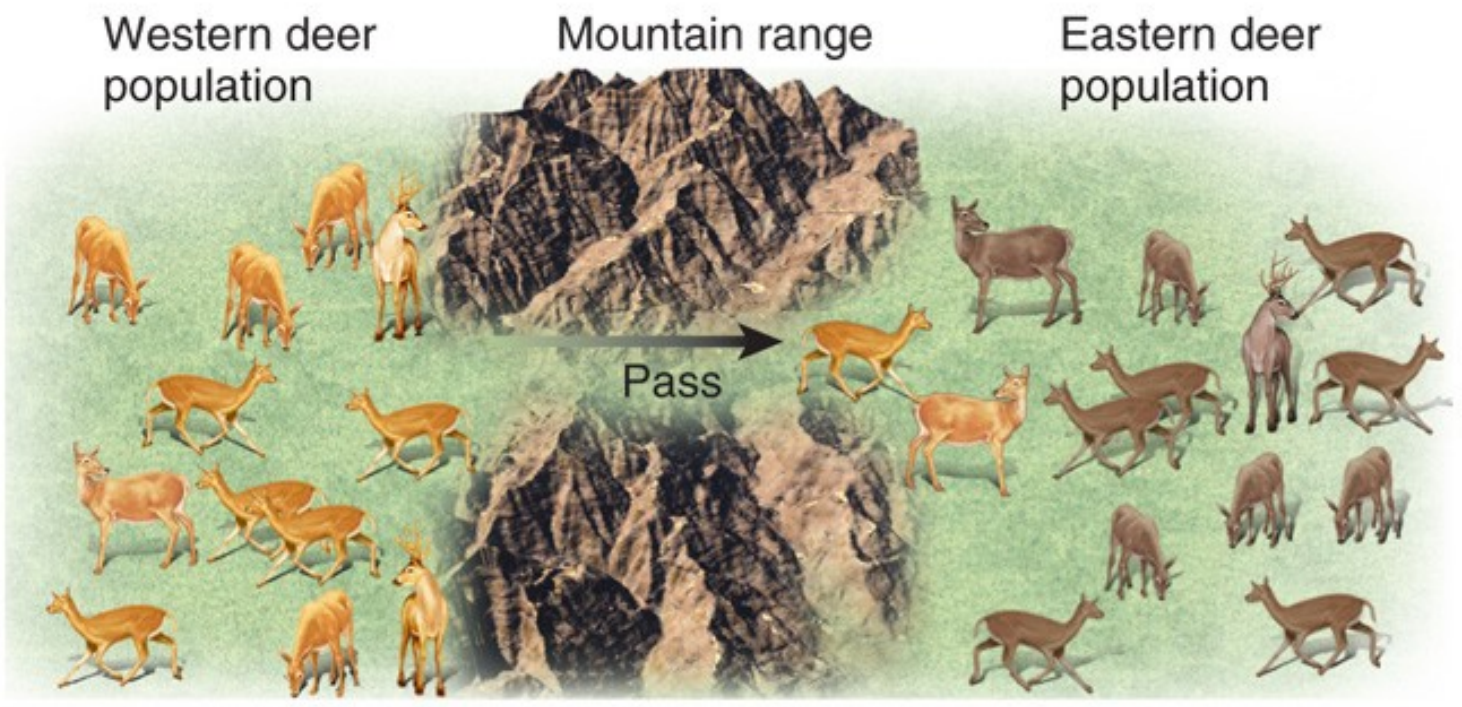
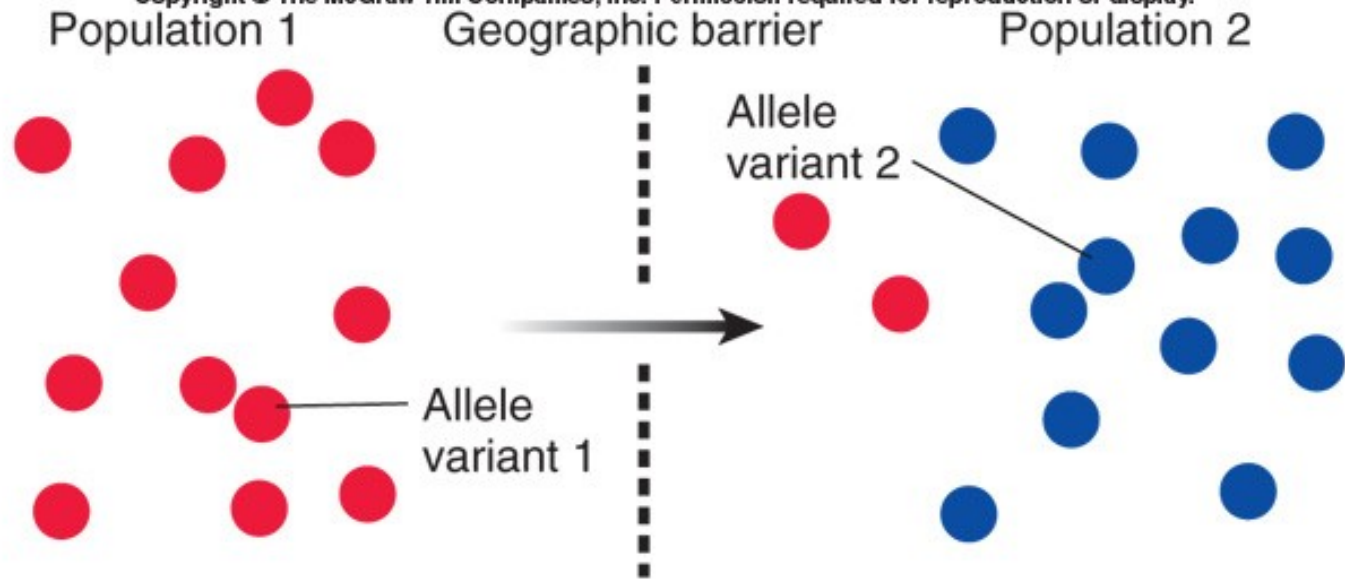
Mechanisms of Evolution: Altering Allele Frequencies

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Mechanisms of Evolution: Altering Allele Frequencies





Mechanisms of Evolution: Altering Allele Frequencies

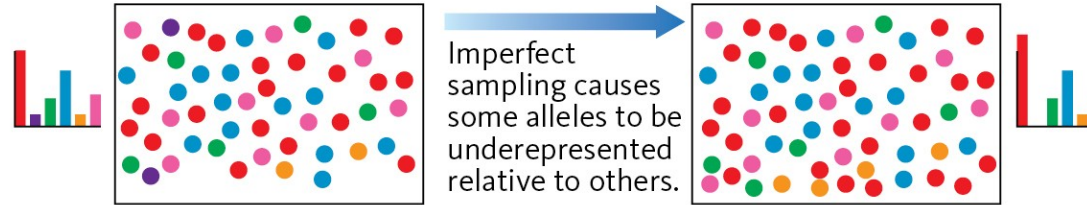
Mechanism

Ancestral population

Later Population

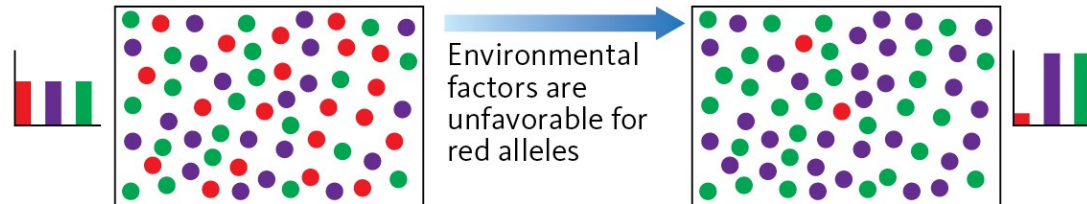
Result

Drift



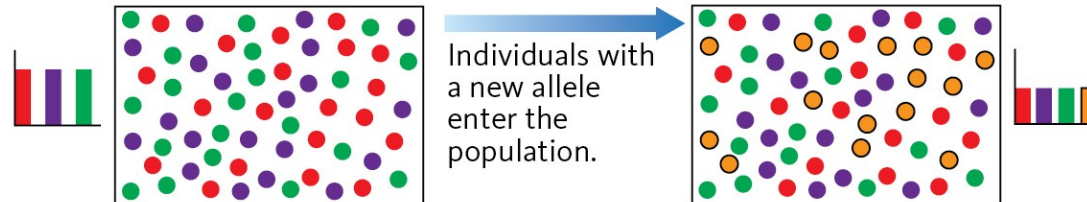
Purple allele is lost.

Natural selection



Red allele becomes less common.

Migration (gene flow)



Allele that enters becomes more common.

Mutation

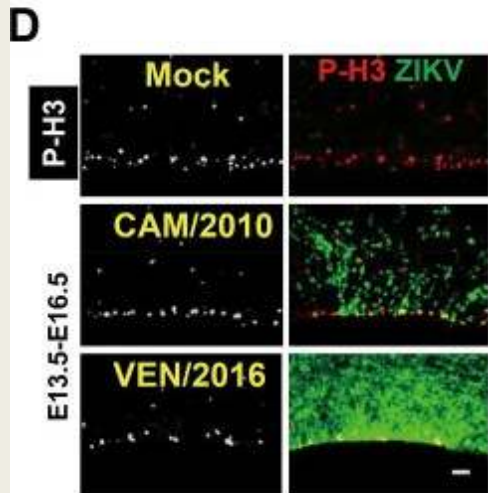
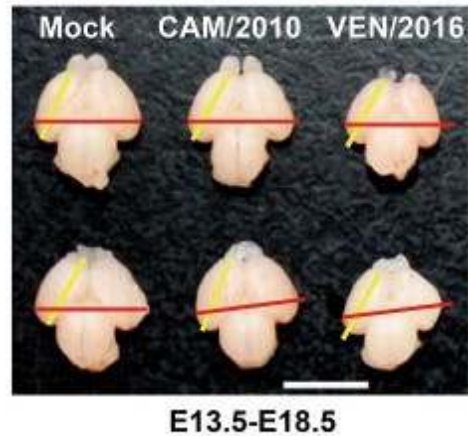


New genetic variant appears in the population.

