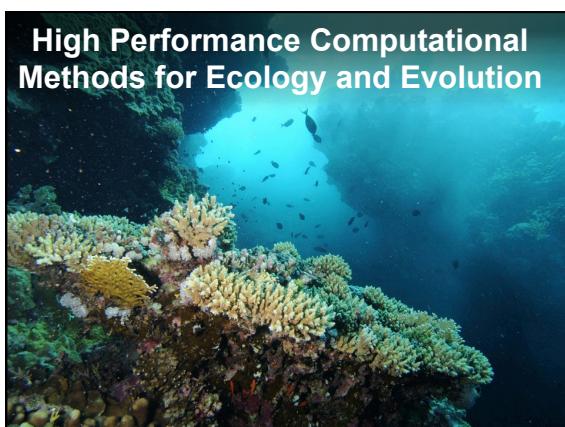


Photo: Carsten Ullrich



Photo: Argonne National Laboratory



High Performance Computational Methods for Ecology and Evolution

Course objectives

Learn about computers and programming
Good programming practice
Running code in parallel on a cluster
Code optimisation

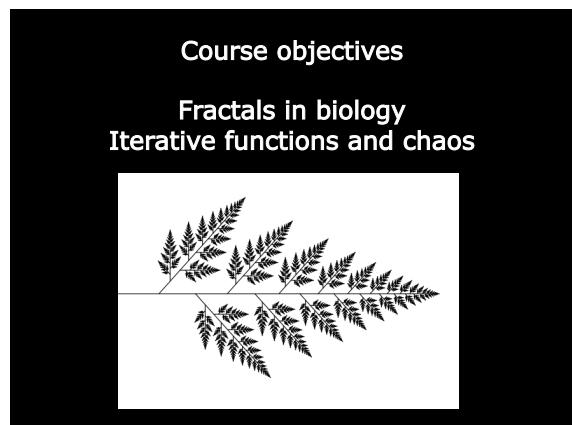


Course objectives

Ecological neutral theory
Stochastic and event based models

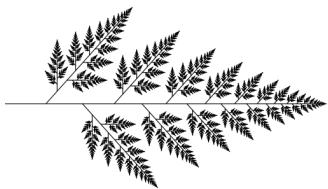
Course objectives

Fractals in biology
Iterative functions and chaos



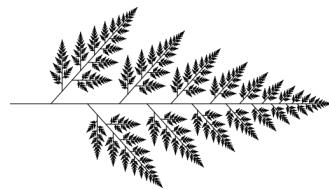
A few other things

- Fewer lectures more practical
- Worksheet to hand in for credit



A few other things

- Fewer lectures more practical
- Worksheet to hand in for credit
- J.Rosindell@imperial.ac.uk
- Munro Building N2.6 (first floor)



Ecological Neutral Theory:

Assumes all individuals are ecologically equivalent

(Caswell 1976)
(Hubbell 1979)
(Hubbell 1997)
(Bell 2000)
(Bell 2001)
(Hubbell 2001)

Ecological Neutral Theory: Madness or Misunderstood?

"This flies in the face of years of ecological theory (supported by data) maintaining that species are *not* ecologically equivalent."

Jerry Coyne

"A preoccupation with neutral theory could marginalize biodiversity science, competing for resources with process-based studies, while having little to offer conservation and policy."

Jim Clark

"It's probably the most misunderstood theory in contemporary ecology"

Arne Schröder

Ecological Neutral Theory: Madness or Misunderstood?

1.) What is neutral theory?

2.) The uses and misuses of neutral theory

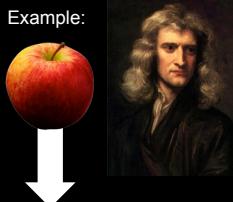
3.) Applications in spatial biodiversity patterns

4.) Applications in island biogeography

A few words about theory in physics ...

- Scientific theory conforms with empirical data and puts forward an 'explanation' for observed phenomena

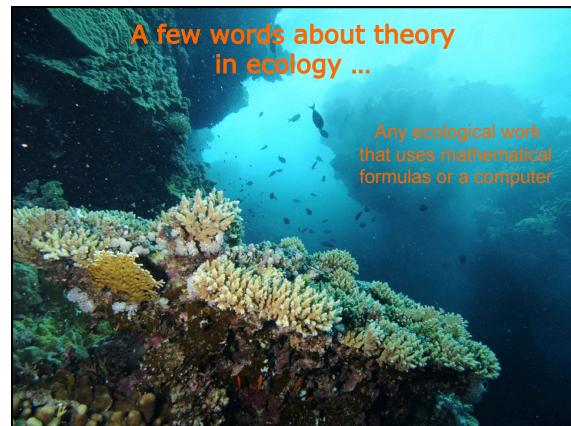
Example:



$$F = G \frac{m_1 m_2}{r^2}$$

A few words about theory in ecology ...

