# Tempo and mode of evolution of the genus *Conus* (Gastropoda: Neogastropoda) in the Cape Verde Islands

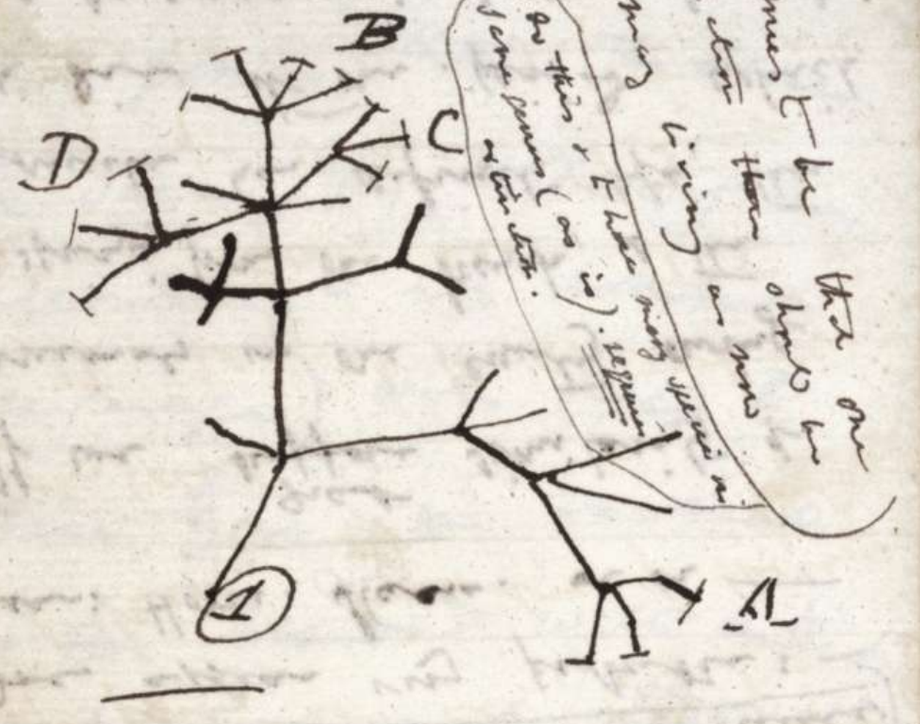
Regina L. Cunha
CCMAR, University of Algarve

# OUTLINE

01 A brief introduction to molecular phylogenetics

02 Model system: Cape Verde cone snails

I think

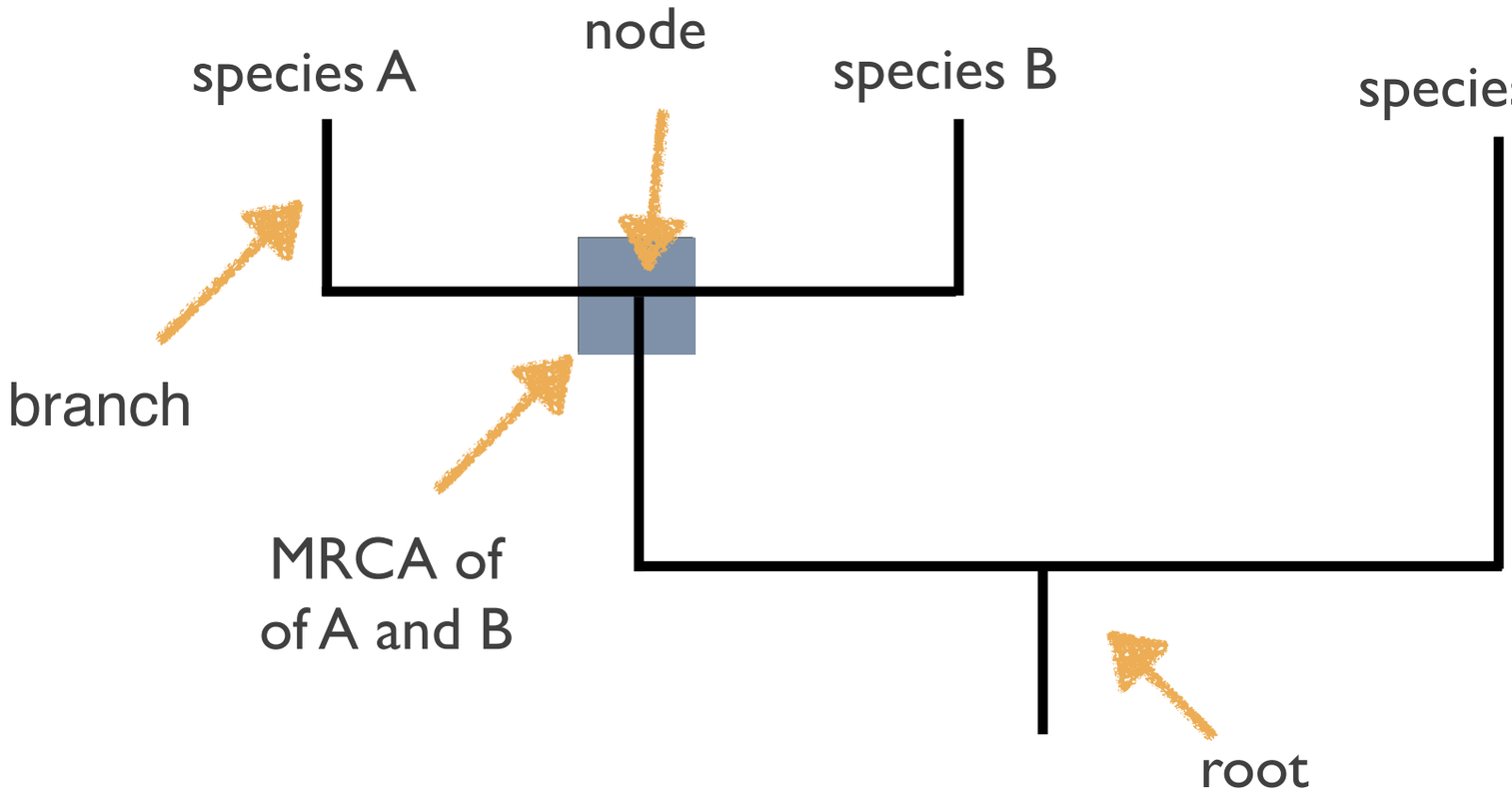



Can must be the chart in
some such there in some
forms still living in some
in mind
Do the this + these going upwards
forms (as in) ~~between~~
and this sketch.

Then between A & D. Chasms
lost of relation. C & B. The
first gradation, B & D
rather greater distinction
Then genera would be
formed. - bearing relation