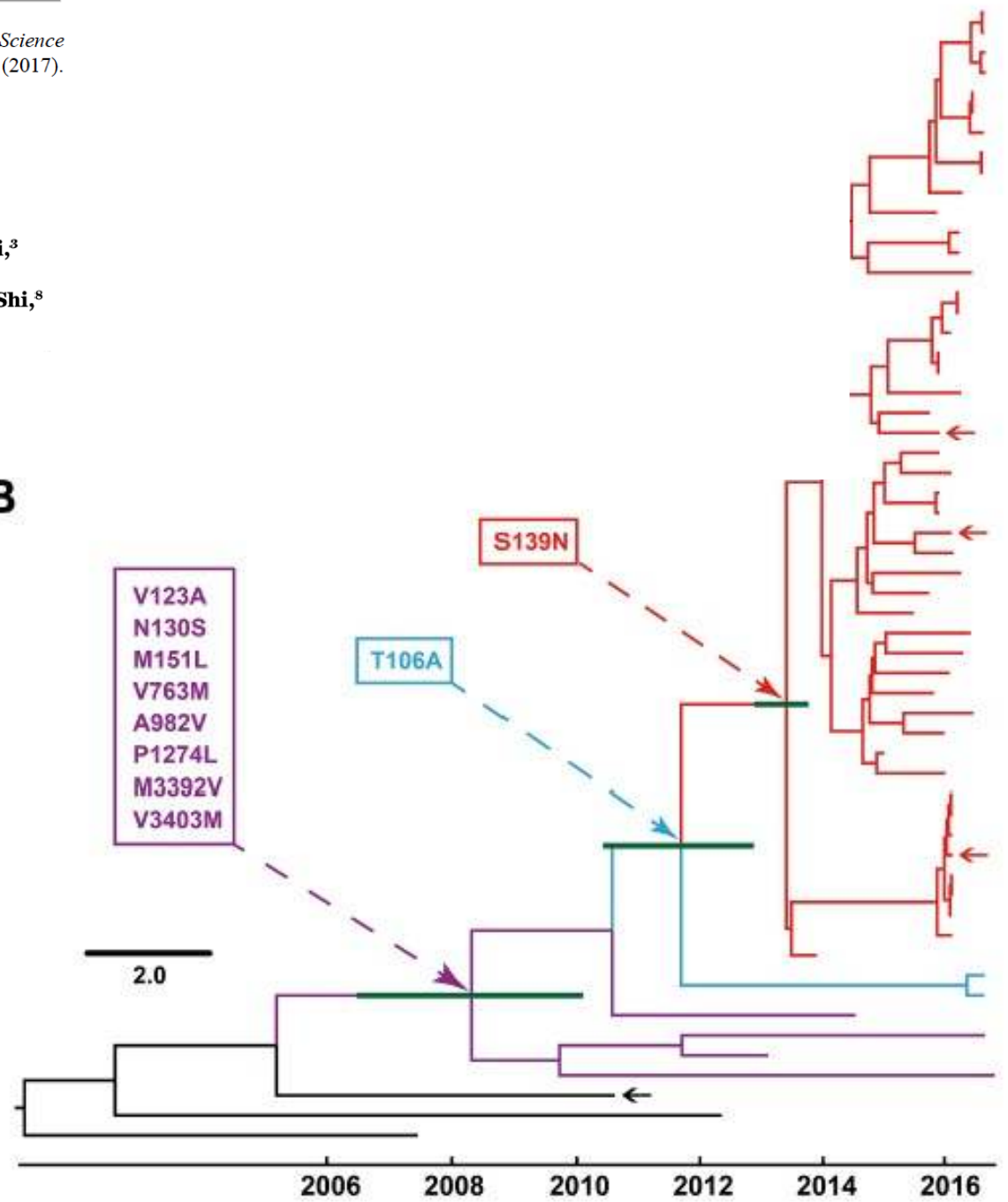
Cite as: L. Yuan *et al.*, *Science* 10.1126/science.aam7120 (2017).

A single mutation in the prM protein of Zika virus contributes to fetal microcephaly

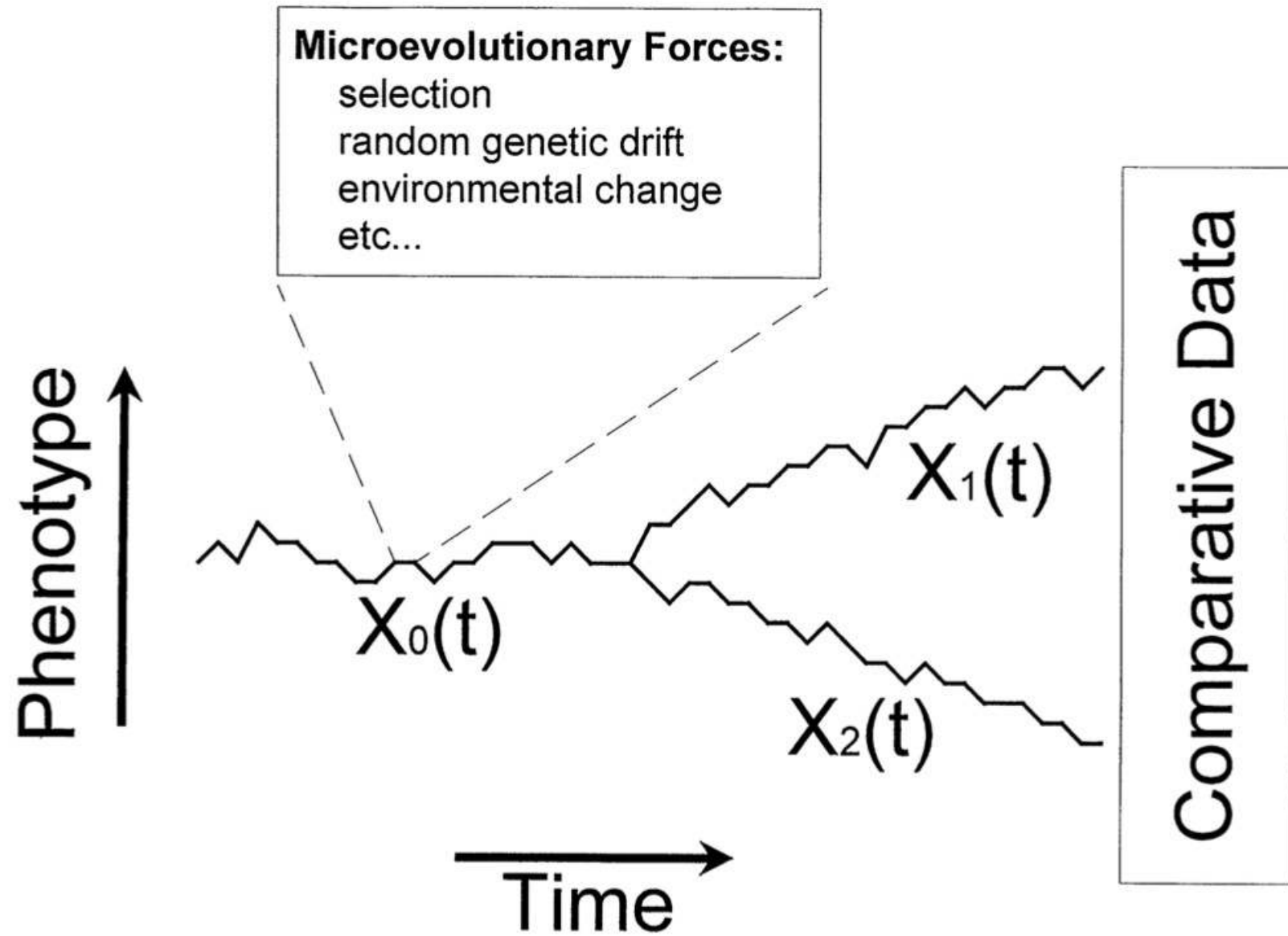
Ling Yuan,^{1,2*} Xing-Yao Huang,^{3*} Zhong-Yu Liu,^{3*} Feng Zhang,^{1,2*} Xing-Liang Zhu,^{1,2*} Jiu-Yang Yu,^{3*} Xue Ji,³ Yan-Peng Xu,³ Guanghui Li,^{1,2} Cui Li,^{1,2} Hong-Jiang Wang,³ Yong-Qiang Deng,³ Menghua Wu,⁴ Meng-Li Cheng,^{3,5} Qing Ye,³ Dong-Yang Xie,^{3,5} Xiao-Feng Li,³ Xiangxi Wang,⁶ Weifeng Shi,⁷ Baoyang Hu,⁴ Pei-Yong Shi,⁸ Zhiheng Xu,^{1,2,9†} Cheng-Feng Qin^{3†}

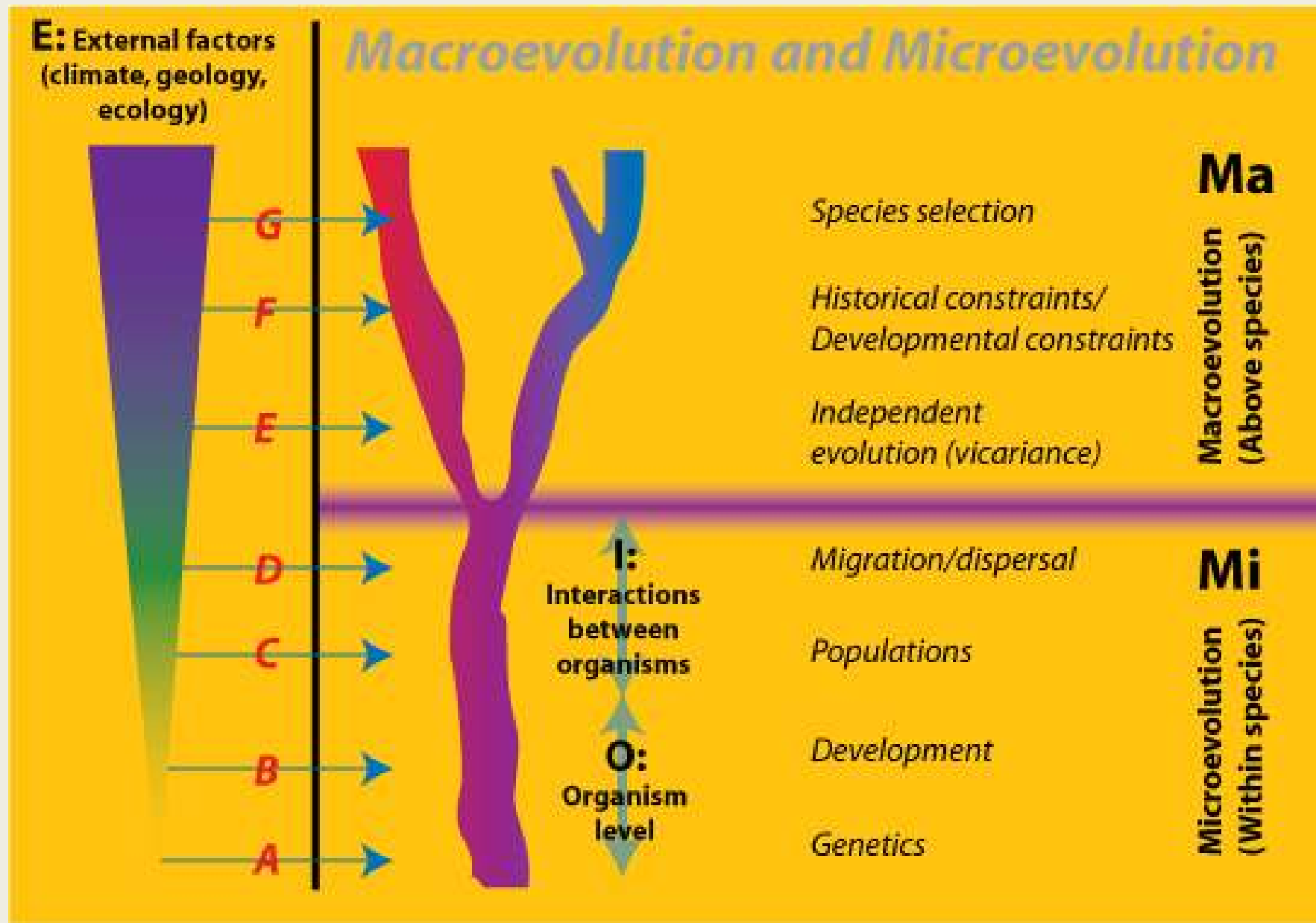


B

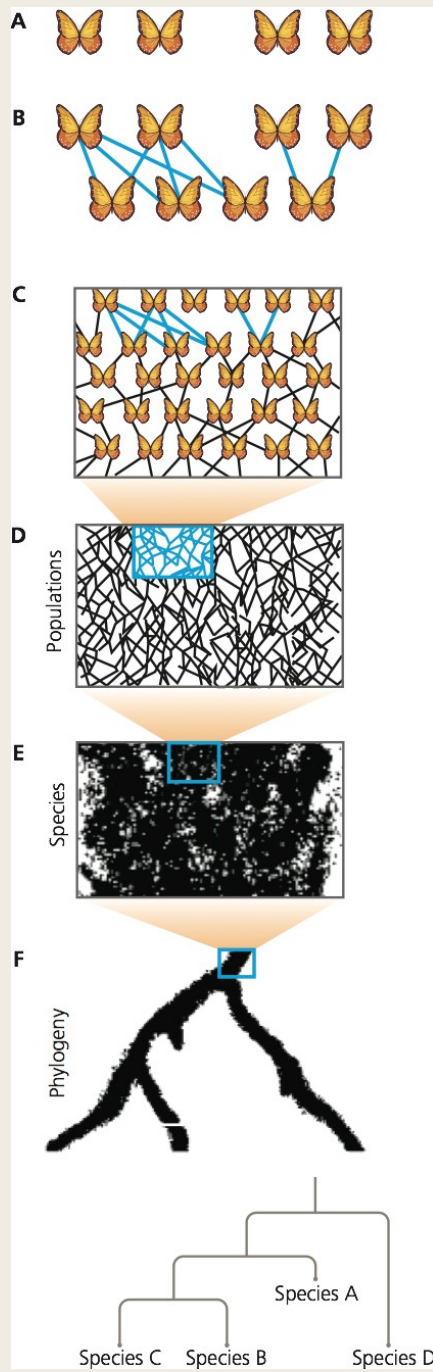


Sepa
ancestral
(Camboja)
Sepa
virulenta
(atual)