Any ecological work that uses mathematical formulas or a computer



Ecological Neutral Theory

Assumes all individuals are ecologically equivalent

Is not a claim that all individuals are ecologically equivalent

Is about making some assumptions and seeing where they get us

Caswell 1976
Hubbell 1979
Hubbell 1997
(Bell 2000)
(Bell 2001)
(Hubbell 2001)



Essentially, all models are wrong, but some are useful

George E P Box

(Box & Draper 1987)

Defining ecological neutral theory

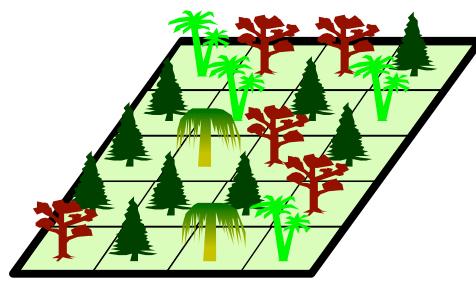
'Neutral theory' is a claim that all individuals are ecologically equivalent

'Neutral theory' refers to the contents of the 2001 book by Hubbell
"The Unified Neutral Theory of Biodiversity and Biogeography"

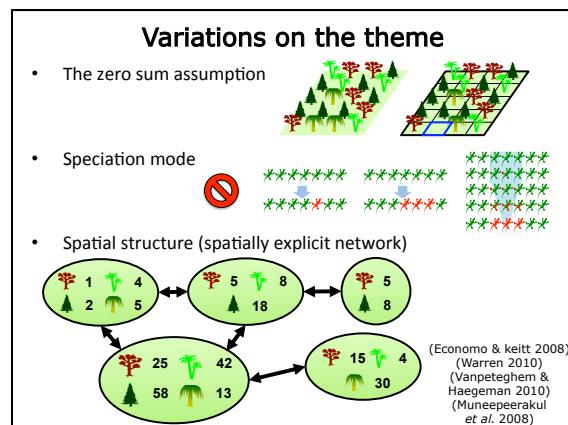
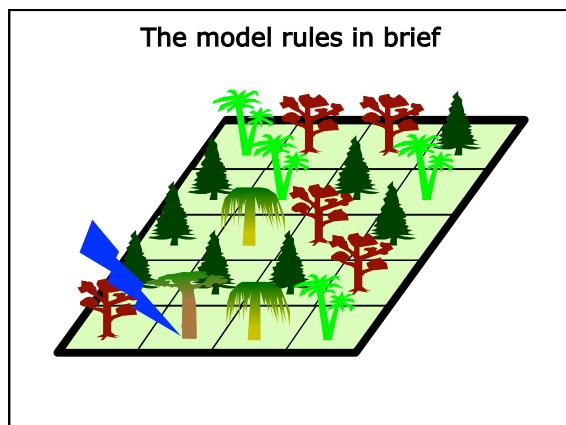
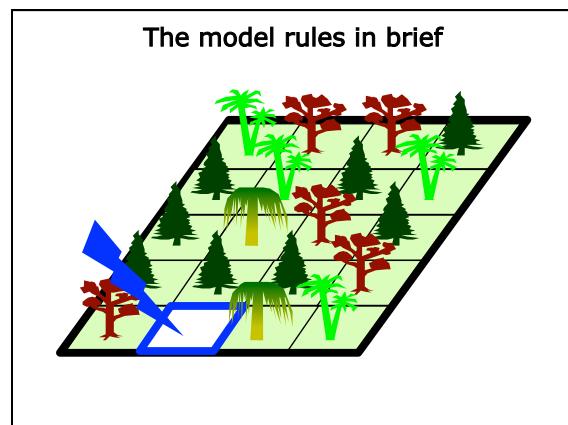
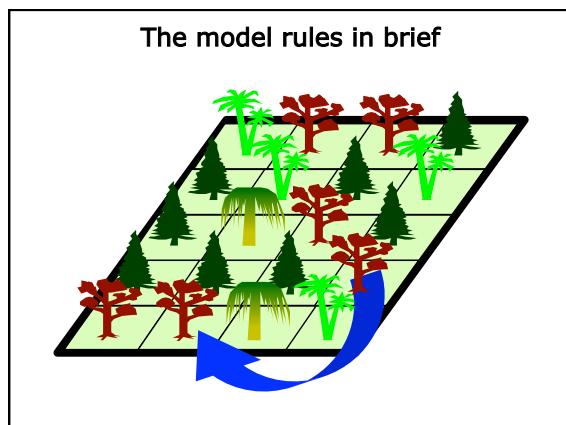
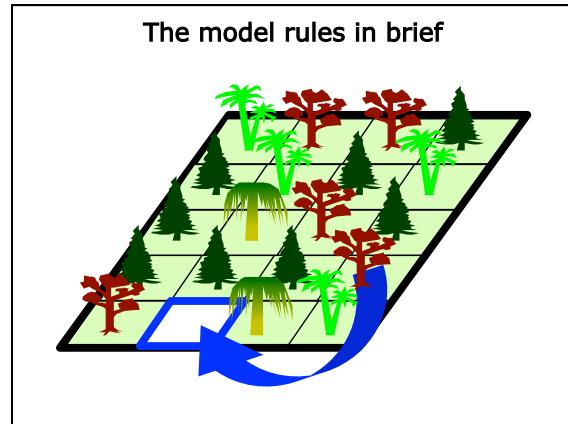
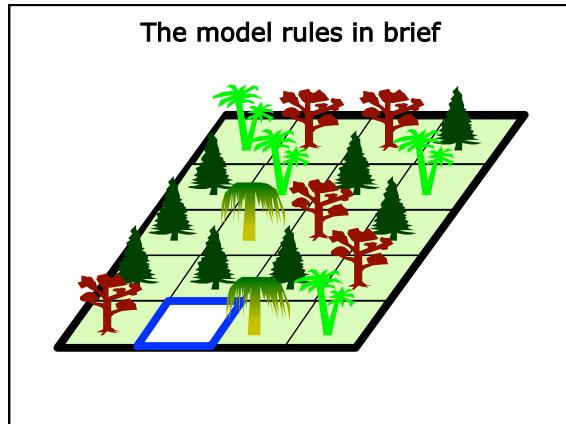
'Neutral theory' refers to a suite of neutral models