01

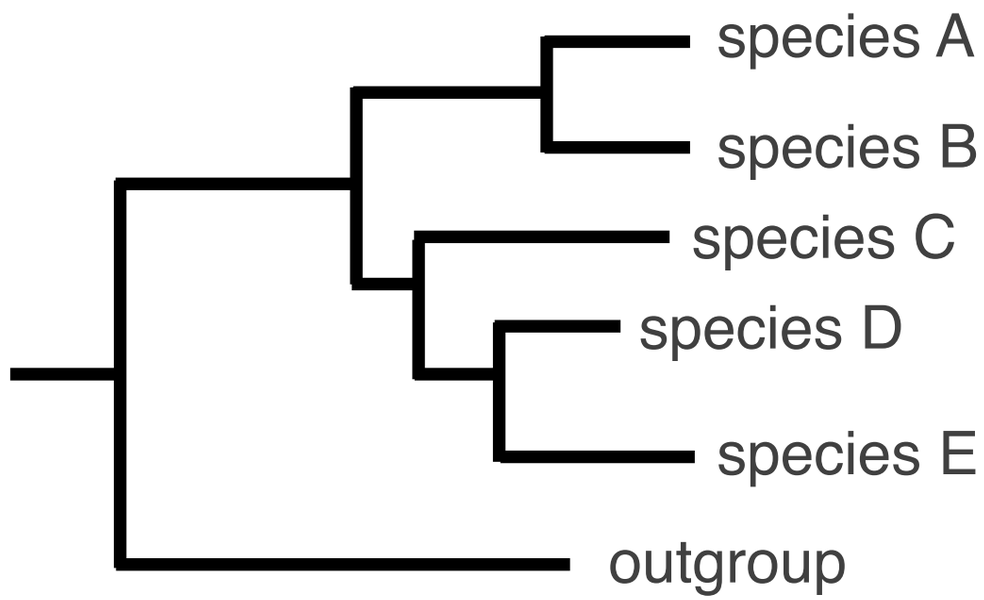
A and B are **sister** groups




C is the **outgroup**
to A and B

01

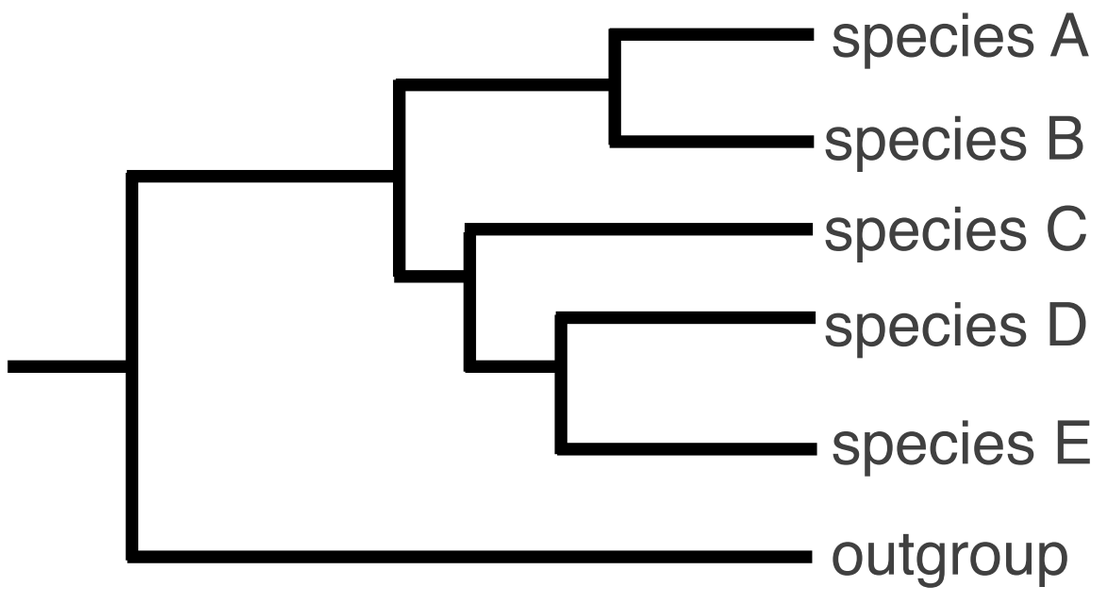
# Phylogram




0.002 subs. per site

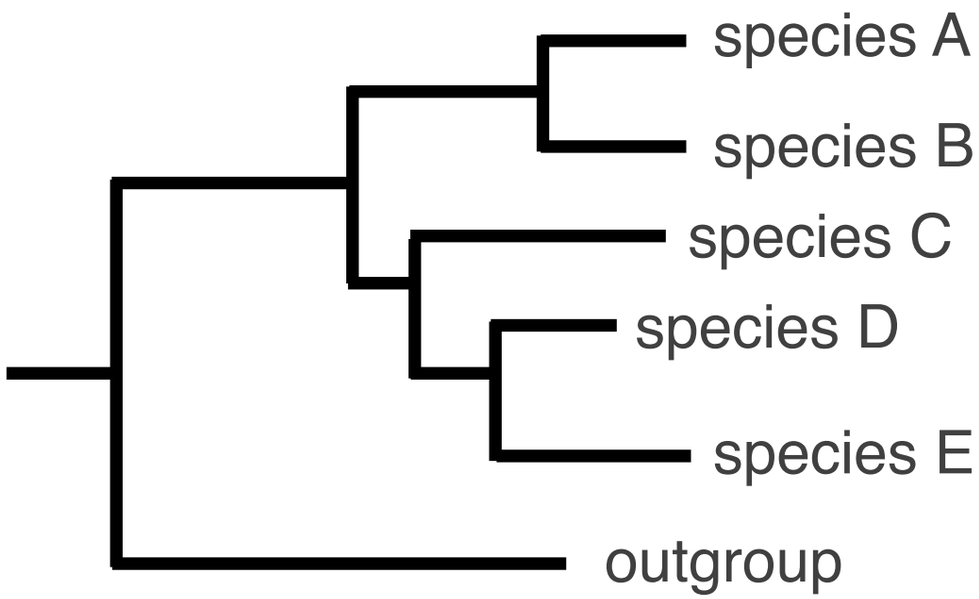
01

# Cladogram



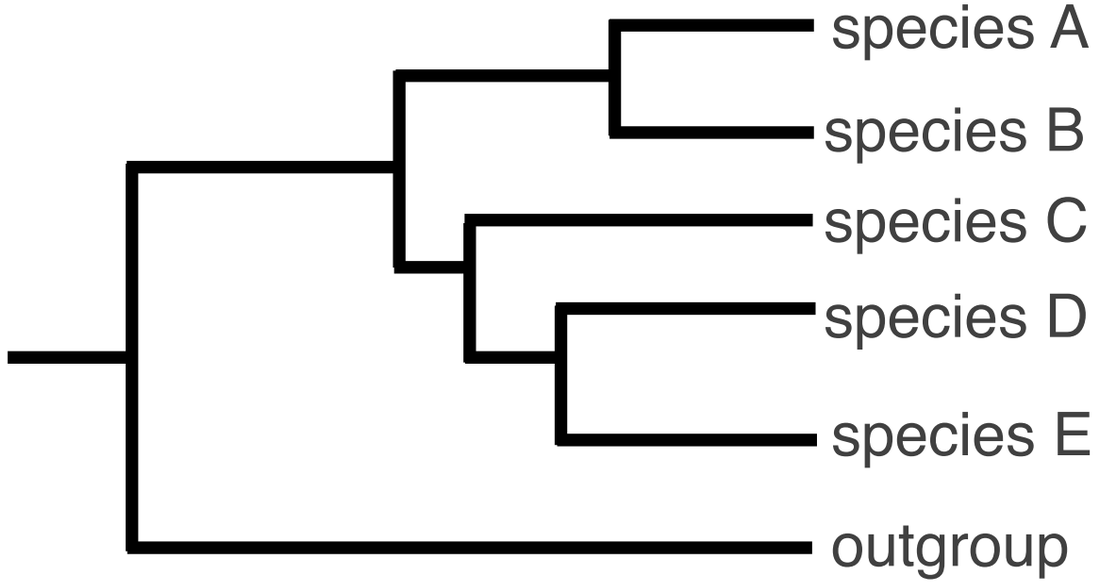
01