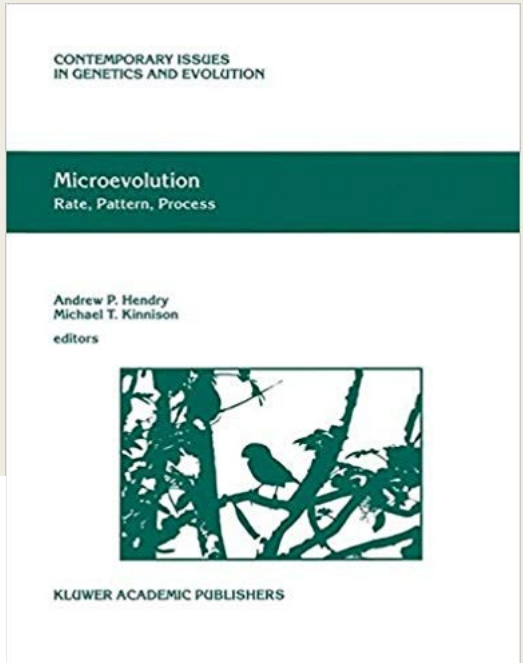
<http://www.talkorigins.org/faqs/macroevolution.html>




Filogenia: Representação visual da história evolutiva de populações, genes, e espécies.

Unificando micro- e
macroevolução
- Perspectivas -

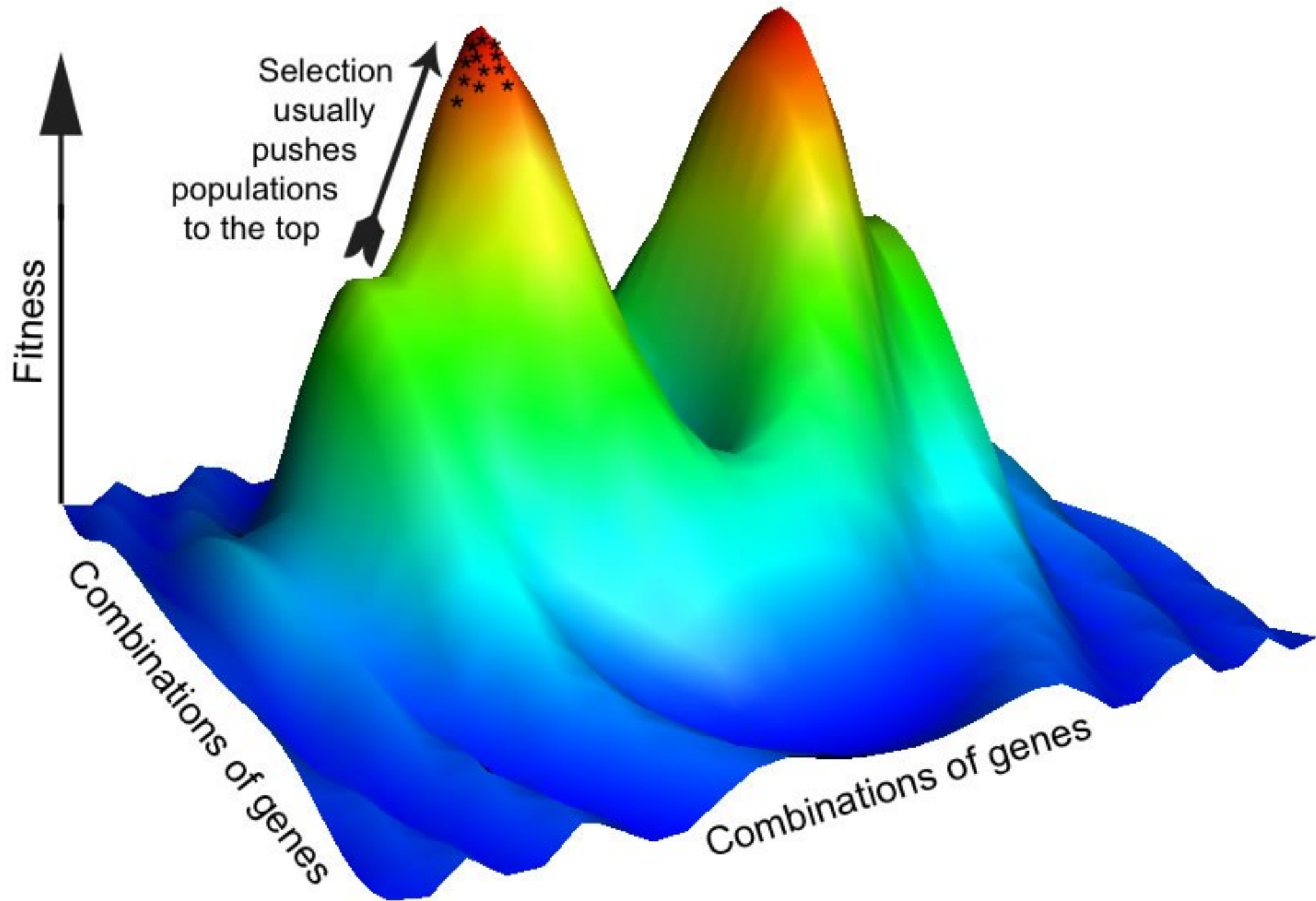
Genética quantitativa



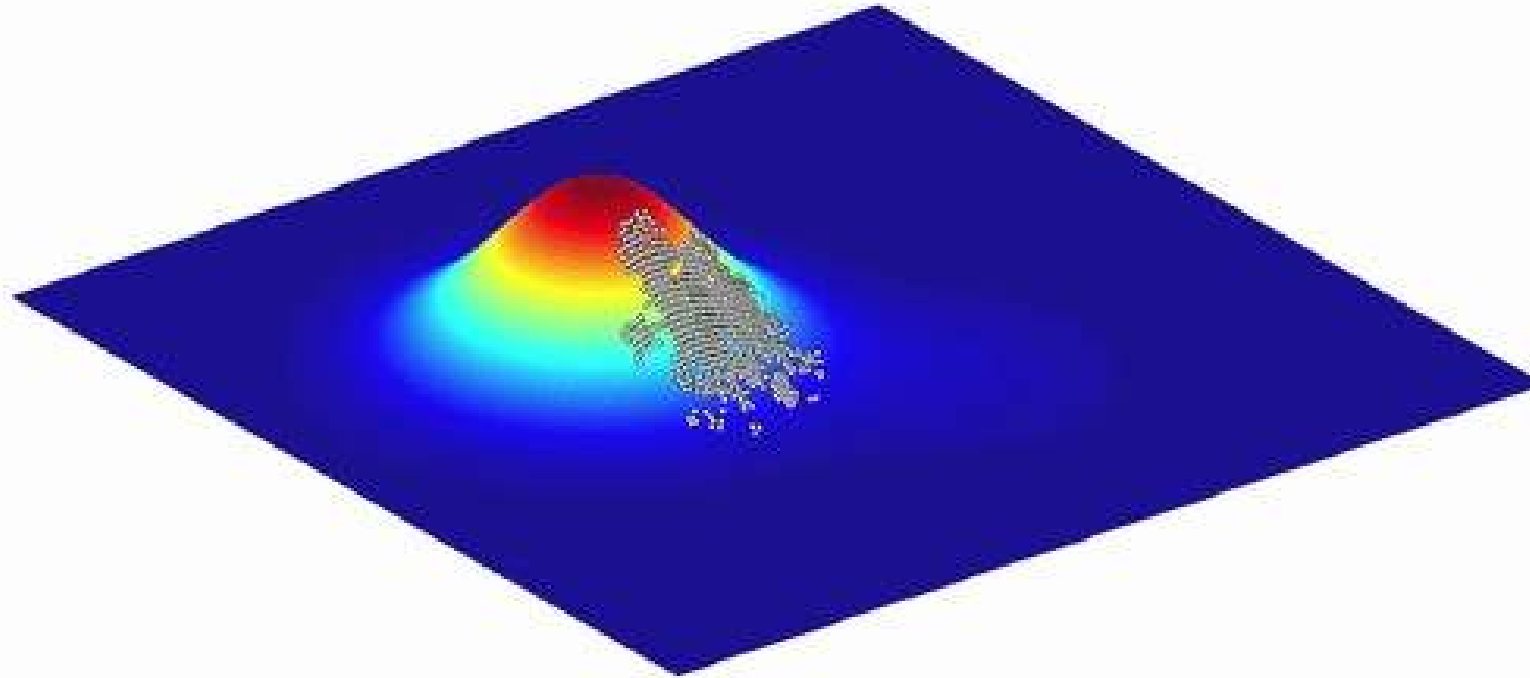
 *Genetica* 112–113: 9–32, 2001.
© 2001 Kluwer Academic Publishers. Printed in the Netherlands.

The adaptive landscape as a conceptual bridge between micro- and macroevolution

Stevan J. Arnold, Michael E. Pfrender & Adam G. Jones



Dynamic fitness landscape



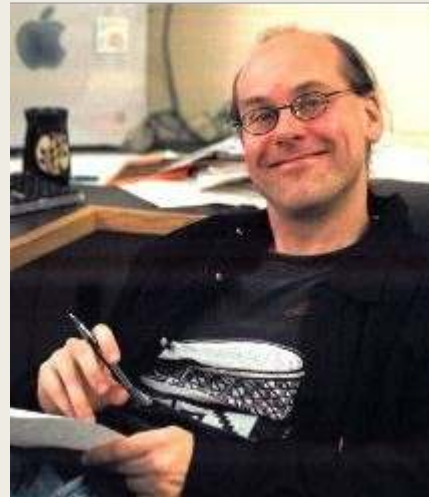
Population size, $N = 2,304$
Mutation rate, $\mu = 0.5$ per trait

© Randy Olson and Bjørn Østman

Josef C Uyeda, Thomas F Hansen, S J Arnold & Jason Pienaar
2011
The million-year wait for macroevolutionary bursts.
PNAS USA



