Phylogenies and community structure

November 24, 2014

0.1 Teaching goals

- Know the terms related to the word 'phylogeny'
- Reading dendrograms
- What does a phylogeny show?
- What can a phylogeny tell about species composition?

0.2 Planning

- 10: part 1 (+2: reflect): basic tree representations of data
- 10: part 2 (+2: reflect): types of things being depicted
- 10: part 3 (+2: reflect): advanced tree representations of data
- 10: part 4 (+2: reflect): phylogenies and inferring species communies

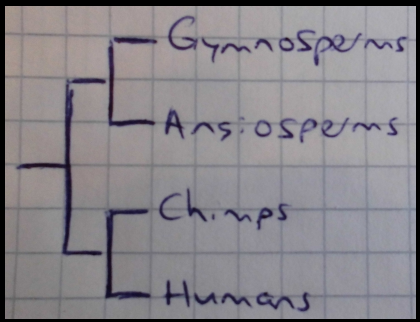
Chapter 1

Basic tree representations of data

1.1 Overview

- Types of tree representations
- What is a phylogeny?
- How to read a phylogeny? Or: how to deceive your audience

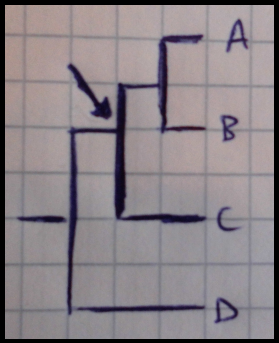
1.2 Quiz



Cladogram from molecular data

'Humans are evolutionary as close to chimps as gymnosperms are to angiosperms'

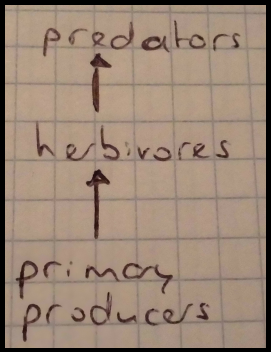
1.3 Quiz



Phylogram from molecular data (legend omitted)
'D is closer to A then to C'

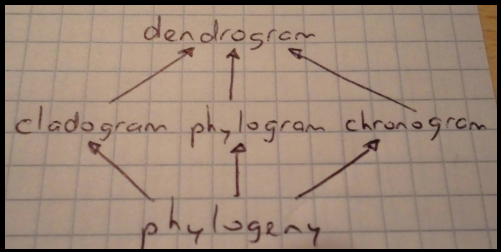
1.4 Dendrogram

- Most general term for any tree-like clustering
- 'dendron' = tree, 'gramma' = drawing



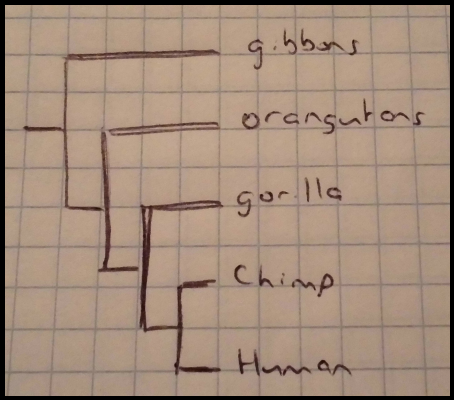
1.5 Dendrogram types

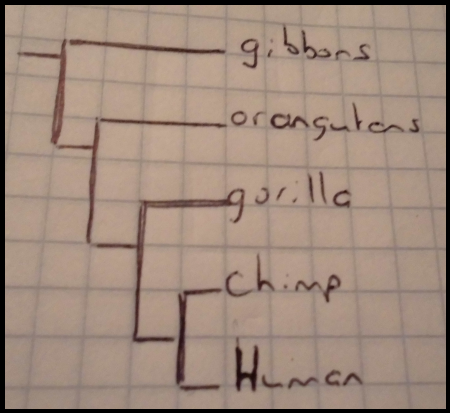
- Cladogram: branch lengths have no meaning
- Phylogram: branch lengths propertionally to character change
- Chronogram: branch lengths propertionally to time