## Phylogram



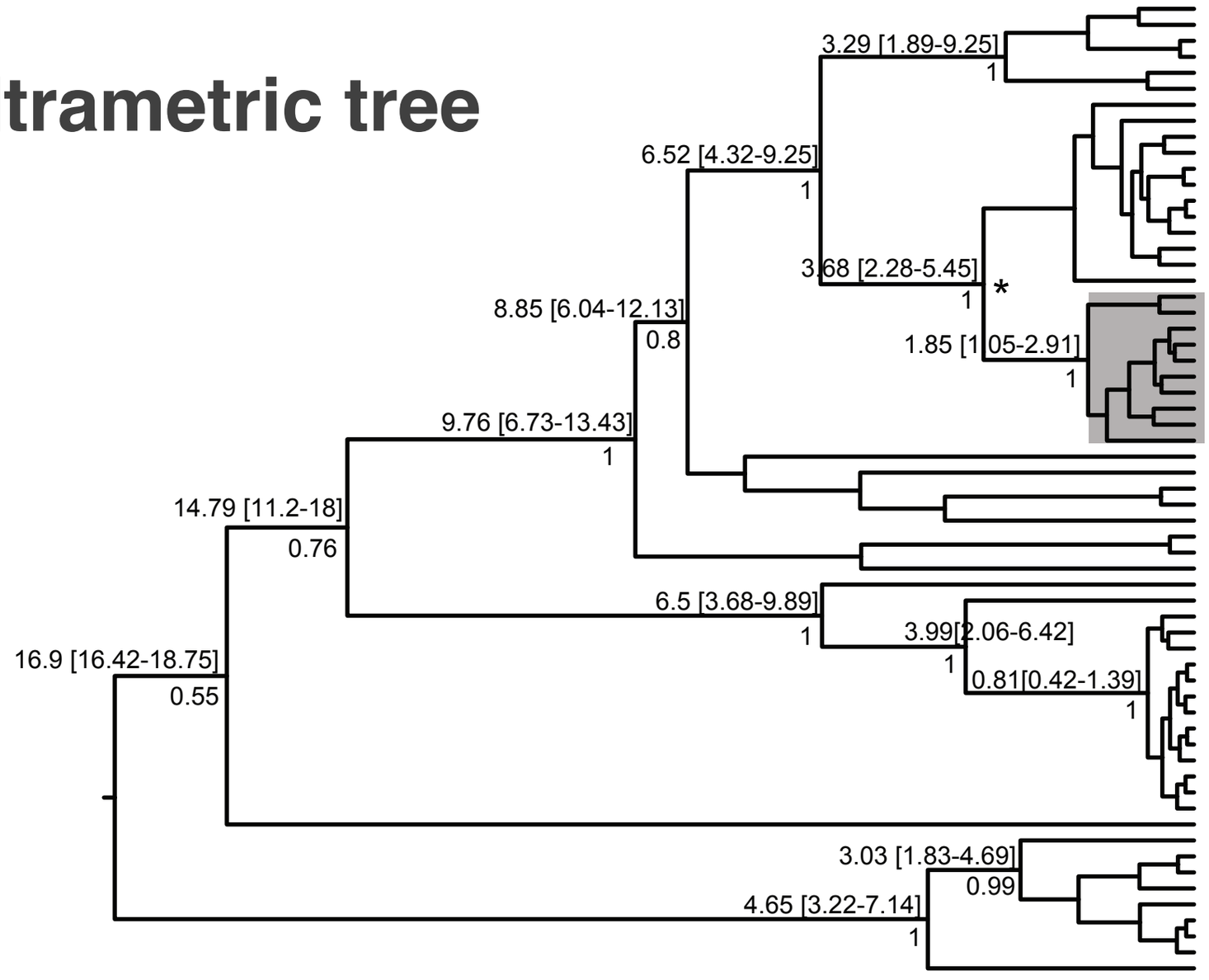

0.002 subs. per site

## Cladogram



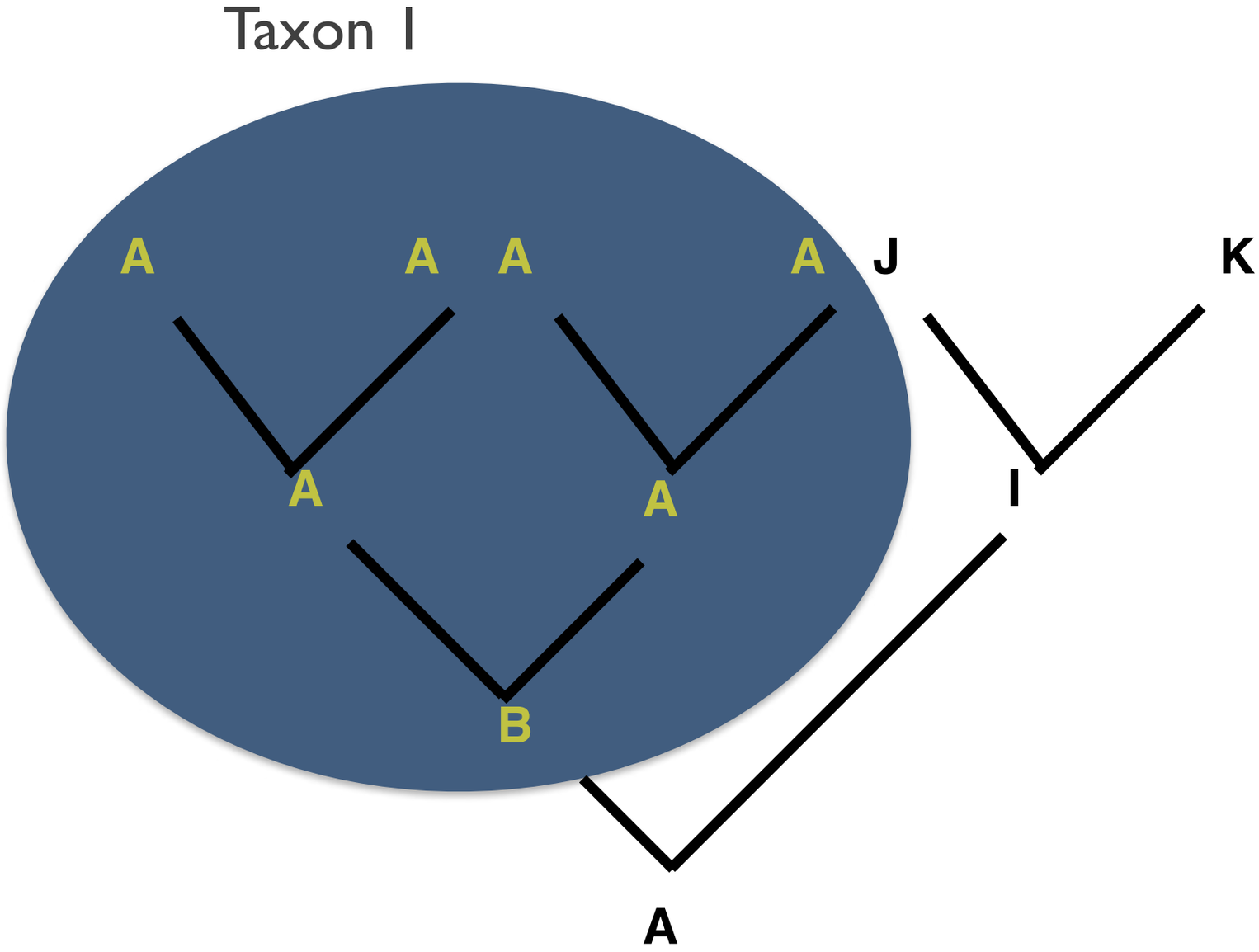
01

# Ultrametric tree




01

monophyletic



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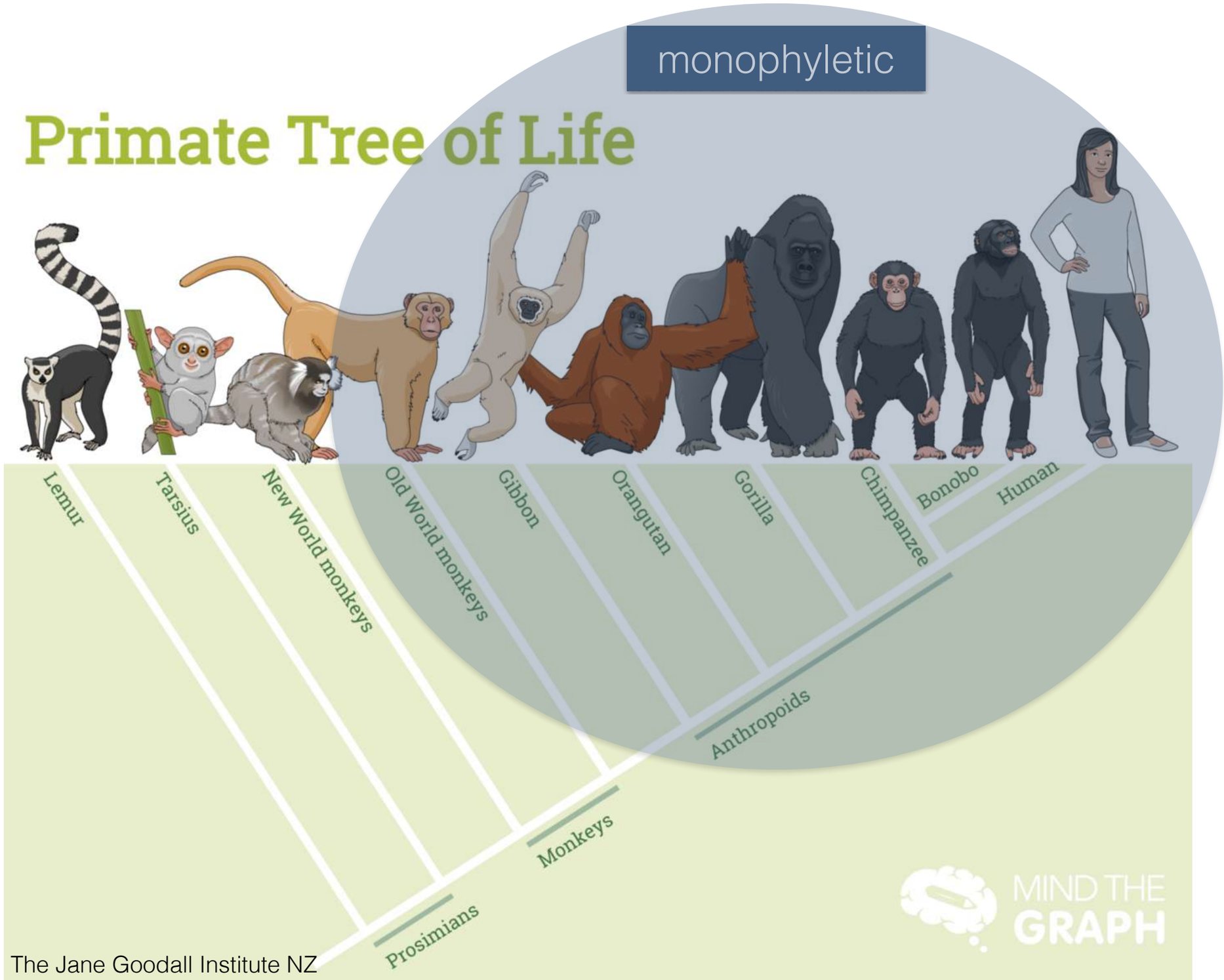
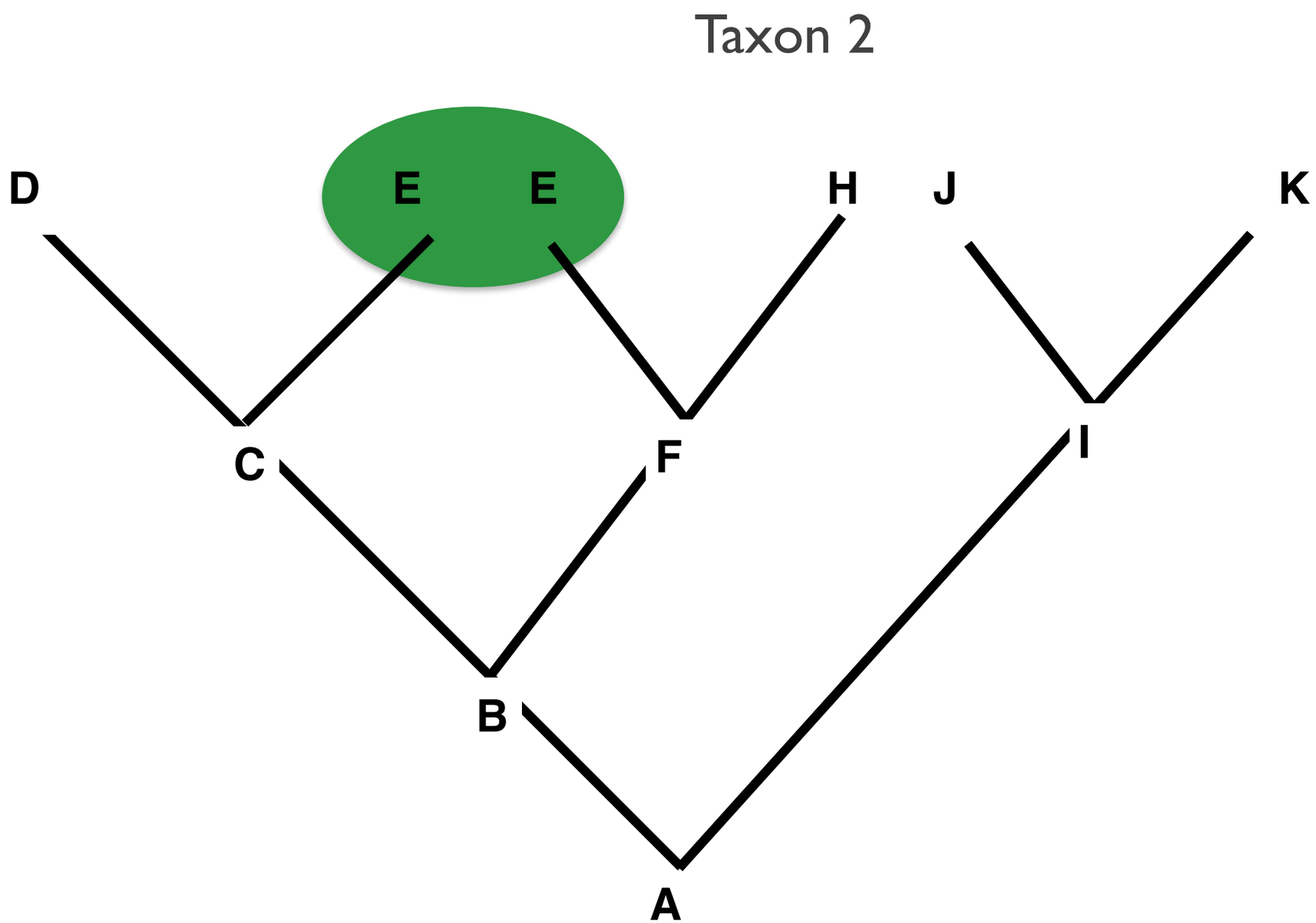