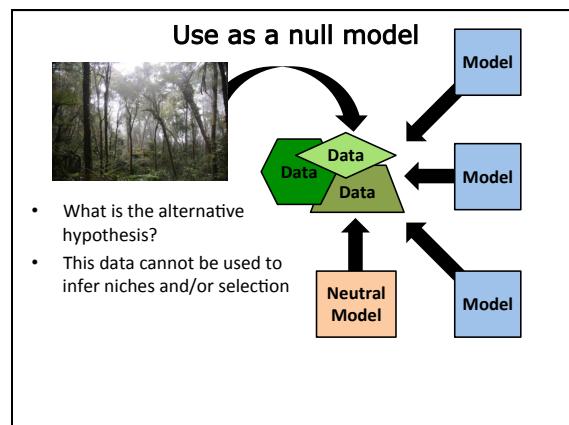
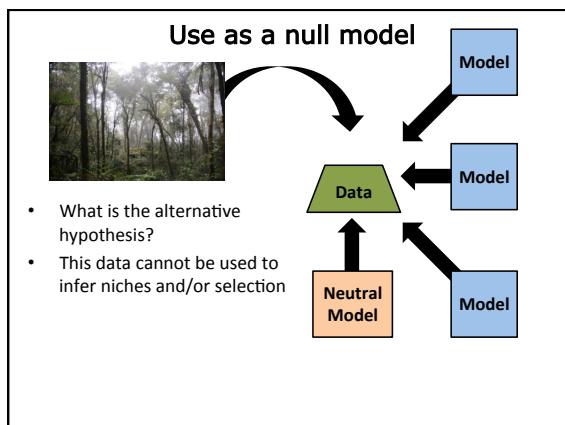
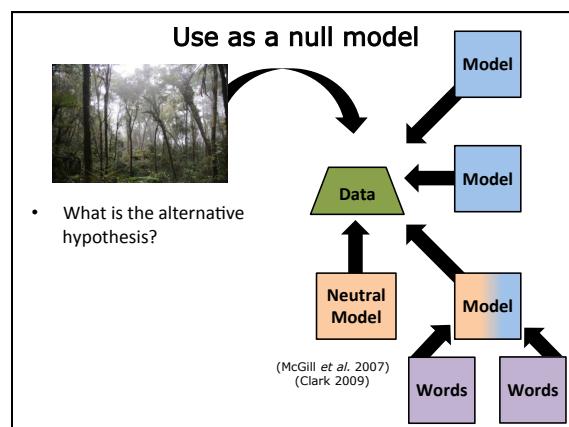
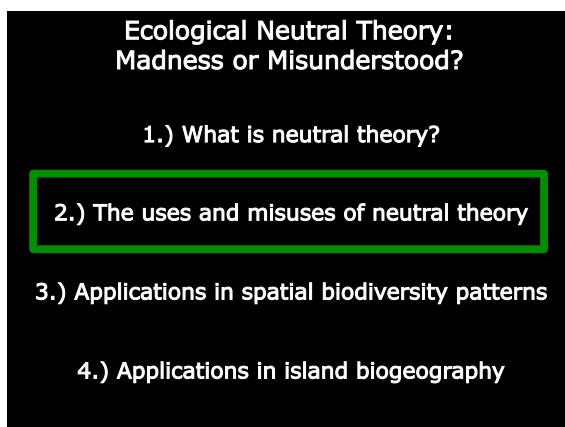
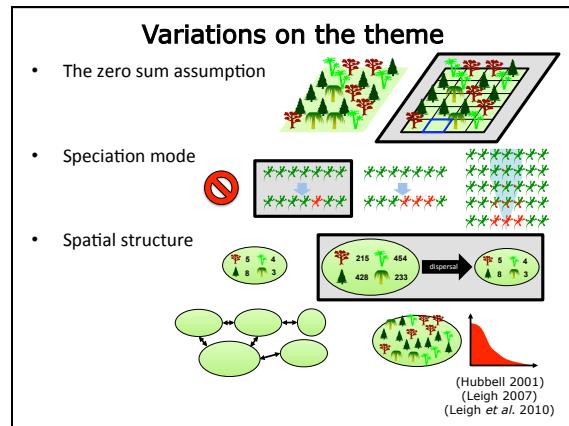
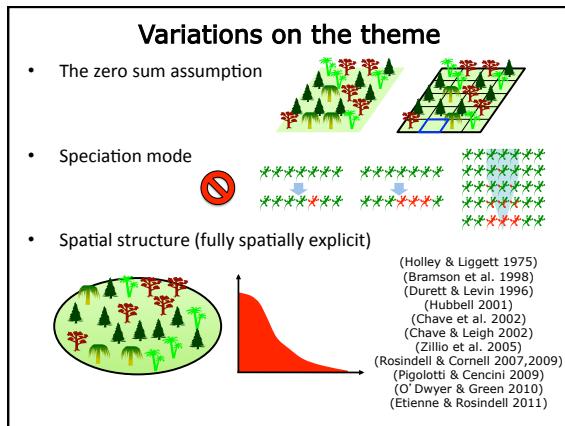
Neutral models assume that the properties of an individual organism are independent of its species identity