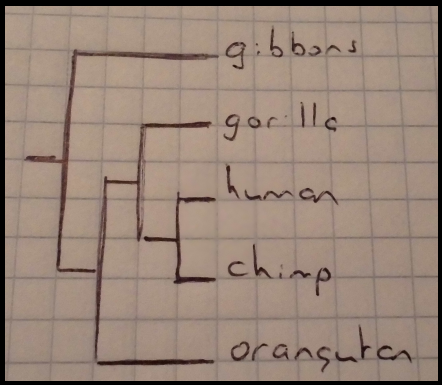
1.6 Cladograms: Great Chain Of Being

- 'klados' = branch

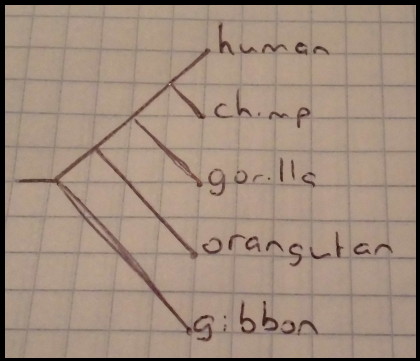




1.7 Cladograms: Man is just a hominid

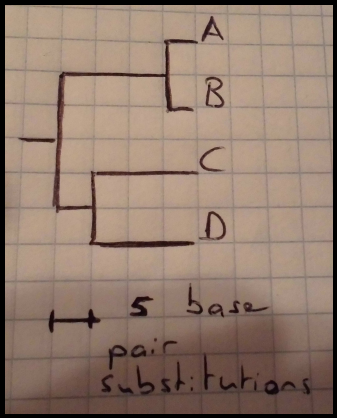


1.8 Cladograms



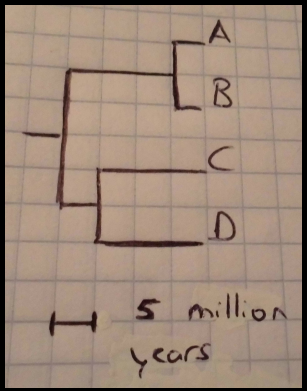
1.9 Phylogram

- 'phylon' = tribe, clan, race

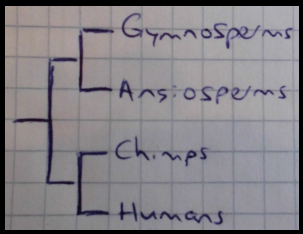


1.10 Chronogram

- 'chronos' = time



1.11 Quiz

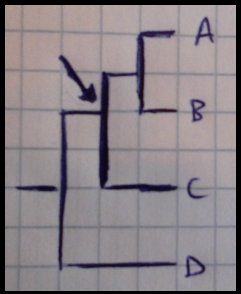


Cladogram from molecular data

'Humans are evolutionary as close to chimps as gymnosperms are to angiosperms'

1. Must be accepted
2. Cannot be sure
3. Must be rejected

1.12 Quiz



Phylogram from molecular data (legend omitted)

1. D is closer to A then to C
2. D is as close to A as to C
3. D is closer to C then to A

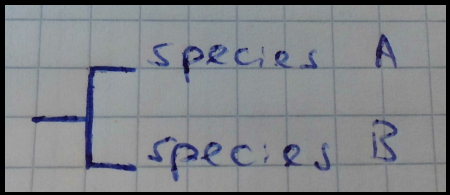
Chapter 2

Other things

2.1 Overview

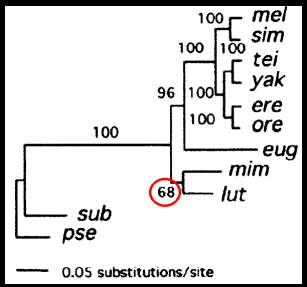
- Quiz
- Types of things being depicted
- Types of things not being depicted
- Bootstrap values

2.2 Quiz



Phylogeny
'There are no biological forces acting in this (boring) system'

2.3 Quiz



Phylogenetic tree of Adh in Drosophila

'mim[1] and lut[2] share only 68% similarity with their common ancestor'

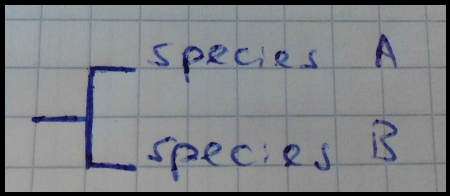
[1] Drosphila mimetica
[2] Drosphila lutescens

2.4 Types of things being depicted

- Phylogeny: hypothesis about the evolutionary history of taxonomic groups
- Gene tree: gene sequences from different species
- Phylogenetic tree: phylogeny derived from a gene tree
- Gene genealogy: gene sequences within species