The Jane Goodall Institute NZ

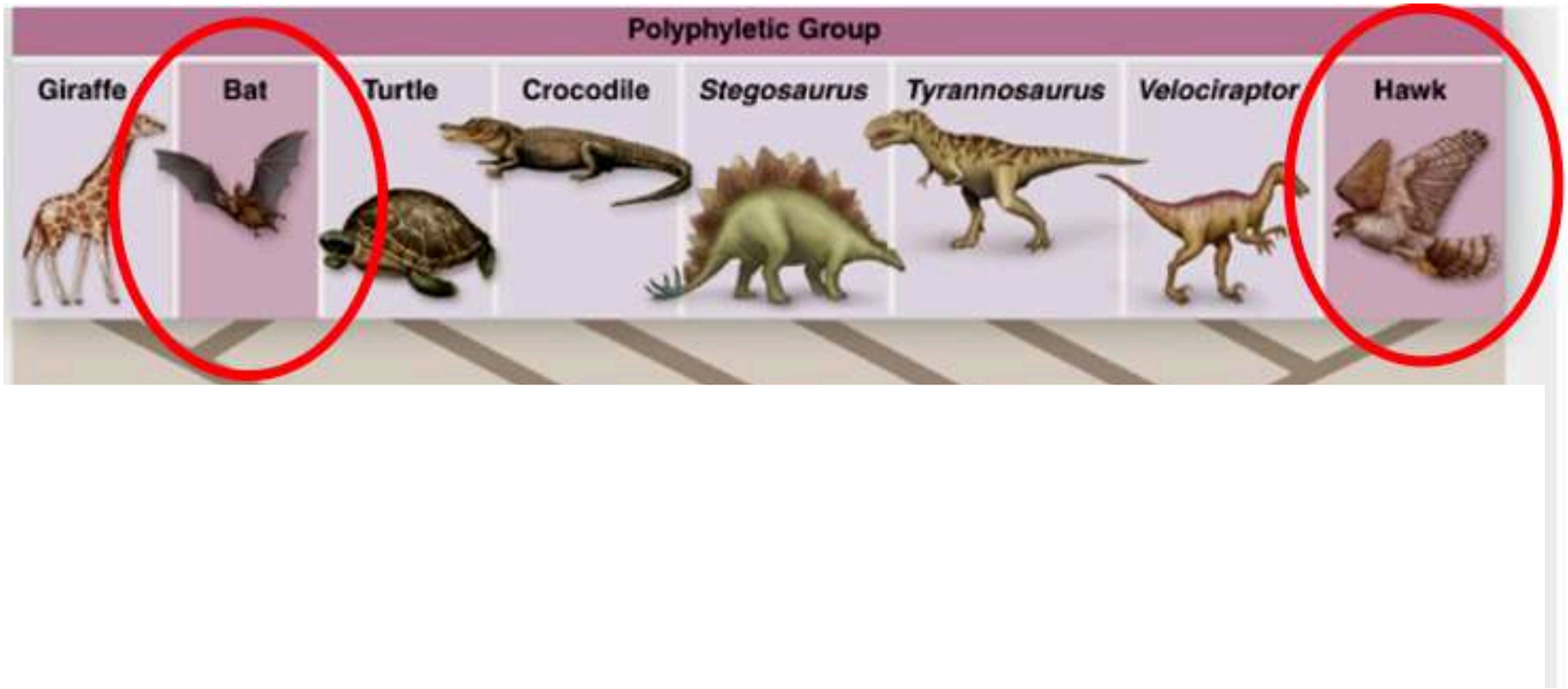
01

polyphyletic



01

polyphyletic



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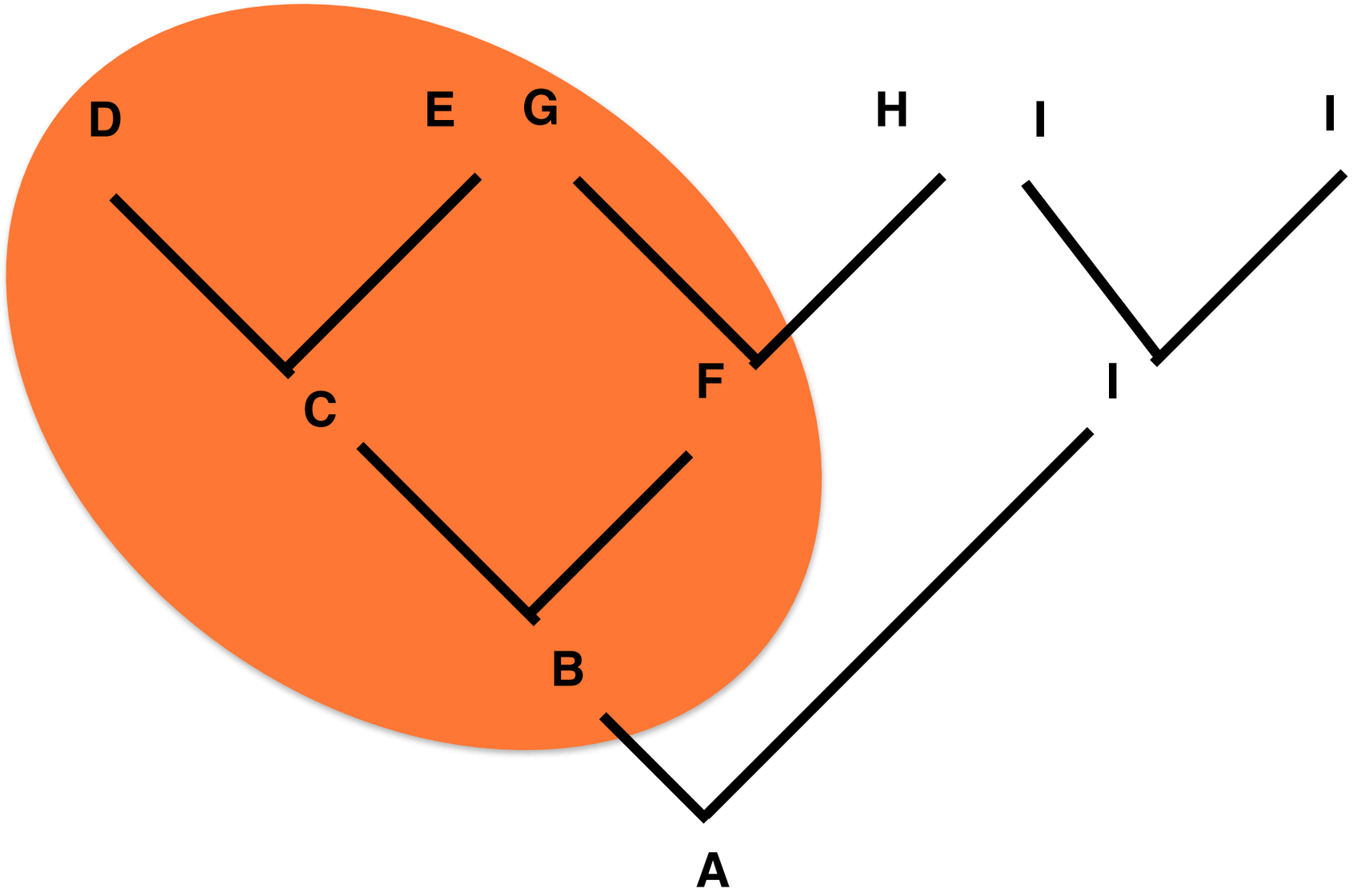
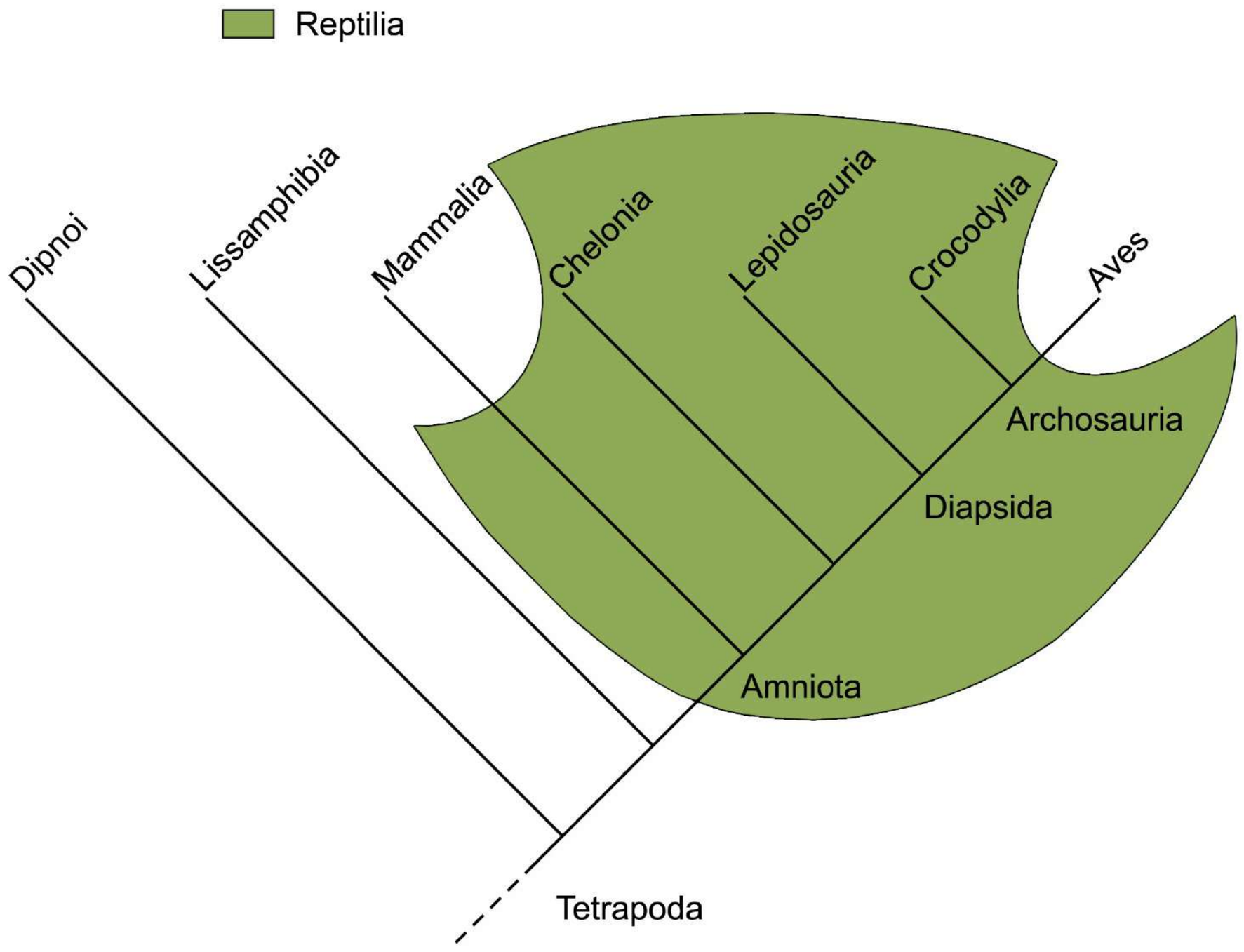
Taxon 3