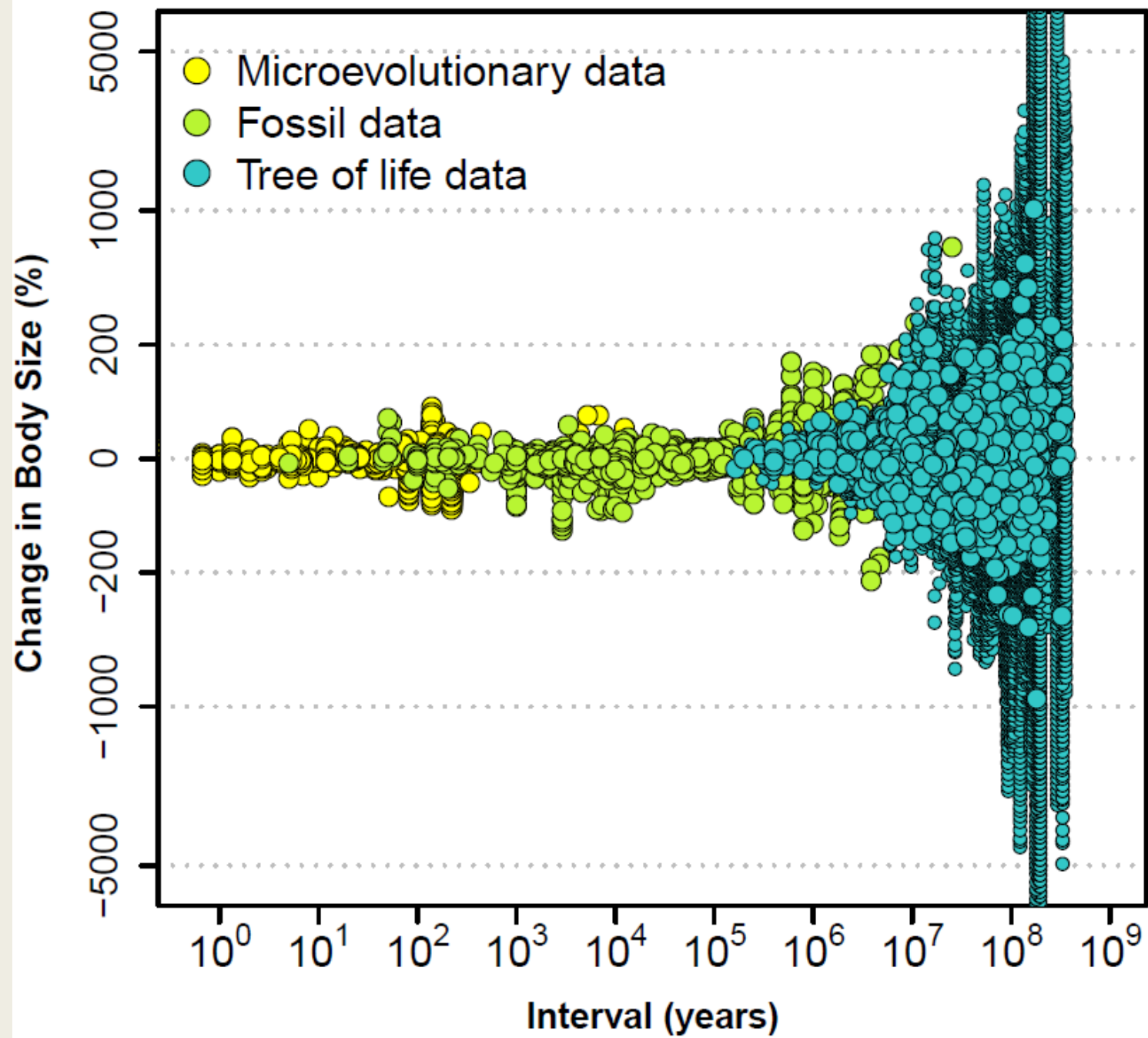
Josef
Uyeda



Thomas
Hansen

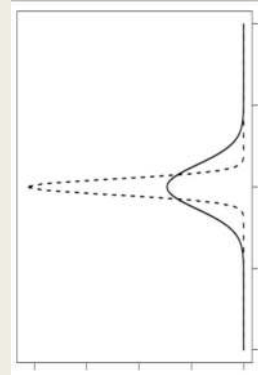


Jason
Pienaar



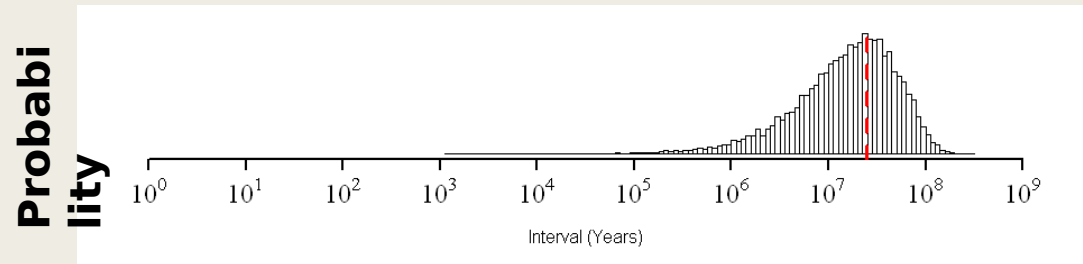
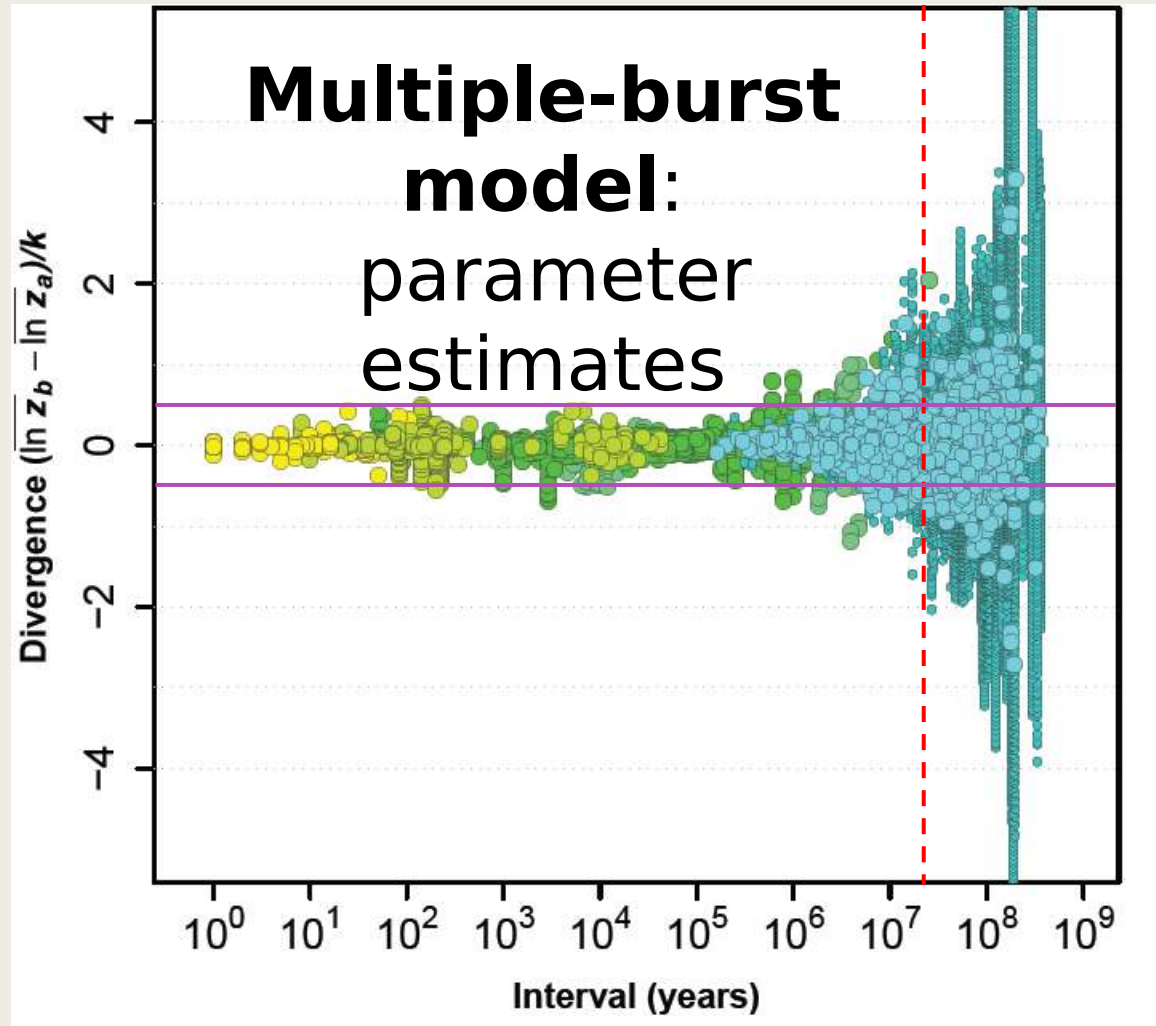
White noise distribution
(dashed)

Burst size distribution
(solid)



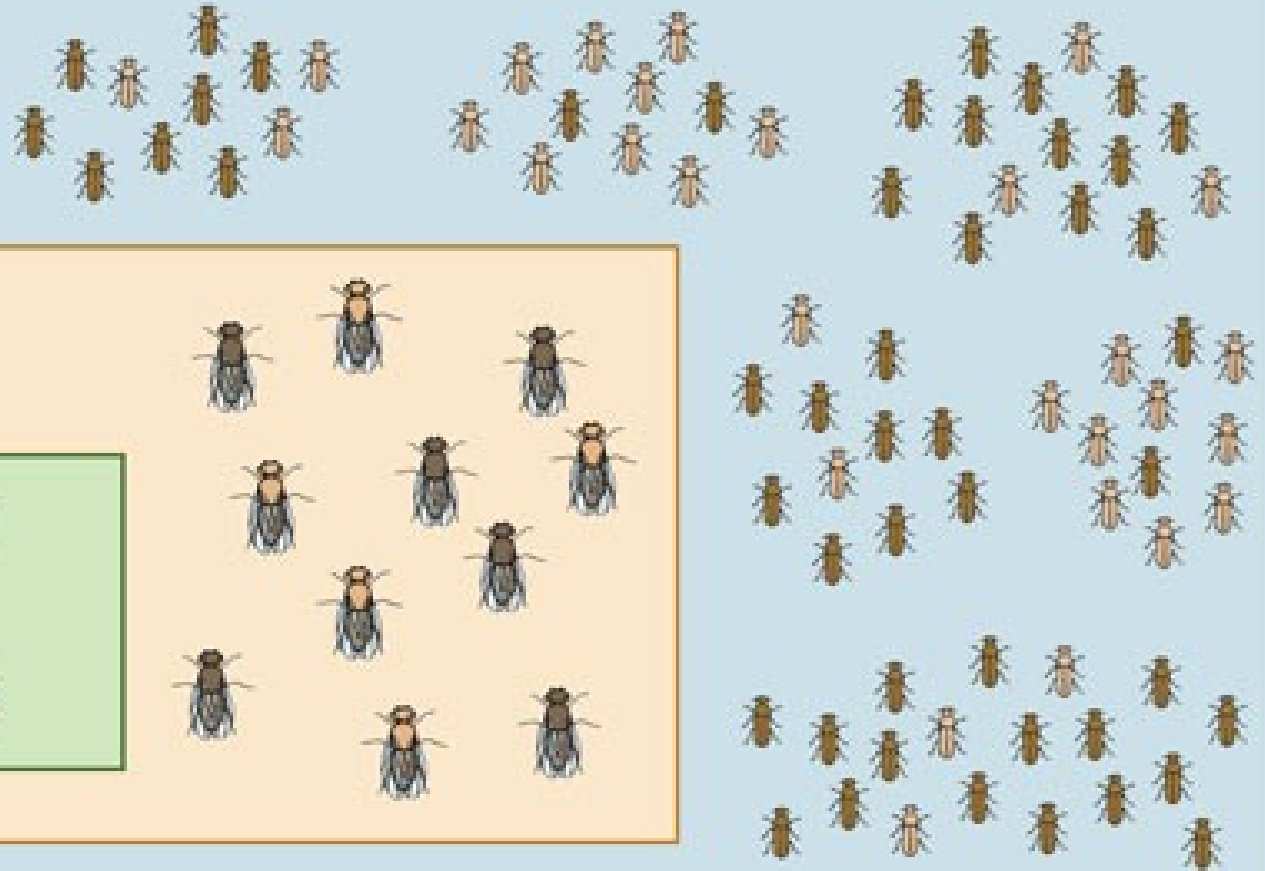
Probability

Burst timing distribution
(mean time between bursts = 25 my)