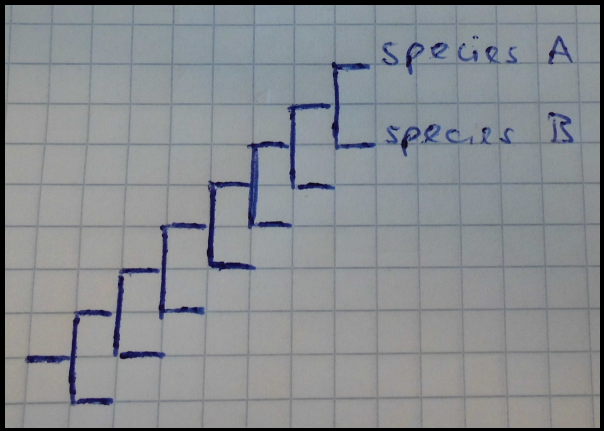
2.5 Types of things not being depicted

- Phylograms commonly deal with extant species



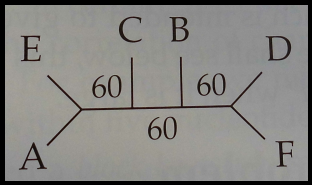
2.6 Types of things not being depicted

- That does not mean nothing is going on!

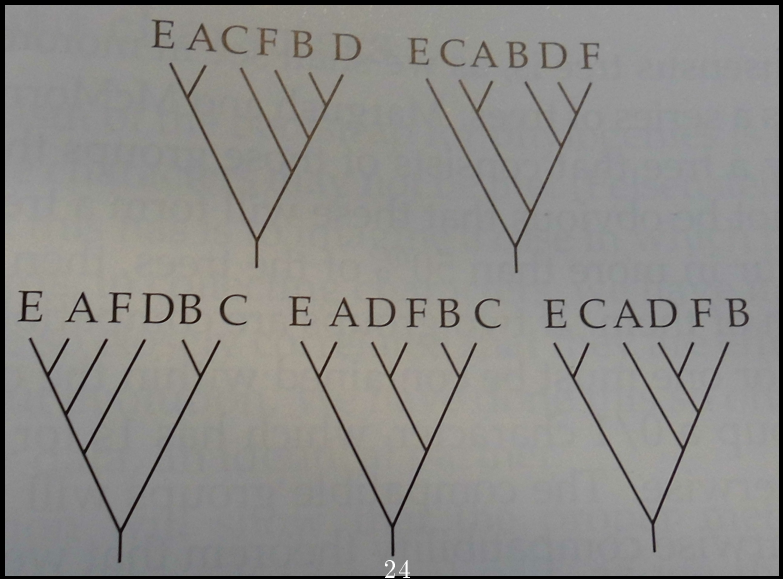


2.7 Bootstrap values

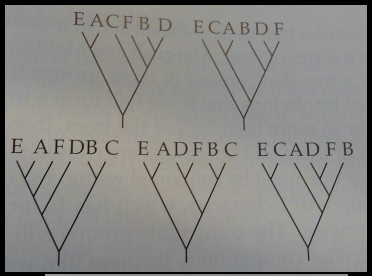
- Inferring a dendrogram is hard
- Trick: generate multiple candidates, then count these candidates
- Bootstrapping shows how often the candates agree
- Threshold for publication: about 70%

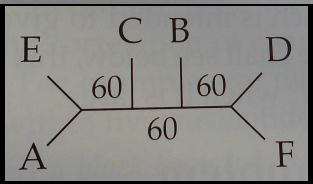


2.8 Bootstrap values: generate candidates



2.9 Bootstrap values: count agreement





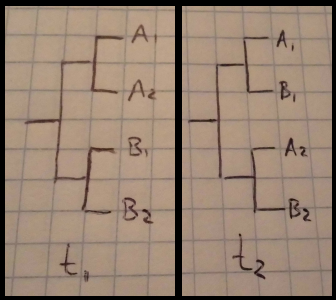
Chapter 3

What phylogenies can tell

3.1 Overview

- Quiz
- What phylogenies can tell

3.2 Quiz



Gene trees of two genes (A and B) in two species (1 and 2) measured at two points in time

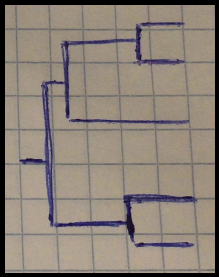
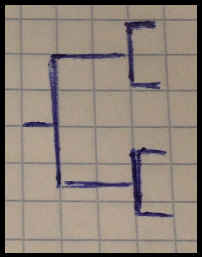
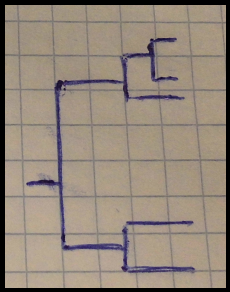
How can this be?