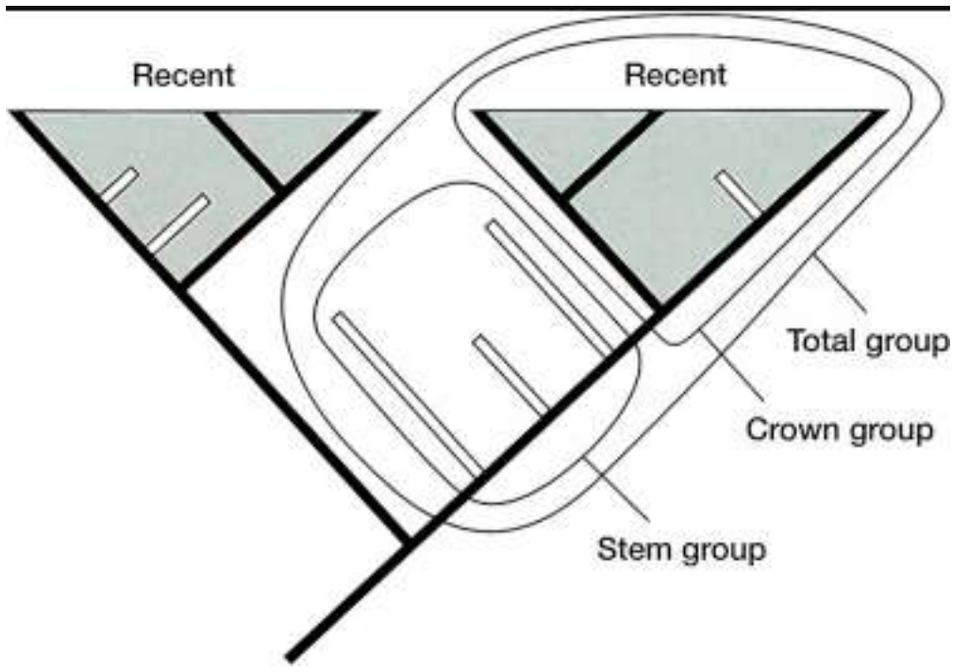

paraphyletic

01

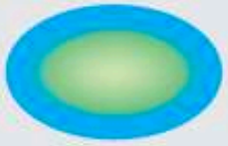
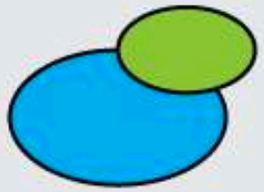
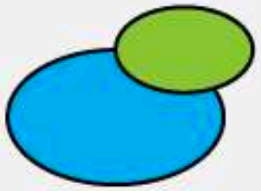
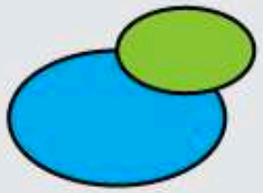
paraphyletic




By Petter Bøckman - Own work, CC0, https://commons.wikimedia.org/w/index.php?curid=18538461


Recent
Recent
Total group
Crown group
Stem group

01

| | Allopatric | Parapatric | Sympatric |
|---|---|---|---|
| Continous population of one species |  |  |  |
| Formation of barrier to gene flow |  Geographic barrier |  Adjacent habitat |  Trait polymorphism |
| Reproductive isolation occurs |  |  |  |
| | NO GENE FLOW | | |
| Two new species are formed |  |  |  |

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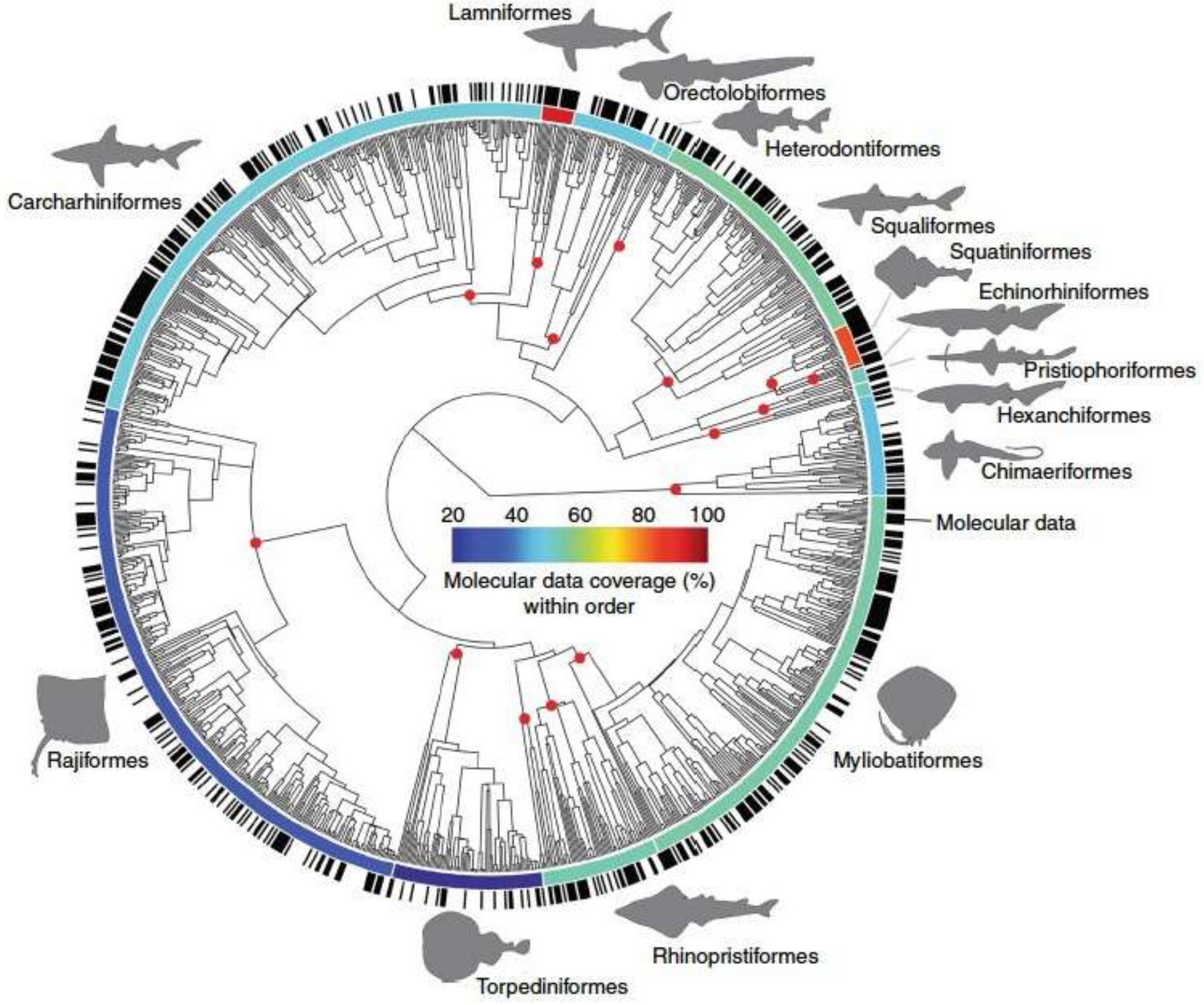
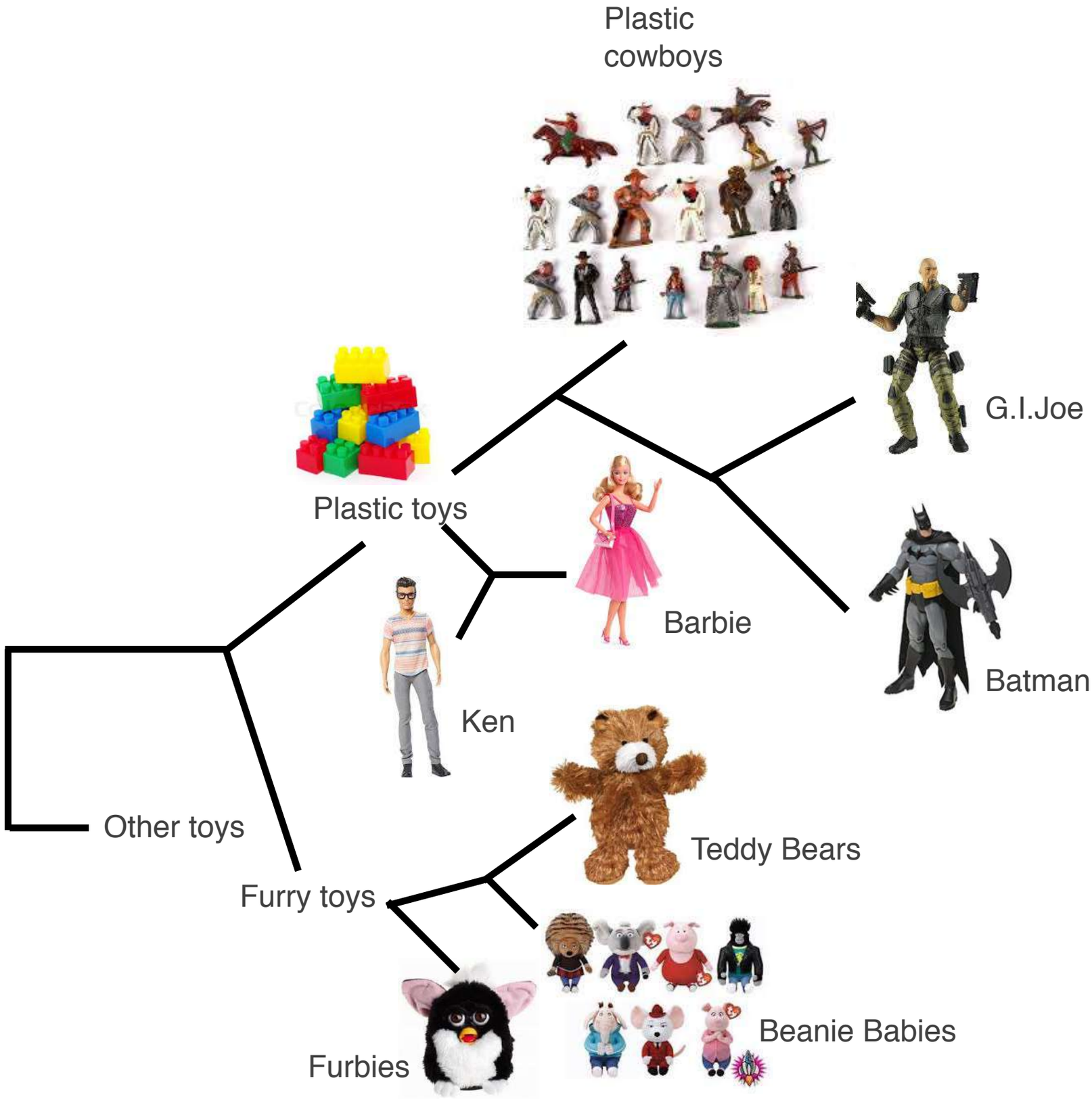