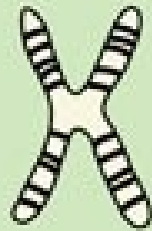
Multi-level selection theory

selection between groups
within a population



selection between
individuals within a group

selection between
genes within an
individual



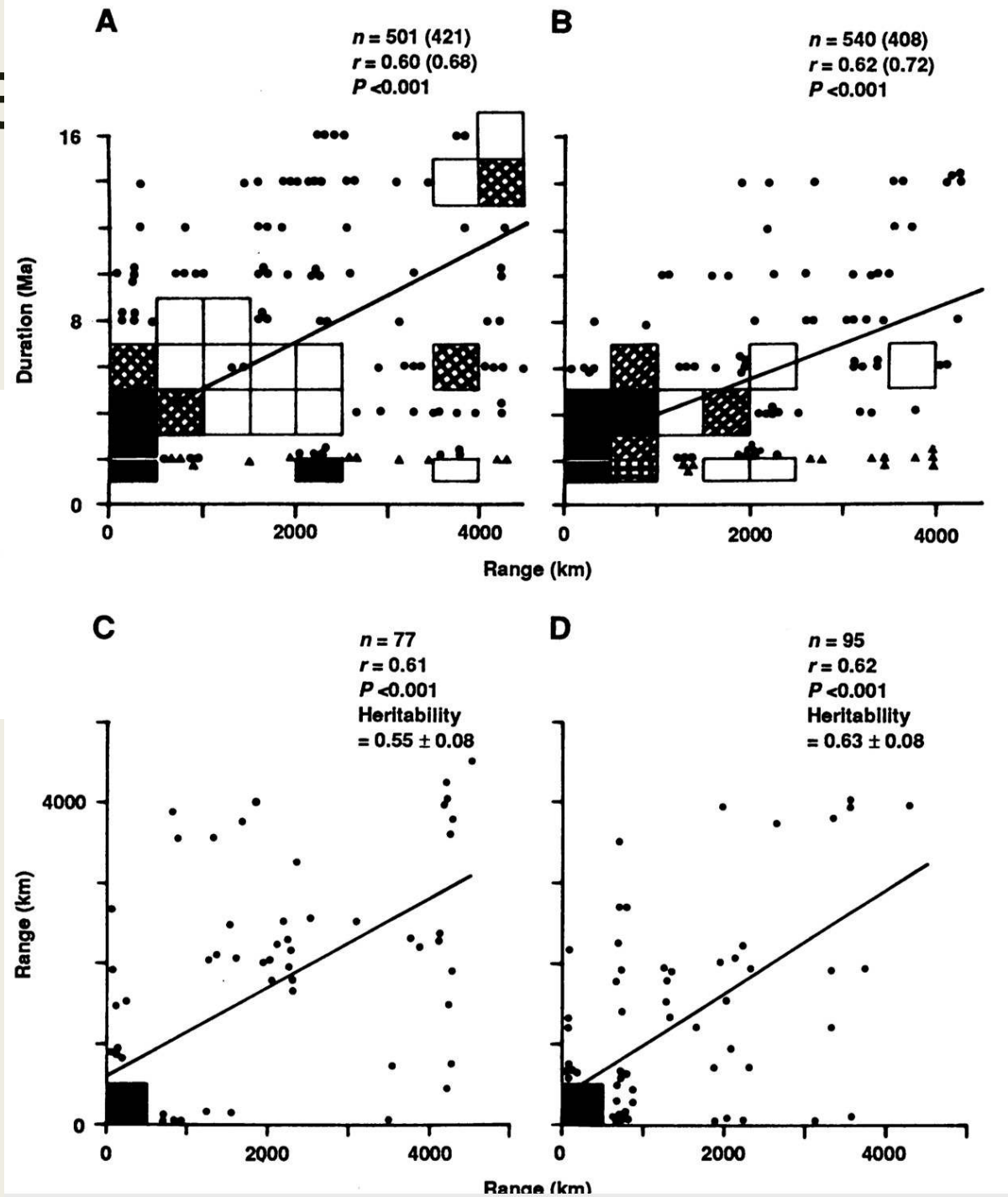
Seleção de espécie

Heritability at the Species Level: Analysis of Geographic Ranges of Cretaceous Mollusks

DAVID JABLONSKI

1987

SCIENCE, VOL. 238



Reinventing species selection with molecular phylogenies

Daniel L. Rabosky^{1,2} and Amy R. McCune¹

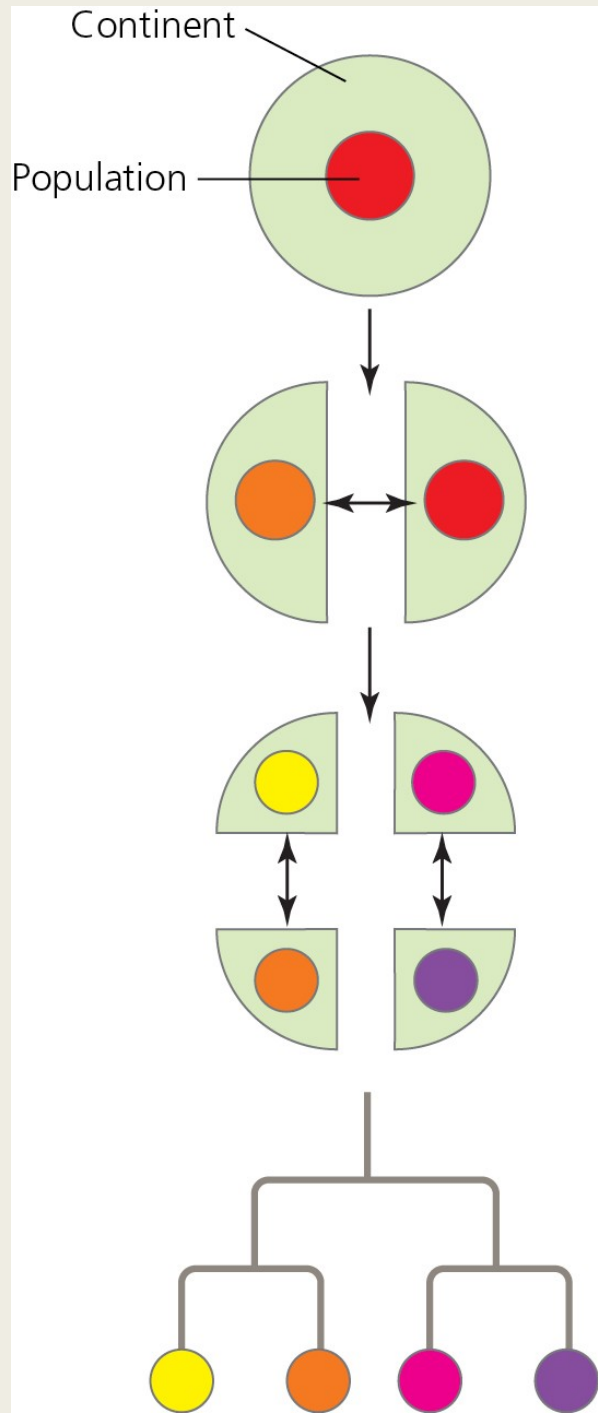
TREE 2010

Species Selection: Theory and Data

David Jablonski

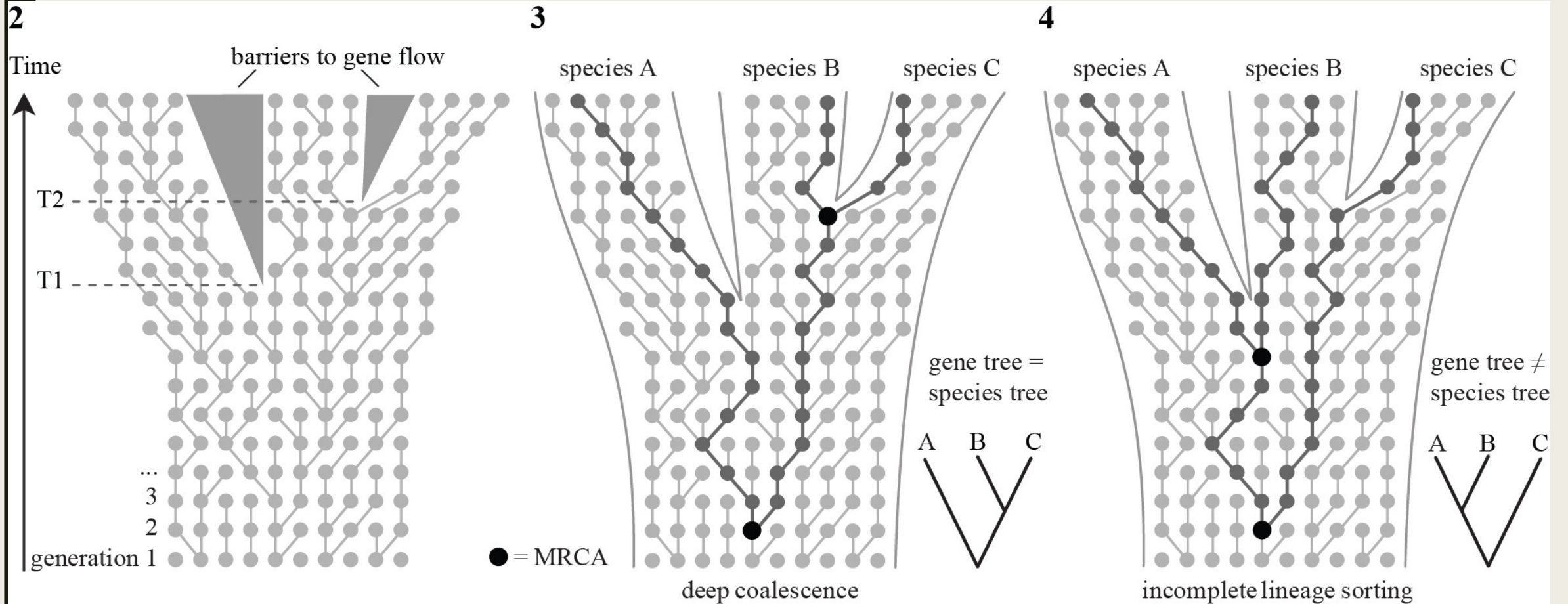
Annu. Rev. Ecol. Evol. Syst. 2008. 39:501–24

Department of Geophysical Sciences, University of Chicago, Chicago, Illinois 60637;
email: djablons@uchicago.edu



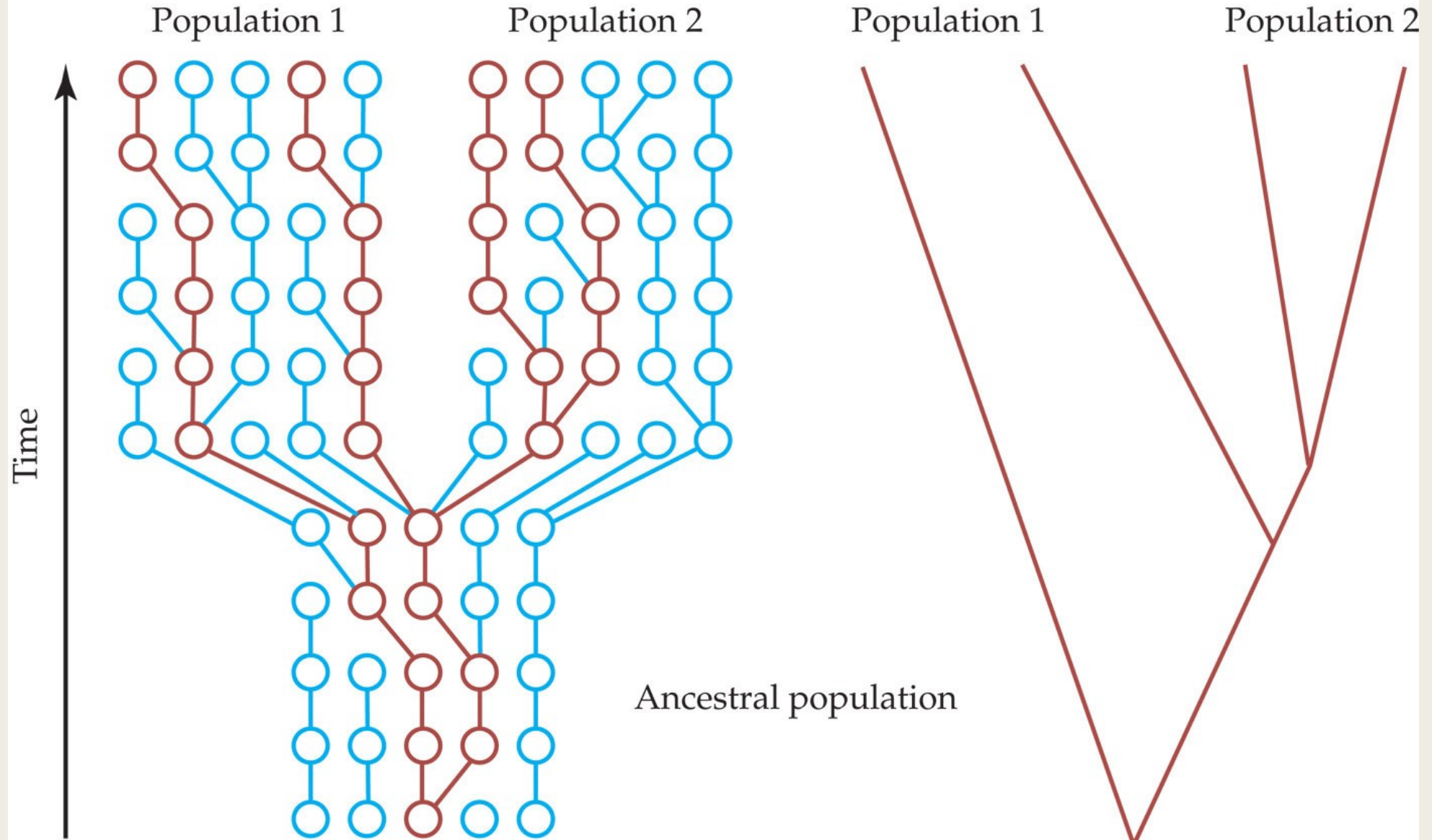
Vicariância deixa uma *assinatura* na filogenia