3.3 What phylogenies can tell

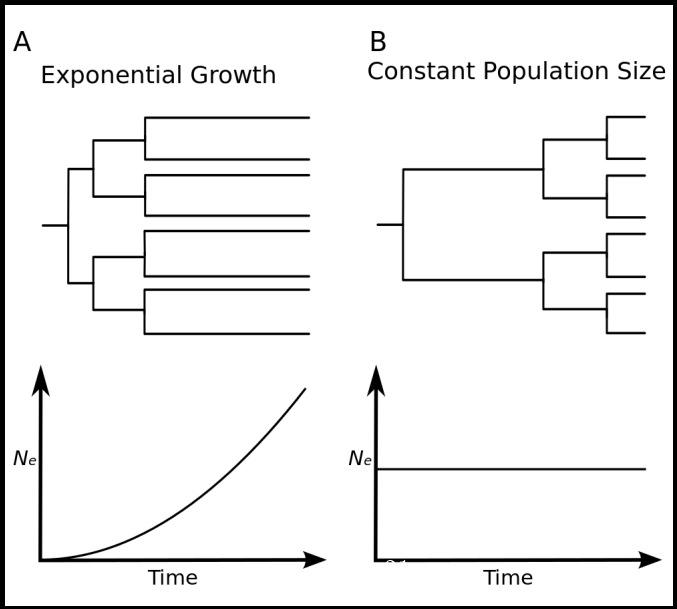
- Type of selection: no, purifying, stabilizing
- Population growth: constant, exponential
- Phylogenies that change: concerted evolution
- Type of evolutionary force: habitat filtering, competitive exclusion
- Type of evolution: concerted, divergent, by birth-death process
- Mutation rate

3.4 Type of selection

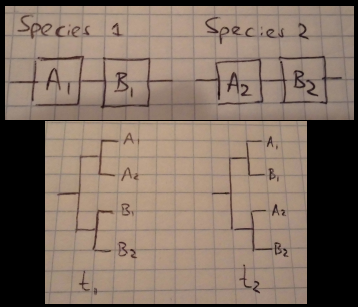
- Neutral, purifying, stabilizing

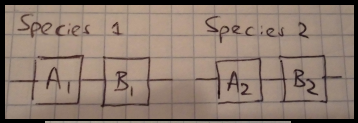
3.5 Population growth

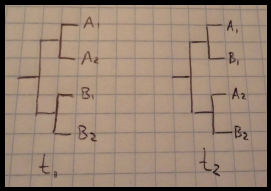


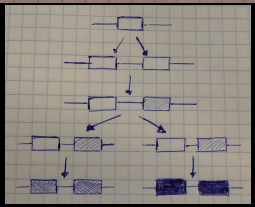
3.6 Phylogenies that change



3.7 Phylogenies that change







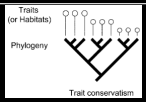
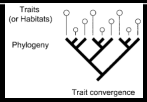
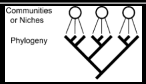
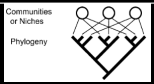
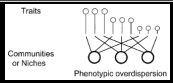
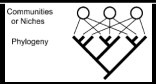
3.8 Type of evolutionary force

> [...] the struggle will generally be more severe between species of the same genus, when they come into competition with another, then species of distinct genera [2]