Stein et al., 2018 Nature Ecology & Evolution (2):288–298

01




Based on Fig. 3 from Lampert and Mook., 2015 The American Biology Teacher (77) 587-599

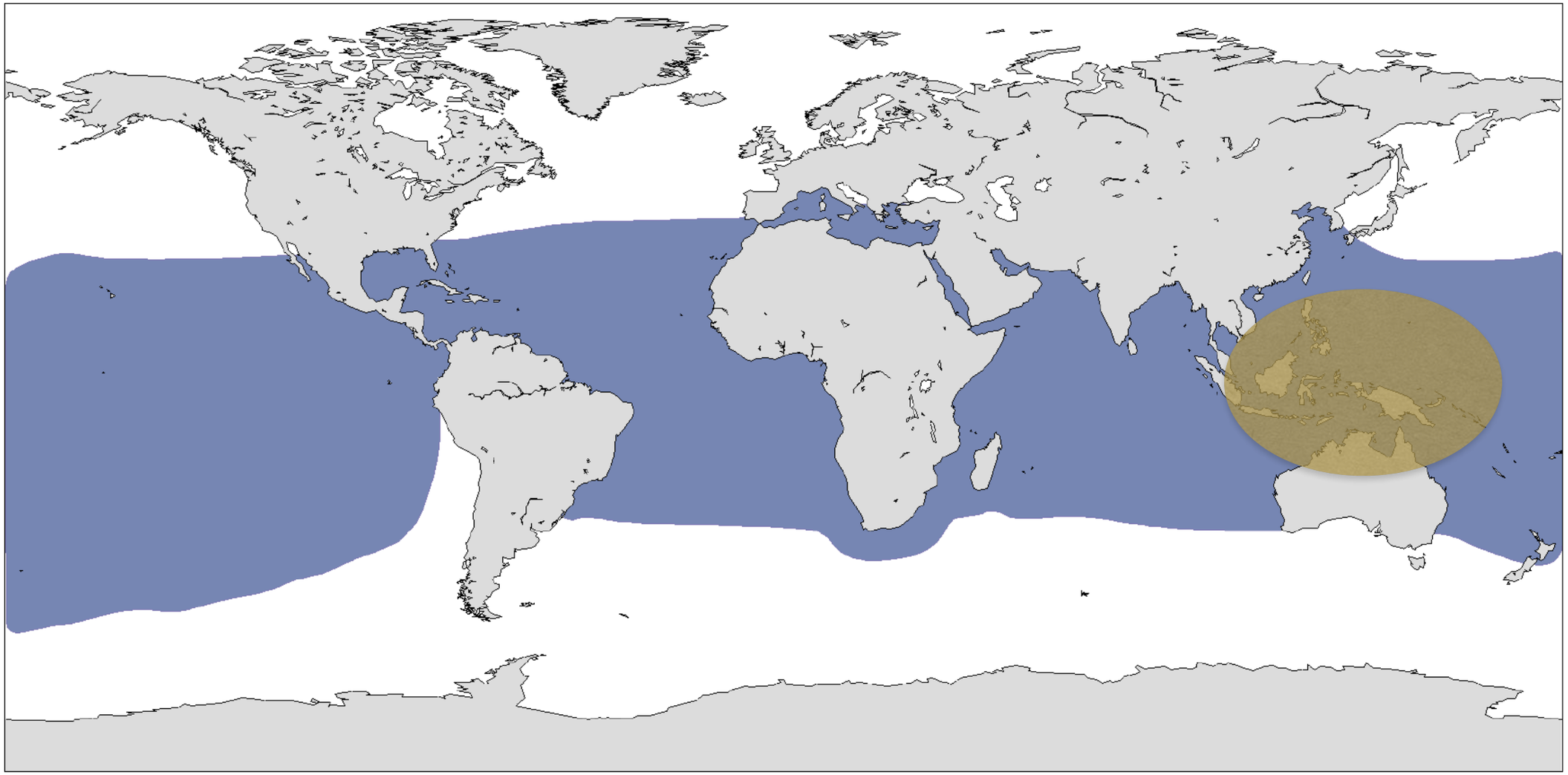
02

# Model system: Cape Verde cone snails

02

02

# Geographic distribution of the genus *Conus*

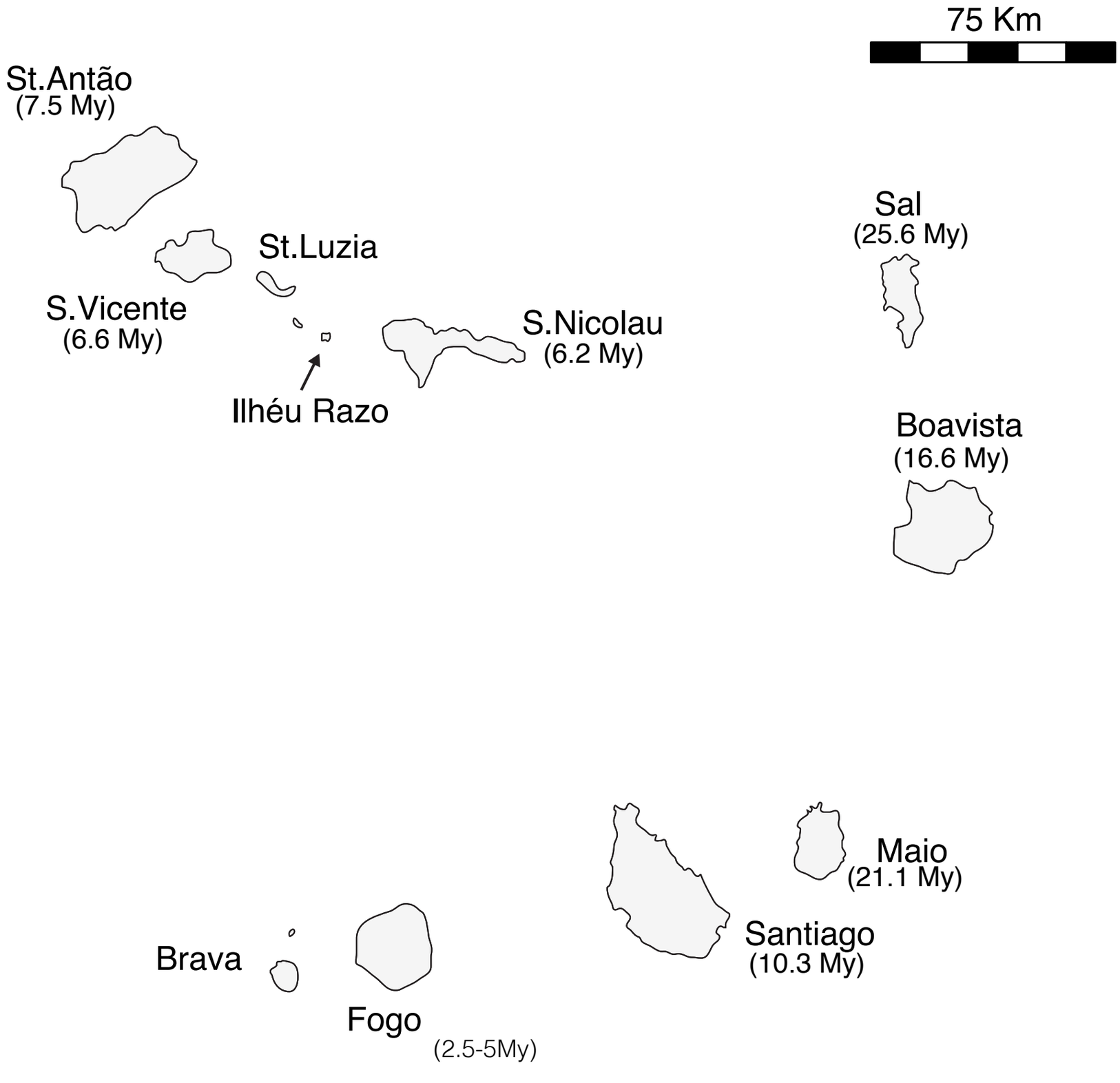


02

# Model system: Cape Verde cone snails

02

# Cape Verde Islands
# Geological ages



02

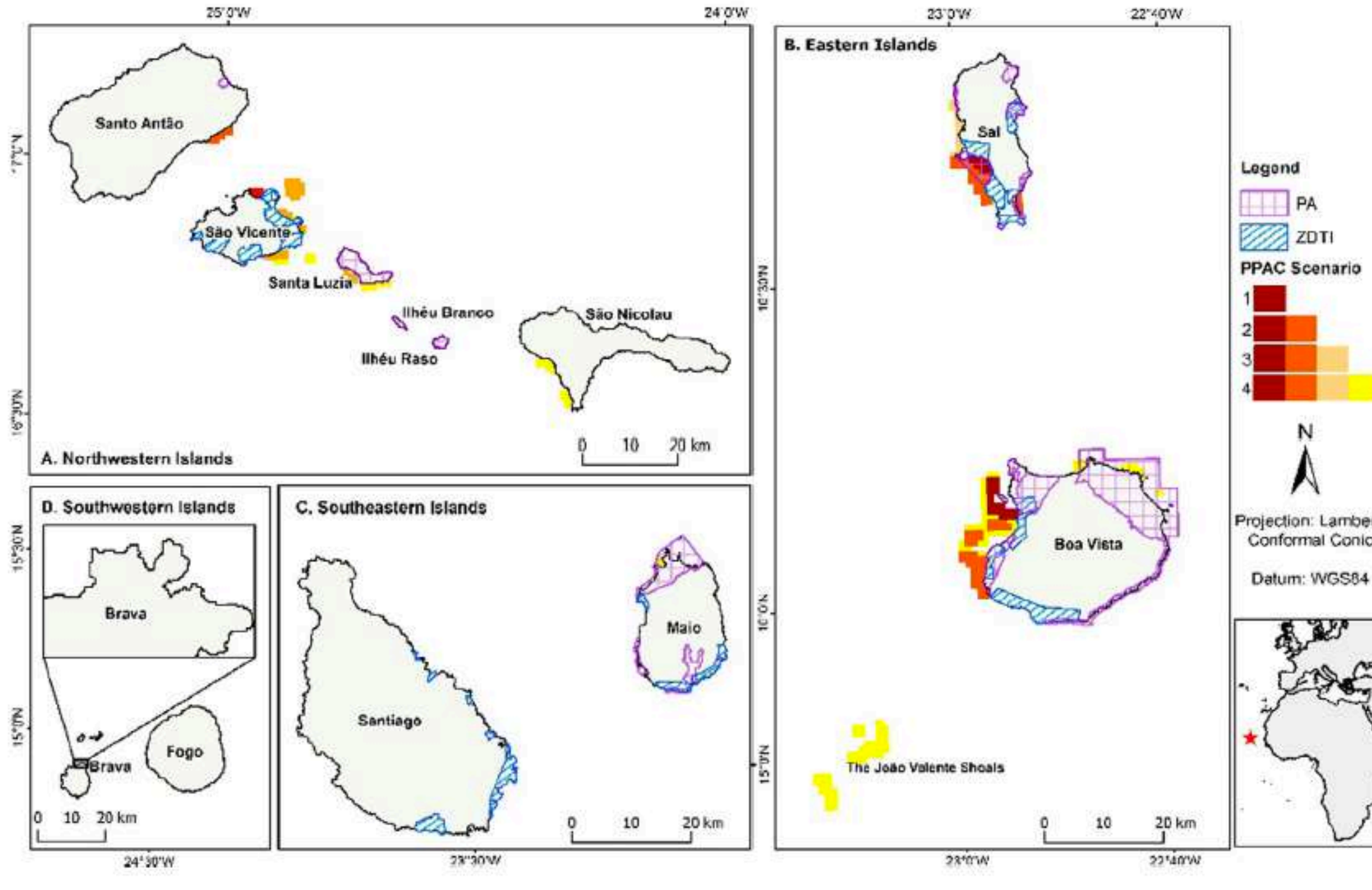
# Fogo Island

02

02