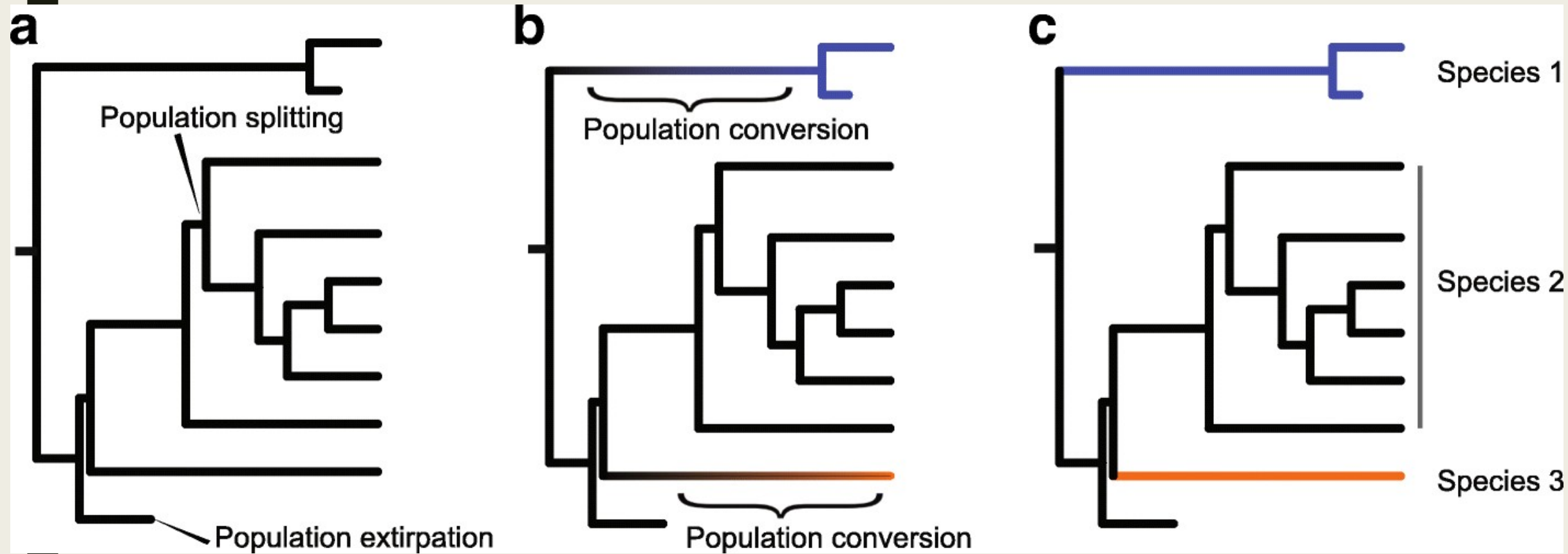
Teoria da Coalescência



(B)

Incomplete lineage sorting

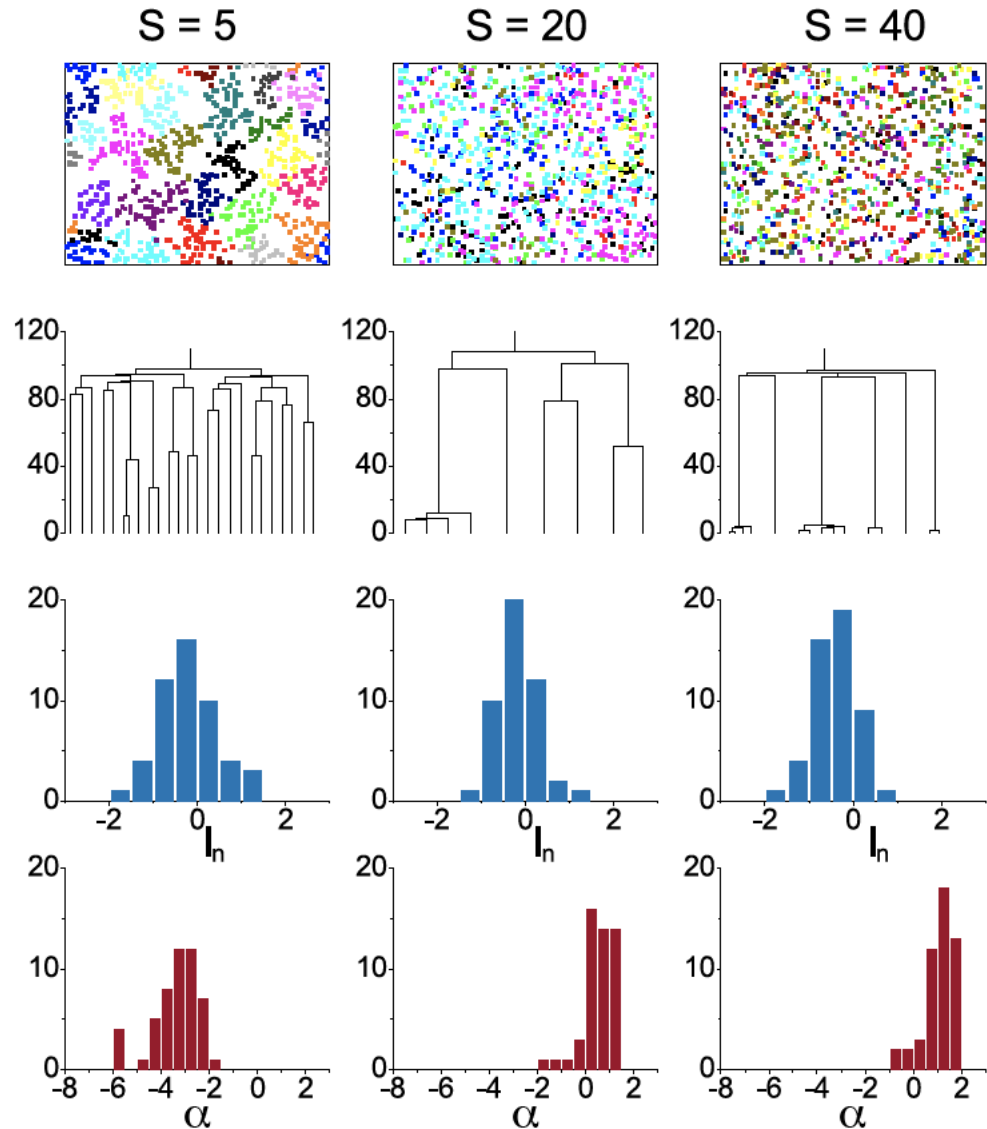




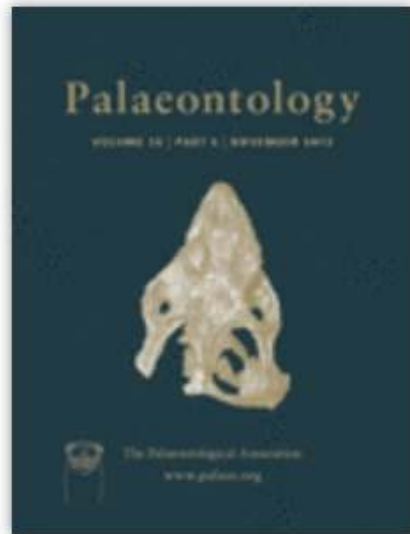
Signatures of microevolutionary processes in phylogenetic patterns

CAROLINA L. N. COSTA^{1,2,*}, PAULA LEMOS-COSTA^{1,2}, FLAVIA M. D. MARQUITTI¹, LUCAS D. FERNANDES³, MARLON F. RAMOS¹, DAVID M. SCHNEIDER¹, AYANA B. MARTINS^{1,4}, AND MARCUS A. M. AGUIAR^{1,*}

Syst Biol. 2018



Predizer formato de filogenias a partir de modelos baseados em indivíduos com processos demográficos



Volume 56, Issue 6

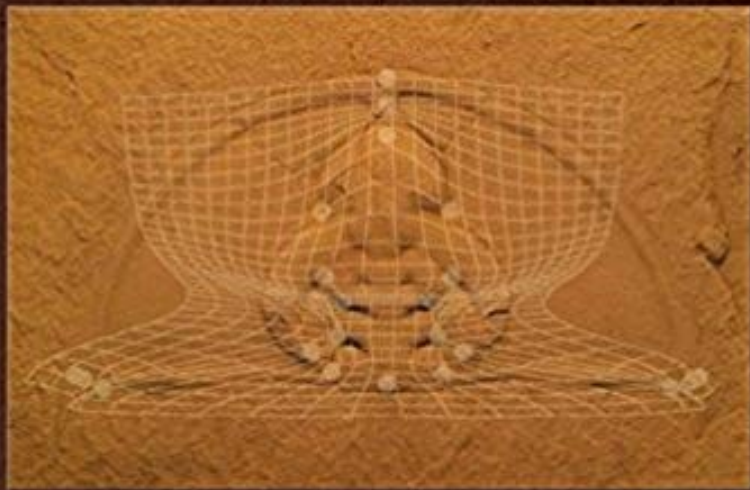
**Special Issue: MACROEVOLUTION
AND THE MODERN SYNTHESIS**