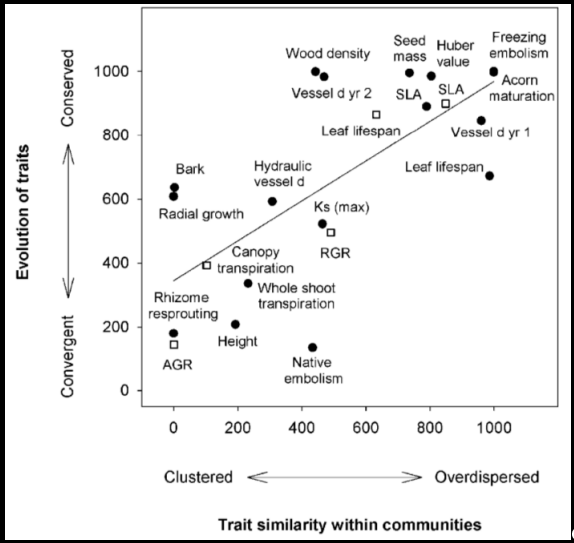
3.9 Type of evolutionary force[3]

Dominant ecological force	Ecological traits phylogenetically	
	Conserved	Convergent
Habitat filtering[1]	Clustered	Overdispersed
Competitive exclusion[2]	Overdispersed	Random

3.10 Type of evolutionary force[1][3]

Dominant ecological force	Ecological traits phylogenetically	
		
		
		Random

3.11 Type of evolutionary force[1]



competitive exclusion

examples: Losos et al 2003

by contrast, in a community of Old World leaf warblers, which like anoles are the result of a more ancient (.10 Myr ago) radiation, ecological and phylogenetic similarity do not appear to be related [21]

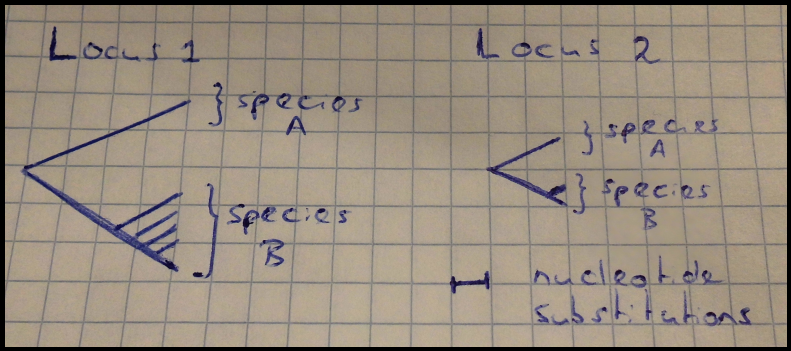
[21] Richman, A. D. & Price, T. Evolution of ecological differences in the Old World leaf warblers. Nature 355, 817–821 (1992).
CANNOT GET

3.12 Neutrality

In Kirkpatrick and Slatkin (1993), authors reviewed six measures of tree asymmetry based solely on the tree topology. They studied the power of these measures to be used as a test for deviation of trees from neutral predictions. A similar analysis was carried out in Maia et al. (2004).

3.13 Mutation speed

- Not all genes have same mutation speed
- Assumes neutral selection



3.14 Goal

Integrating phylogenetic knowledge into studies of commity organisation [3]

- Examining the phylogenetic structure of species assemblages
- Exploring the phylogenetic basis of community niche structure
- Adding a community context to studies of trait evolution and biogeography

Habitat filtering

From 'Habitat filtering and niche differentiation jointly explain species relative abundance within grassland communities along fertility and disturbance gradients' Vincent Maire 1,2 * , Nicolas Gross 3,4 * , Luca Bo¨ rger 3,4 , Raphae¨ l Proulx 5,6 , Christian Wirth 5 , Laı´ se da Silveira Pontes 7 , Jean-Franc¸ois Soussana 1 and Fre´ de´ rique Louault :

However, recent studies (Shipley, 2009; Adler et al. , 2010; Cornwell & Ackerly, 2010) suggested that biodiver- sity within communities cannot be understood without taking into account deterministic processes such as habitat filtering (HF; Keddy, 1992) and niche differentiation (ND; MacArthur & Levins, 1967; Silvertown, 2004).

Keddy PA. 1992. Assembly and response rules – 2 goals for predictive community ecology. Journal of Vegetation Science 3 : 157 – 164.

Bibliography

[1] J Cavender-Bares, D D Ackerly, D A Baum, and F A Bazzaz. Phylogenetic overdispersion in floridian oak communities. *The american naturalist*, 163:823–843, 2004.

[2] Charles Darwin. On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for

life. 1859.

[3] O C Webb, D D Ackerly, M A McPeek, and M J Donoghue. Phylogenies and community ecology. *Annu. Rev. Ecol. Syst.*, 33:475–505, 2002.