# Cape Verde Islands
# *Conus* PPACs

H. Peters et al. / Global Ecology and Conservation 7 (2016) 201–213



02

# Cape Verde *Conus*

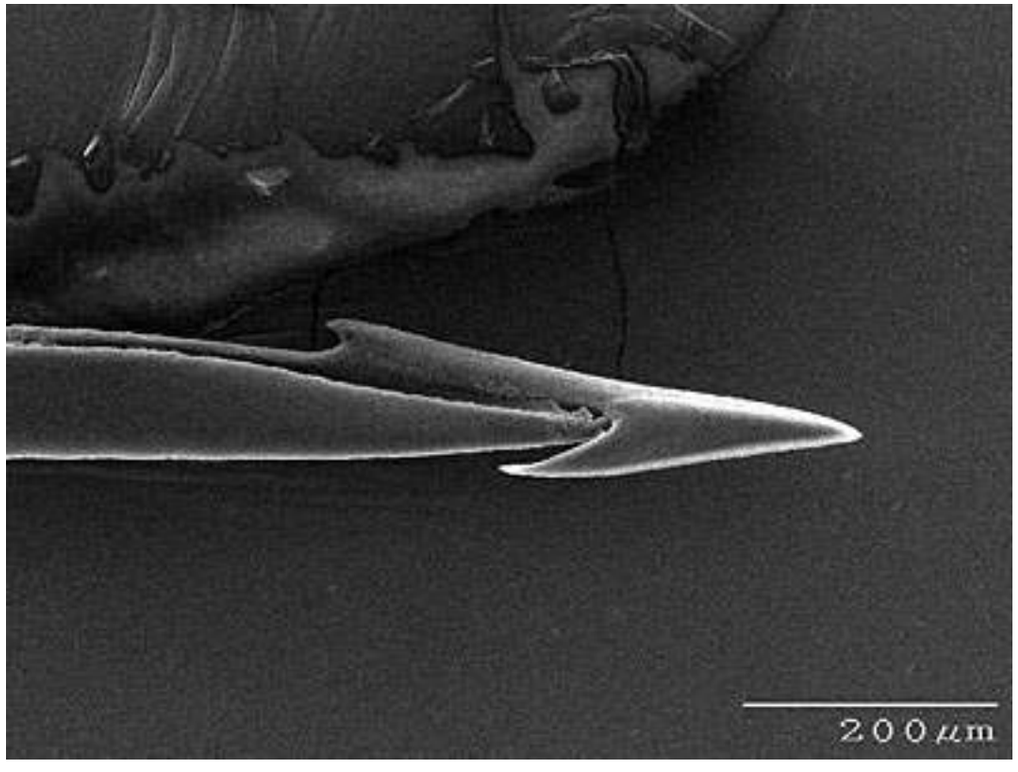
10%

≈ 60 endemics

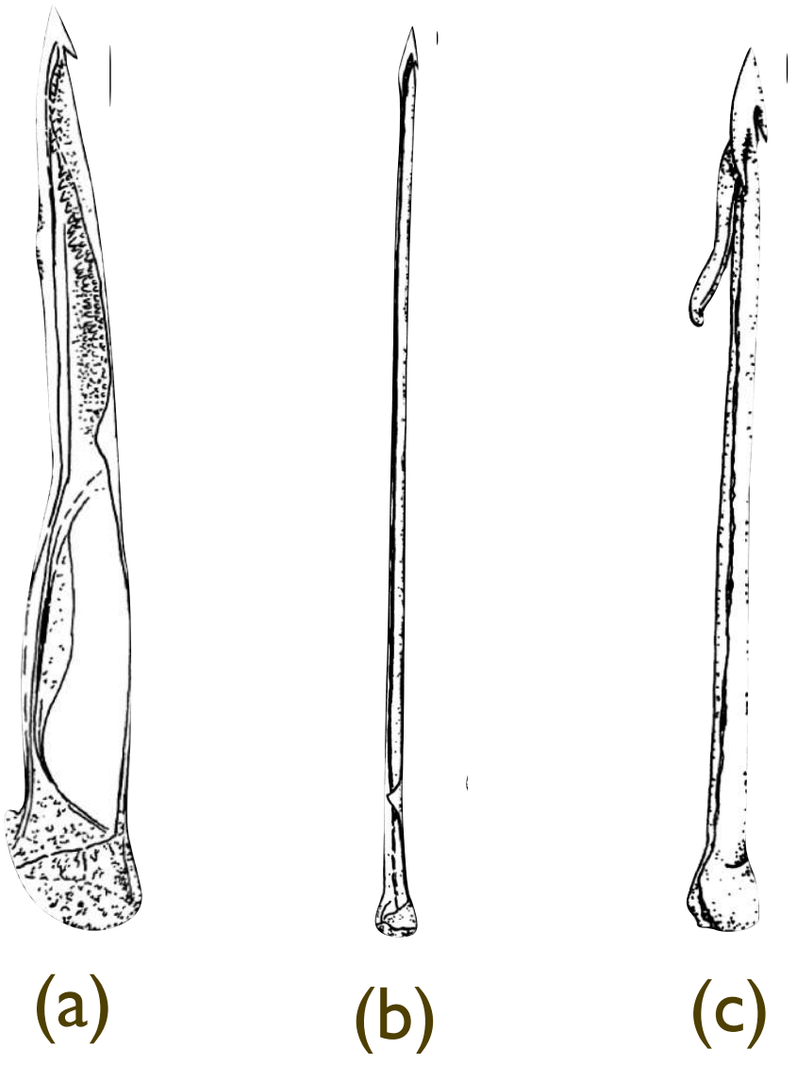
02

# The three main radula types in *Conus*

a) vermivorous
b) molluscivorous
c) piscivorous




https://kristinabarclay.wordpress.com/2016/07/29/fossil-friday-2-cone-snails/



02

02

# Larval development

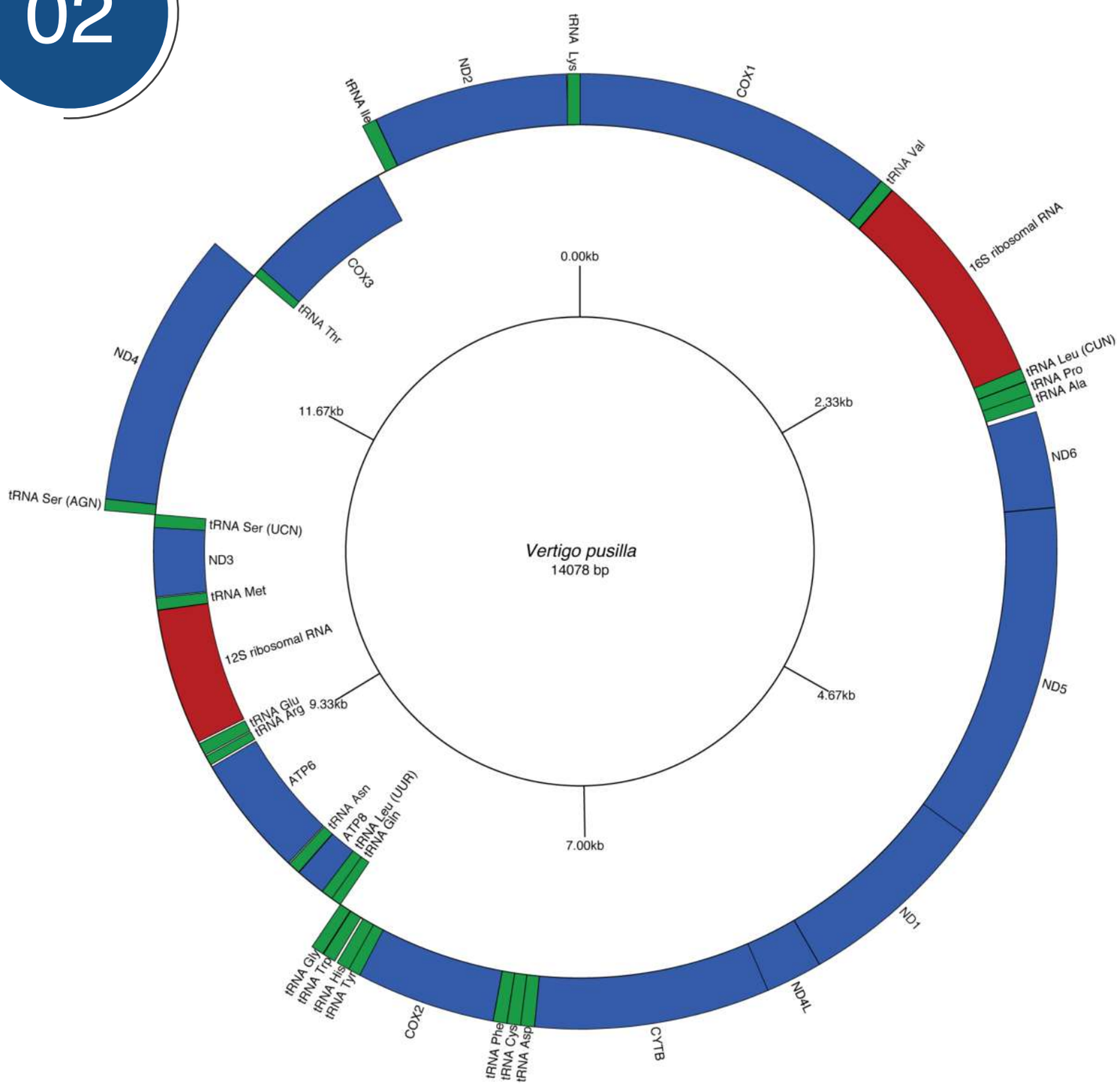