Pages: 1179-1340

November 2013

PRINCIPLES of PALEONTOLOGY

Third Edition



MICHAEL FOOTE • ARNOLD I. MILLER

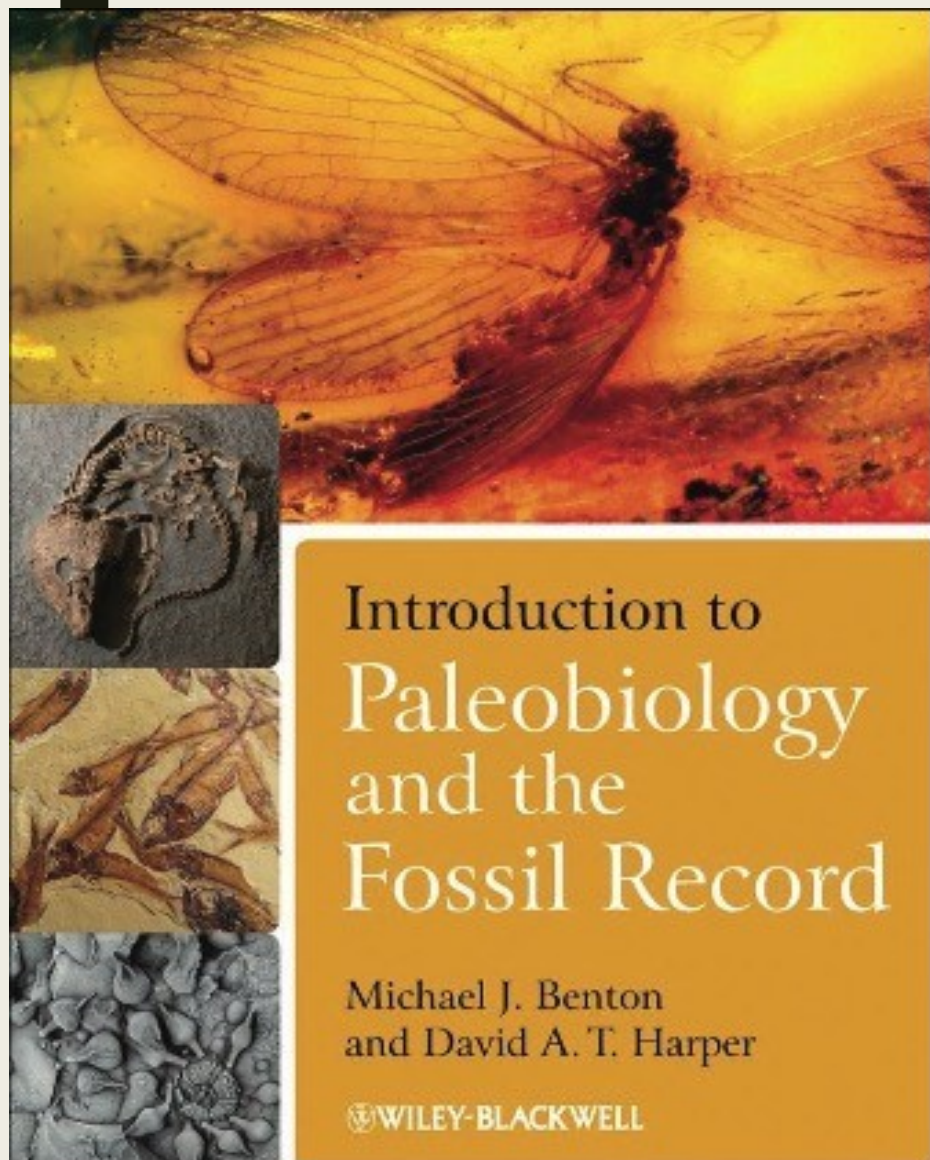
A revised and updated edition of the classic text
by David M. Raup and Steven M. Stanley

Chapter 7

EVOLUTIONARY RATES AND TRENDS

Chapter 8

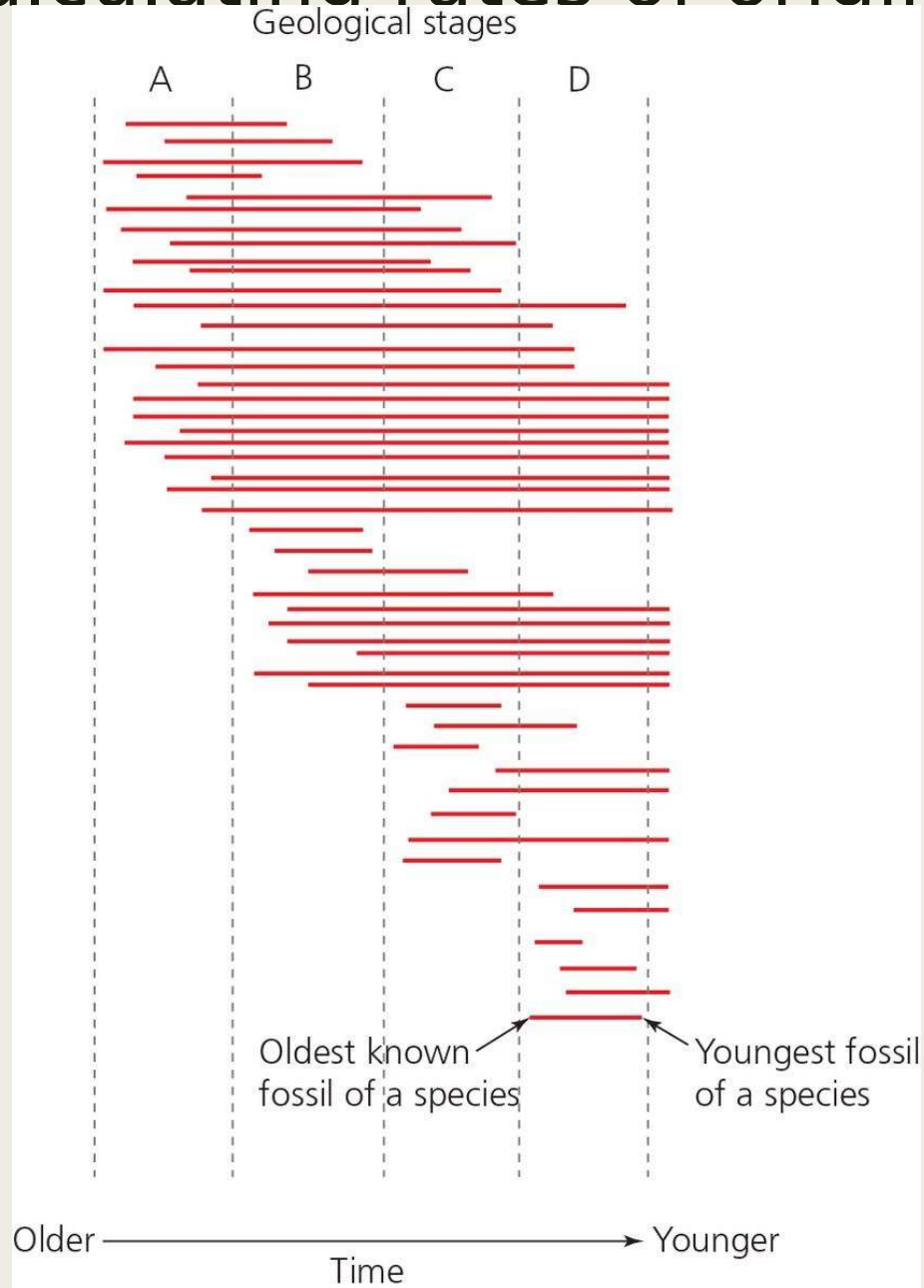
GLOBAL DIVERSIFICATION AND EXTINCTION



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| 2 Fossils in time and space | 22 |
| 3 Taphonomy and the quality of the fossil record | 57 |
| 4 Paleoeology and paleoclimates | 79 |
| 5 Macroevolution and the tree of life | 116 |
| 6 Fossil form and function | 137 |
| 7 Mass extinctions and biodiversity loss | 162 |

Calculating rates of origination and extinction



α = origination rate

Ω = extinction rate

Macroevolução não é só “coisa” de paleontólogo

- Com a crescente disponibilidade de filogenias moleculares datadas, é possível analisar dinâmicas de diversificação de linhagens
 - *Padrões de extinção e especiação*
 - *Variações no tempo (e no espaço - conexões com Biogeografia)*
 - *Possibilitou a integração de disciplinas*
 - Ecologia, Paleobiologia, Biogeografia

ARTICLE

DOI: [10.1038/s41467-018-07622-y](https://doi.org/10.1038/s41467-018-07622-y)

OPEN

Closing the gap between palaeontological and neontological speciation and extinction rate estimates

Daniele Silvestro^{1,2,3,4}, Rachel C.M. Warnock^{4,5}, Alexandra Gavryushkina⁶ & Tanja Stadler^{4,5}

2018

Reconciling molecular phylogenies with the fossil record

Hélène Morlon^{a,b,1}, Todd L. Parsons^b, and Joshua B. Plotkin^b

^aCenter for Applied Mathematics, Ecole Polytechnique, 91128 Palaiseau, France; and ^bBiology Department, University of Pennsylvania, Philadelphia, PA, USA

Edited* by Robert E. Ricklefs, University of Missouri, St. Louis, MO, and approved August 1, 2011 (received for review February 14, 2011)

Historical patterns of species diversity inferred from phylogenies typically contradict the direct evidence found in the fossil record. Recent information to accurately estimate extinction rates and diversity dynamics (15, 20, 21). If this is the case



INTEGRATING FOSSILS WITH MOLECULAR PHYLOGENIES IMPROVES INFERENCE OF TRAIT EVOLUTION

Graham J. Slater,^{1,2} Luke J. Harmon,^{3,4} and Michael E. Alfaro¹

¹Department of Evolution and Systematics, University of California, 610 Charles E. Young Drive South, Los Angeles, CA 90095

Methods in Ecology and Evolution



Methods in Ecology and Evolution 2013, **4**, 699–702

doi: 10.1111/2041-210X.12091

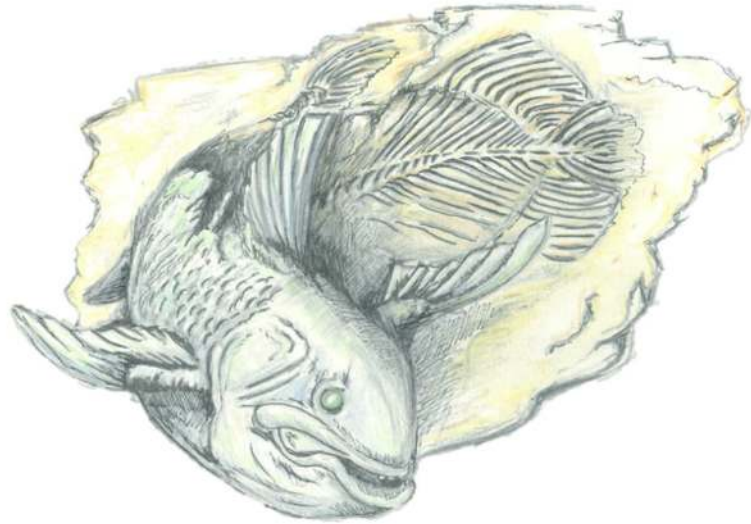
EDITORIAL

Unifying fossils and phylogenies for comparative analyses of diversification and trait evolution

Graham J. Slater^{1*} and Luke J. Harmon^{2,3}

Diversity-dependence brings molecular phylogenies closer to agreement with the fossil record

**Rampal S. Etienne^{1,*}, Bart Haegeman², Tanja Stadler³, Tracy Aze⁴,
Paul N. Pearson⁴, Andy Purvis⁵ and Albert B. Phillimore⁵**



CPEG

Crossing the Palaeontological - Ecological Gap

30th - 31st August, 2018

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[Abstract and registration](#)

[Venue](#)

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Thanks to everyone who attended **CPEG2018** at the [University of Leeds](#). We hosted over 80 delegates from over 10 countries from as far afield as Australia, the USA and Israel. We saw an excellent variety of ecological talks and posters and hope to have facilitated more crossing of the time gap that spans palaeontology and ecology. We hope to see you all again in 2 years time... perhaps.