The model rules in brief



!





Use as a null model

• What is the alternative hypothesis?
• This data cannot be used to infer niches and/or selection

Example data comparison

Species abundance distributions

(Hubbell 2001)

Example data comparison

Mean species lifetimes are too short
(Ricklefs 2003, Nee 2005, Ricklefs 2006)

but that was for point mutation speciation

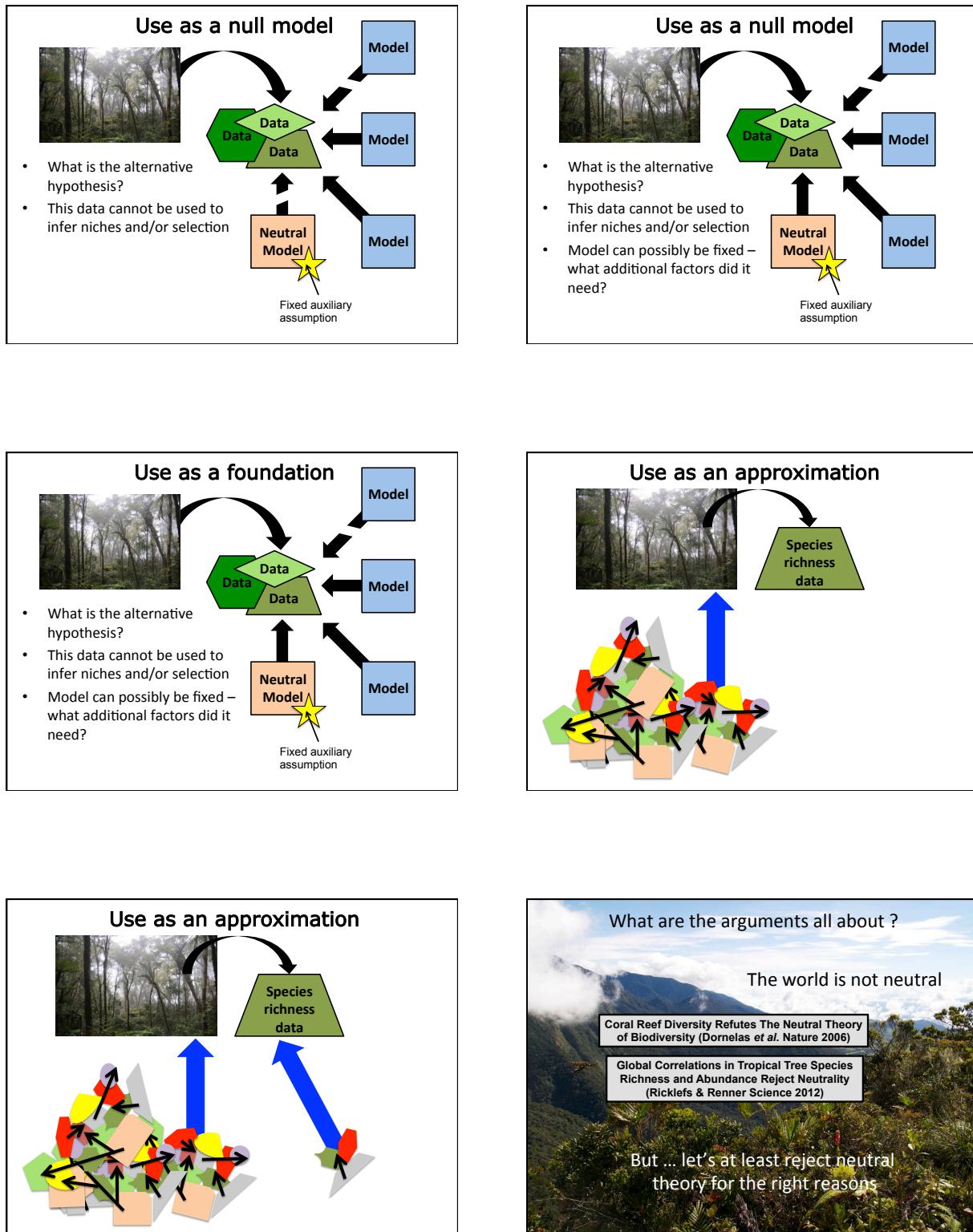
Protracted Speciation

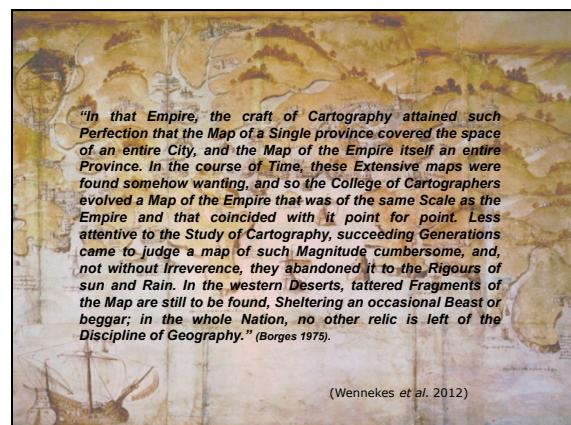
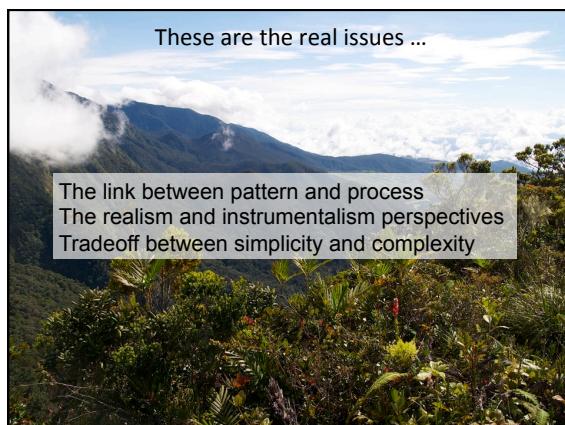
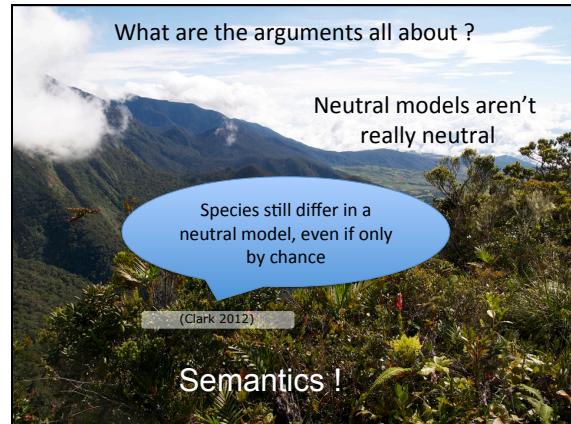
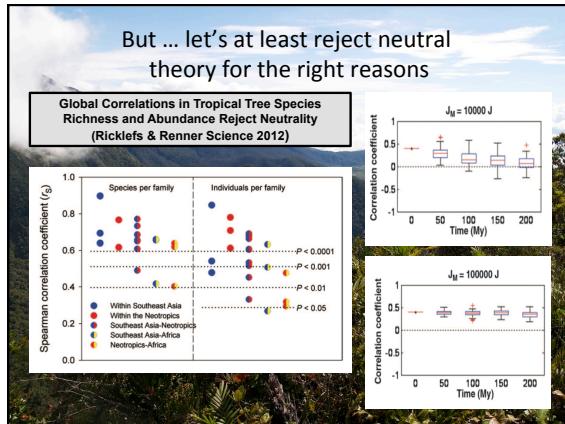
Not an instantaneous event

Tropical Forest Tree Data

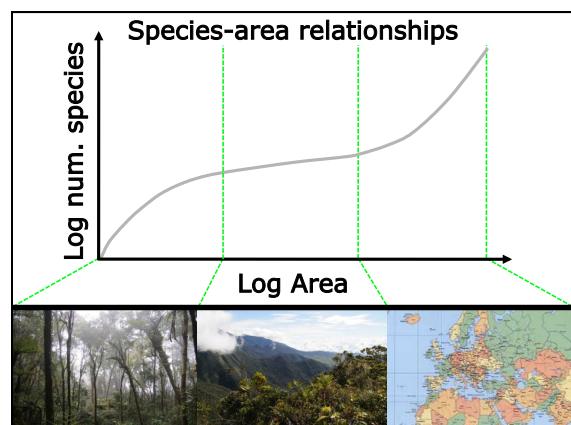
Use as a null model

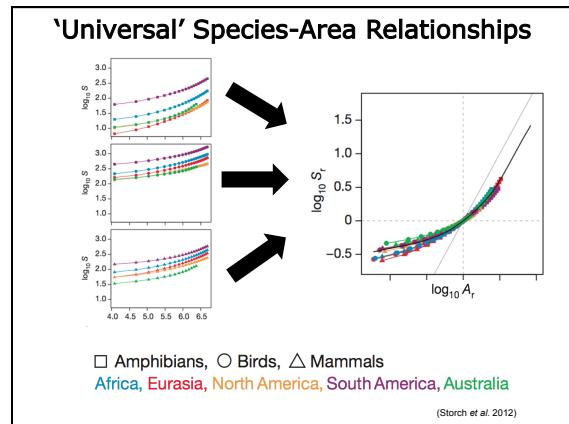
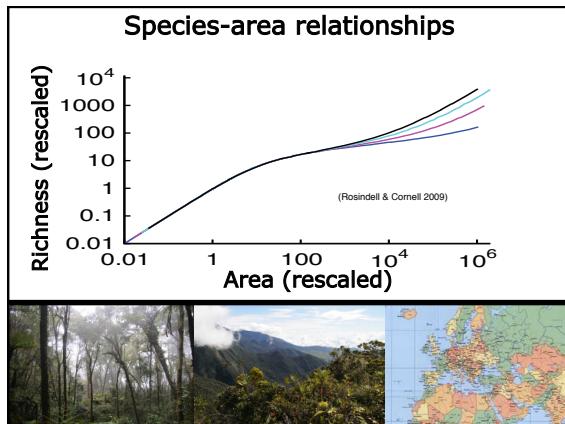
• What is the alternative hypothesis?
• This data cannot be used to infer niches and/or selection