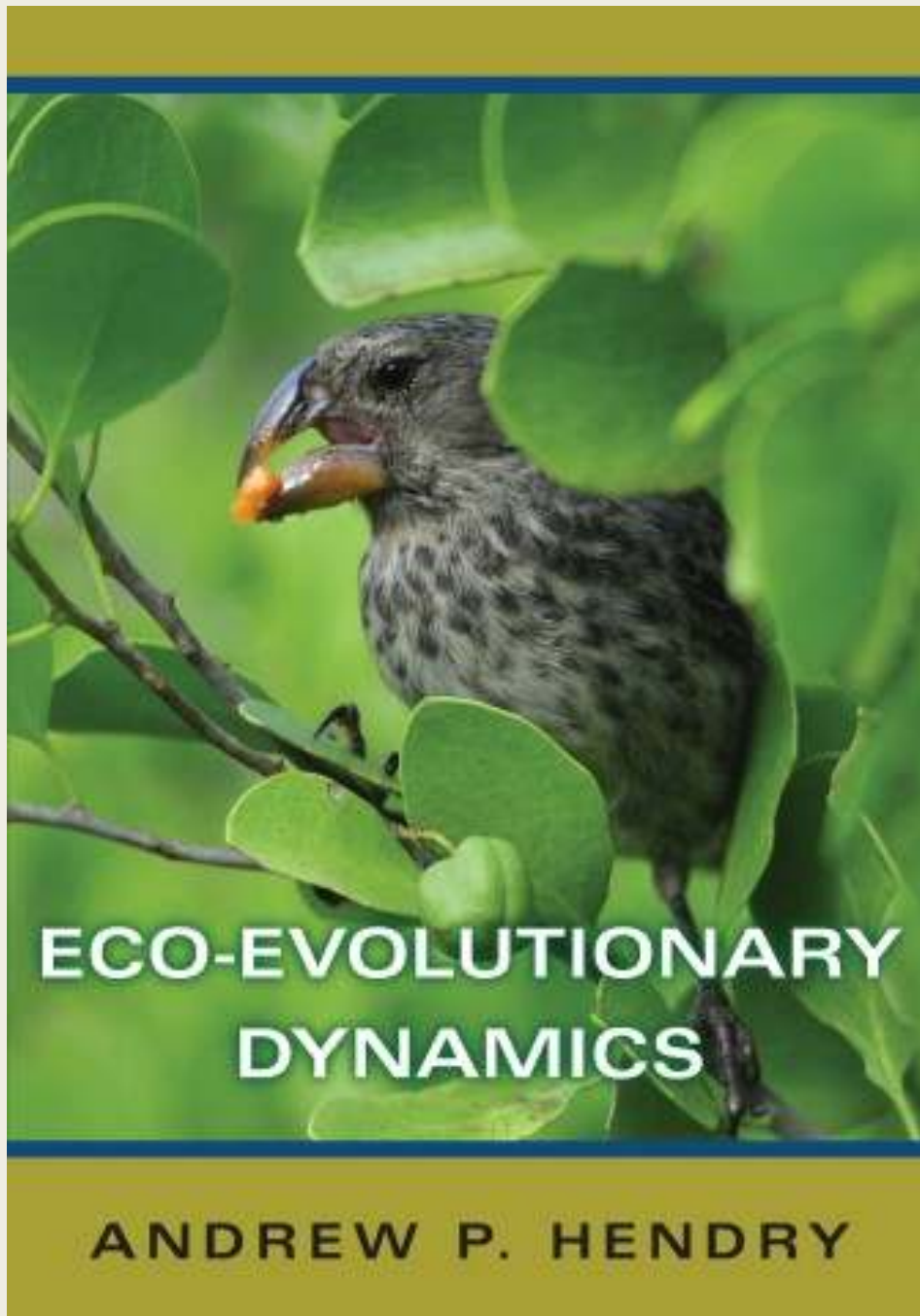
Conference report

POWERED BY **weebly**

...ive conference exceeded its nominal goal to bridge the gap between palaeontology and ecology, spanning in

Porque ecólogos devem estudar macroevolução

- Além disso, percebeu-se que mudanças evolutivas podem ocorrer num curto período de tempo, desde que a seleção seja intensa o suficiente
- Dinâmicas eco-evolutivas => interação entre ecologia e evolução

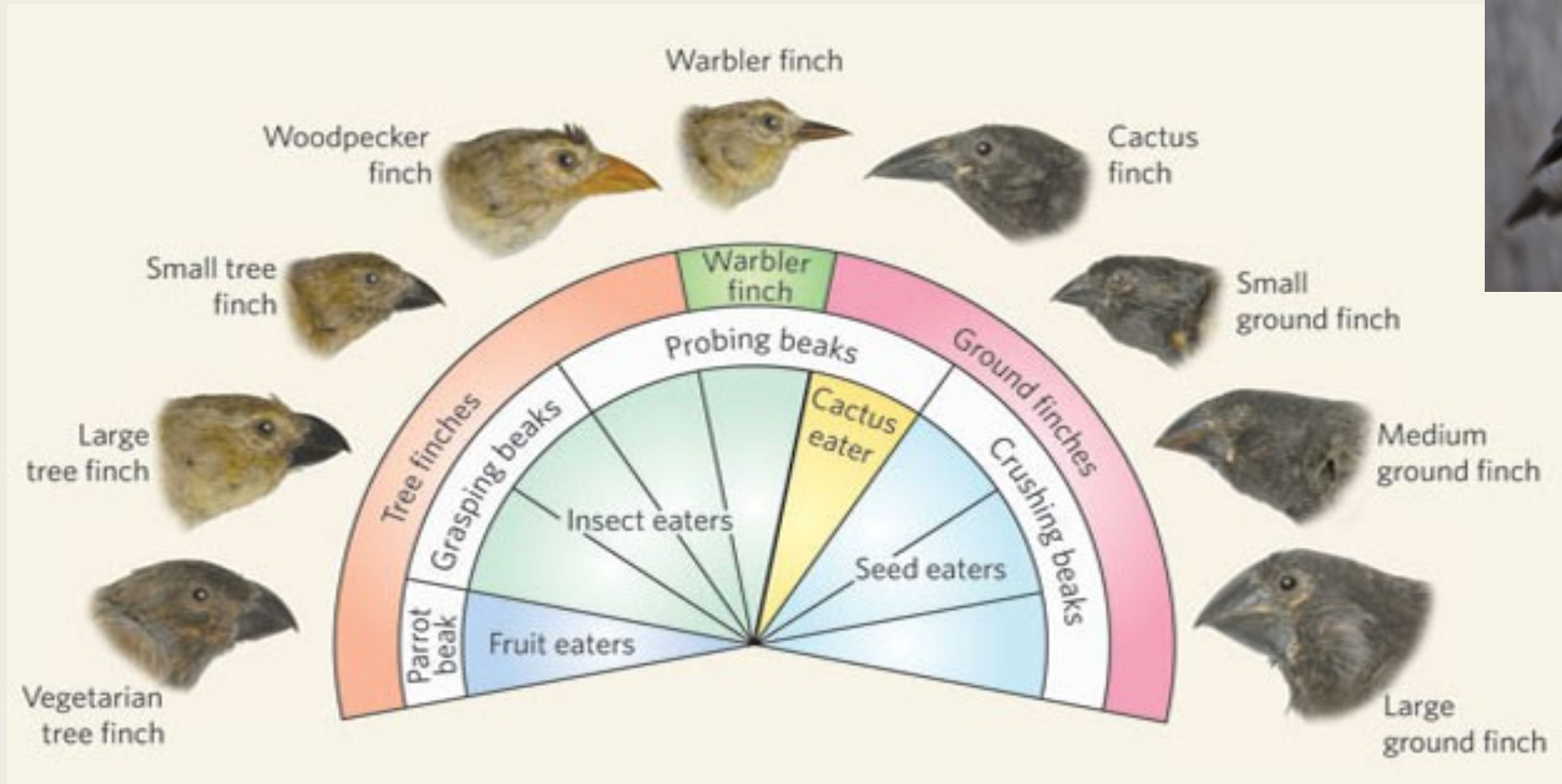


The Newest Synthesis: Understanding the Interplay of Evolutionary and Ecological Dynamics

Thomas W. Schoener

28 JANUARY 2011 VOL 331 **SCIENCE** www.sciencemag.org



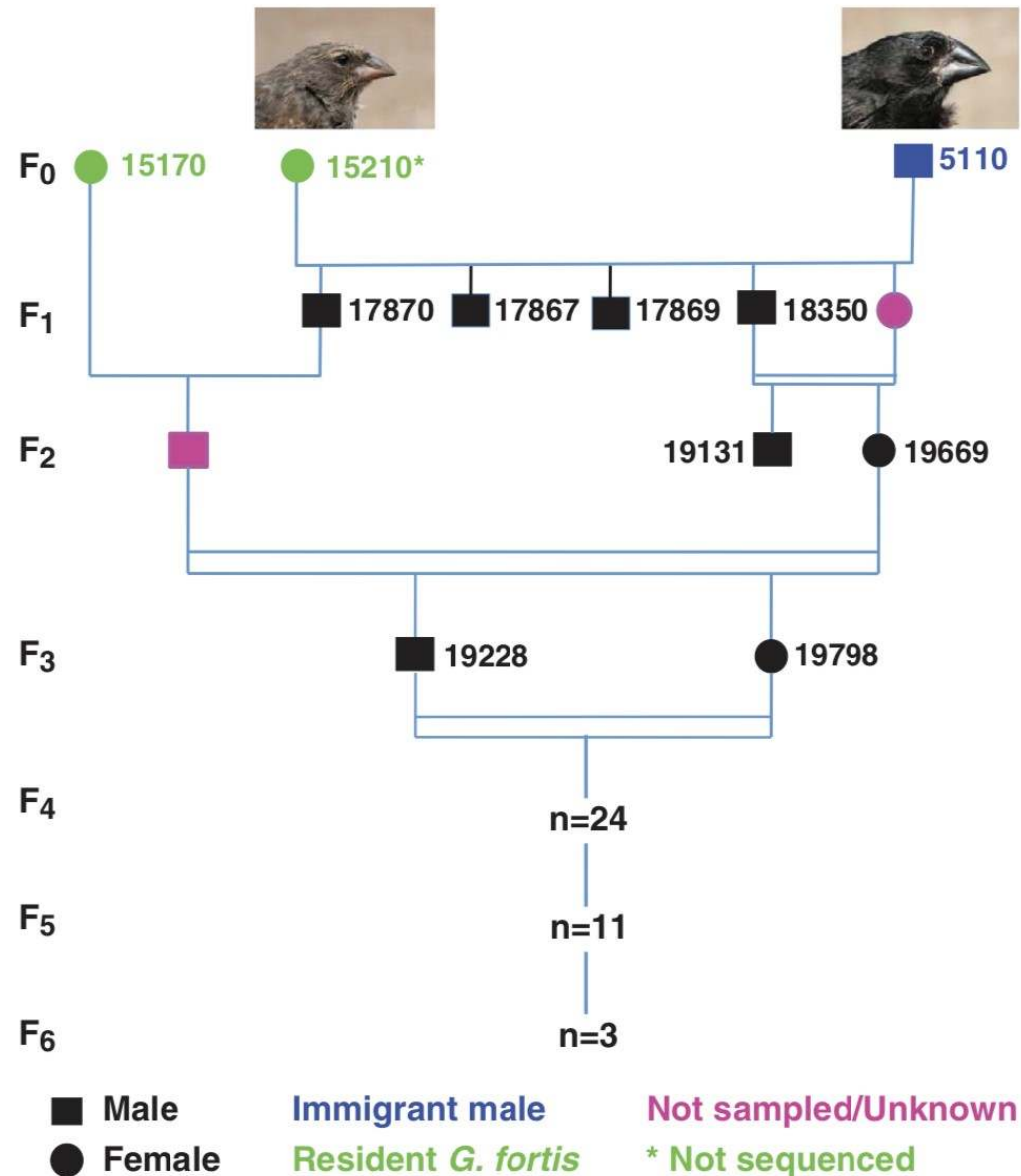


HYBRID SPECIATION

Rapid hybrid speciation in Darwin's finches

Sangeet Lamichhane^{1*} Fan Han¹ Matthew T. Webster¹ Leif Andersson^{1,2,3†}
B. Rosemary Grant⁴ Peter R. Grant⁴

Lamichhane *et al.*, *Science* **359**, 224–228 (2018) 12 January 2018



Especiaçãoção em
apenas 2
gerações!

Fim da Parte 1

Perguntas?