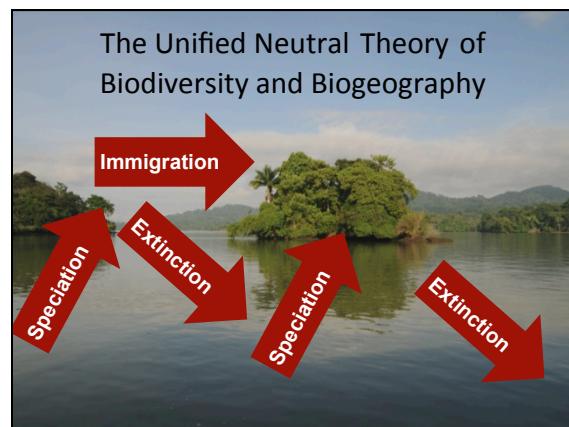
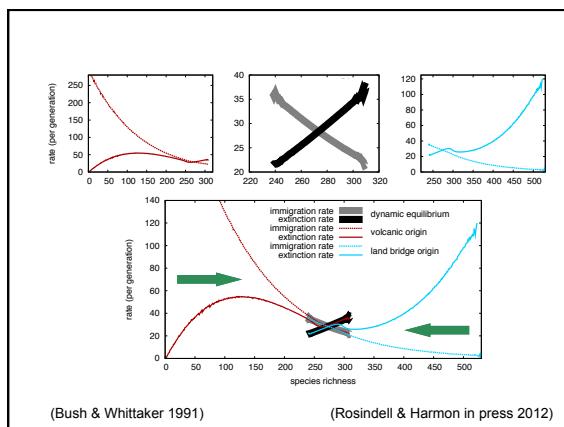
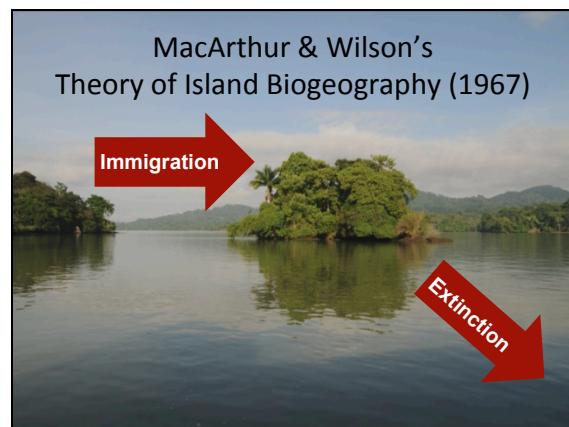


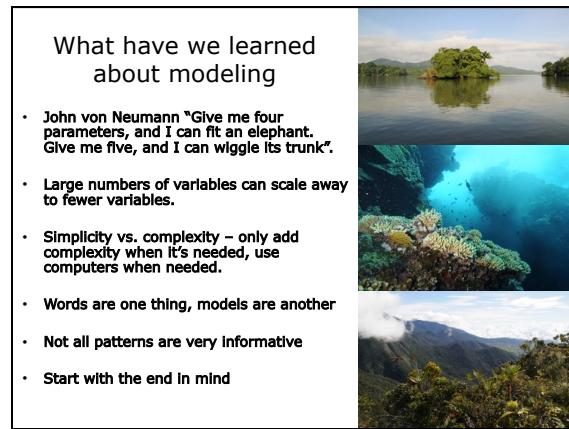
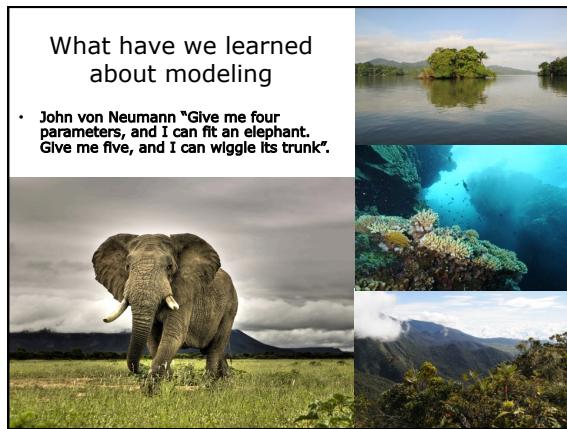
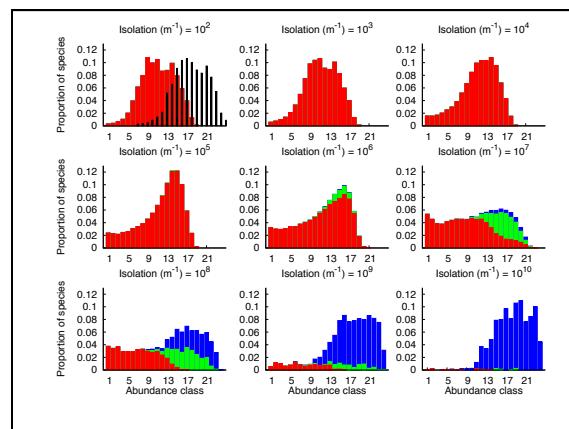
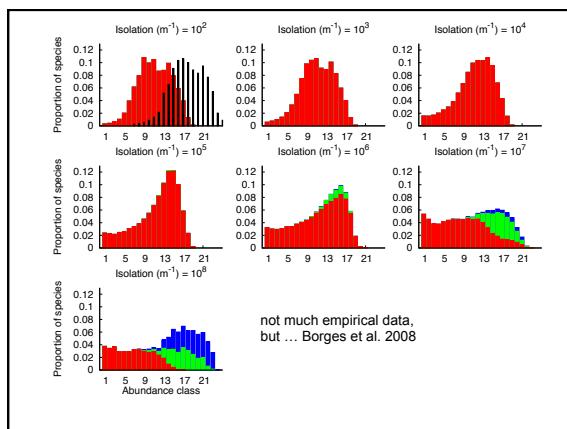
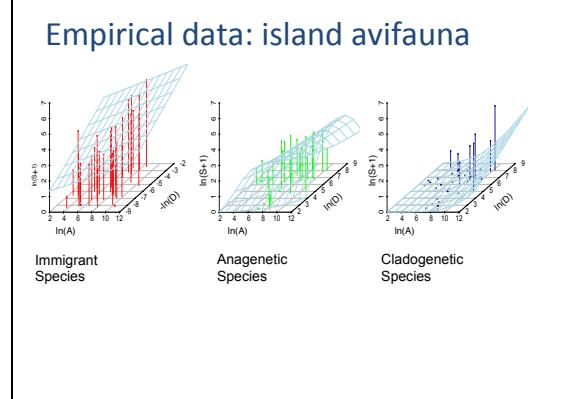
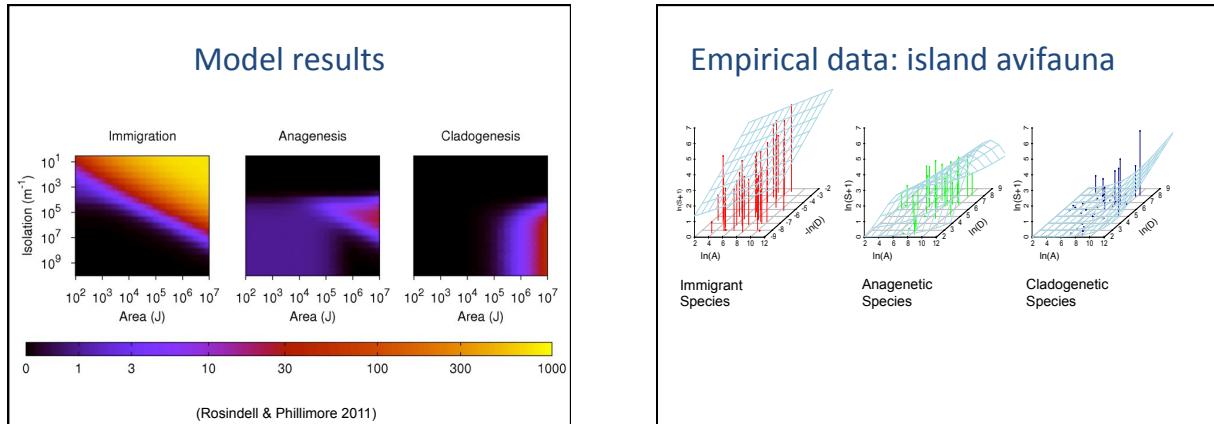
- ### Ecological Neutral Theory: Madness or Misunderstood?
- 1.) What is neutral theory?
 - 2.) The uses and misuses of neutral theory
 - 3.) Applications in spatial biodiversity patterns**
 - 4.) Applications in island biogeography





- Ecological Neutral Theory:
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Neutral theory conclusions	
• Neutral theory is a collection of neutral models assuming ecological equivalence of individuals regardless of their species.	
• Uses as a null model or approximation but not both at the same time.	
• Explains species area relationships and other spatial biodiversity patterns.	
• Makes rich predictions about biodiversity and endemism on islands.	
• Neutral theory is one of the many useful tools you have in your tool box.	