https://s-media-cache-ak0.pinimg.com/736x/34/78/89/347889b21701c671820976334929b22b.jpg

02

# Habitat

02

## mtDNA circular molecule

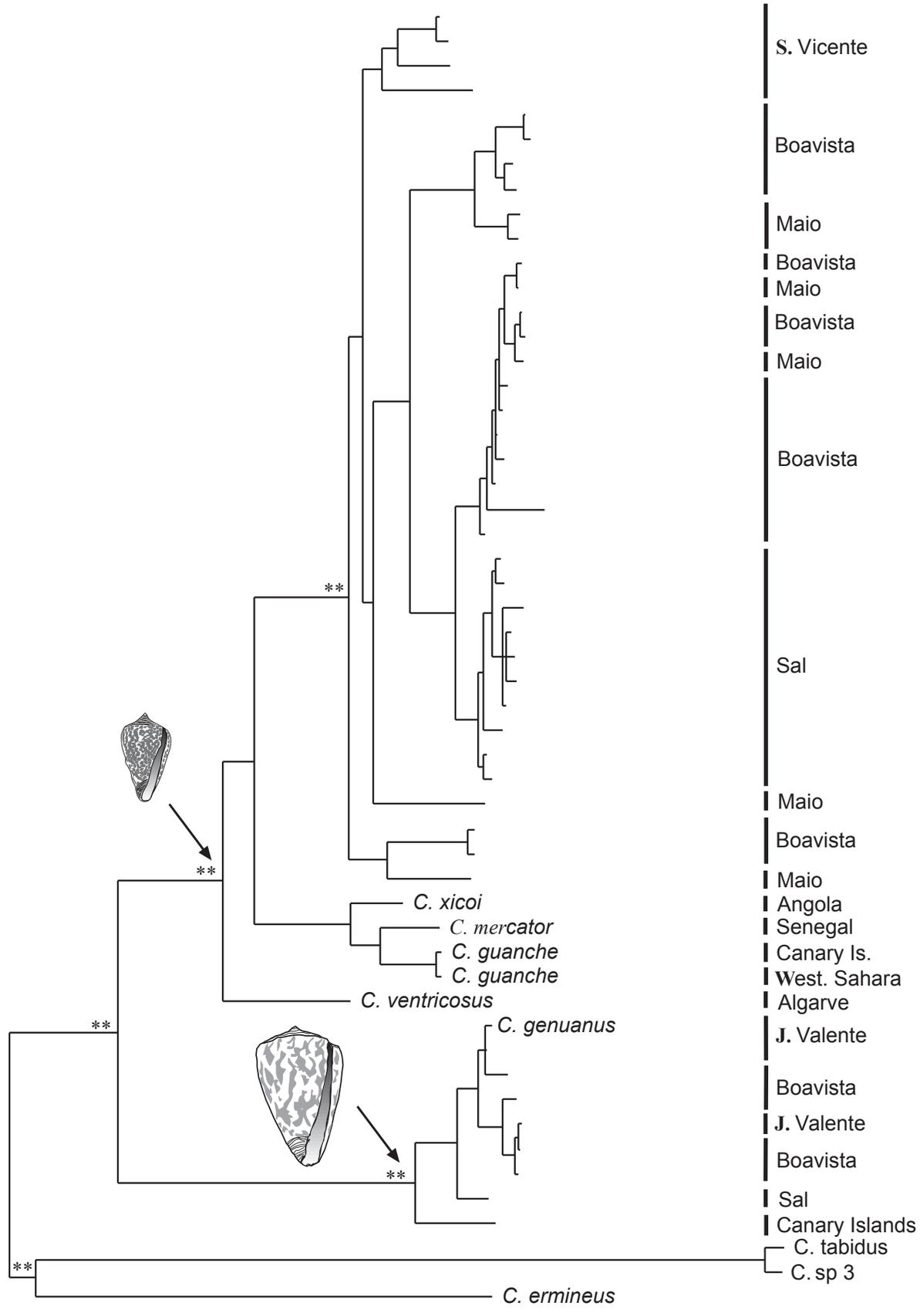



- 22 tRNAs
- 13 protein-coding genes
- 2 ribosomal RNAs

Marquardt, 2013 https://digitalrepository.unm.edu/biol_etds/75

02

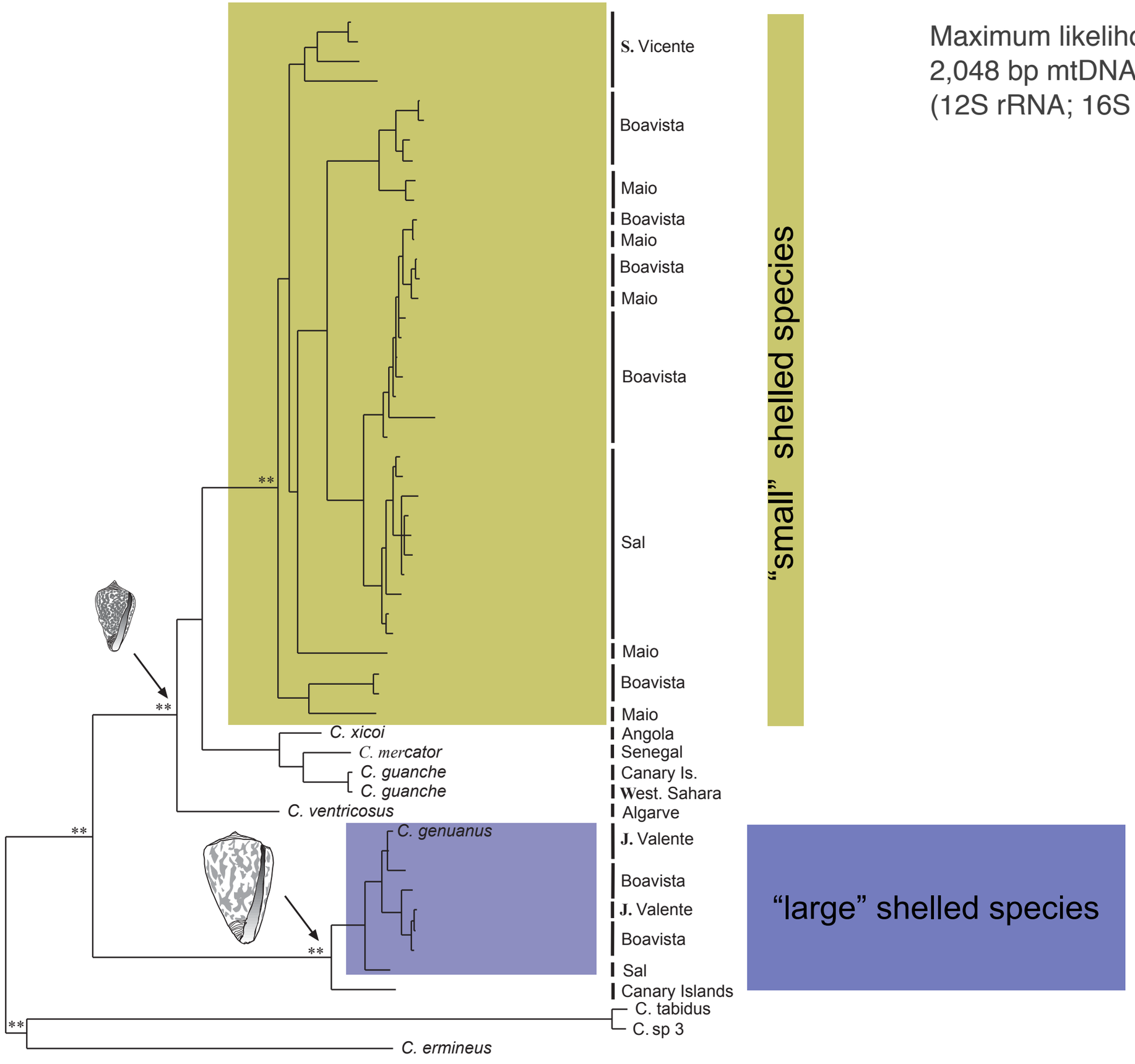
# Molecular analyses




Maximum likelihood tree
2,048 bp mtDNA
(12S rRNA; 16S rRNA, cyt b)

02

# Molecular analyses




Maximum likelihood tree
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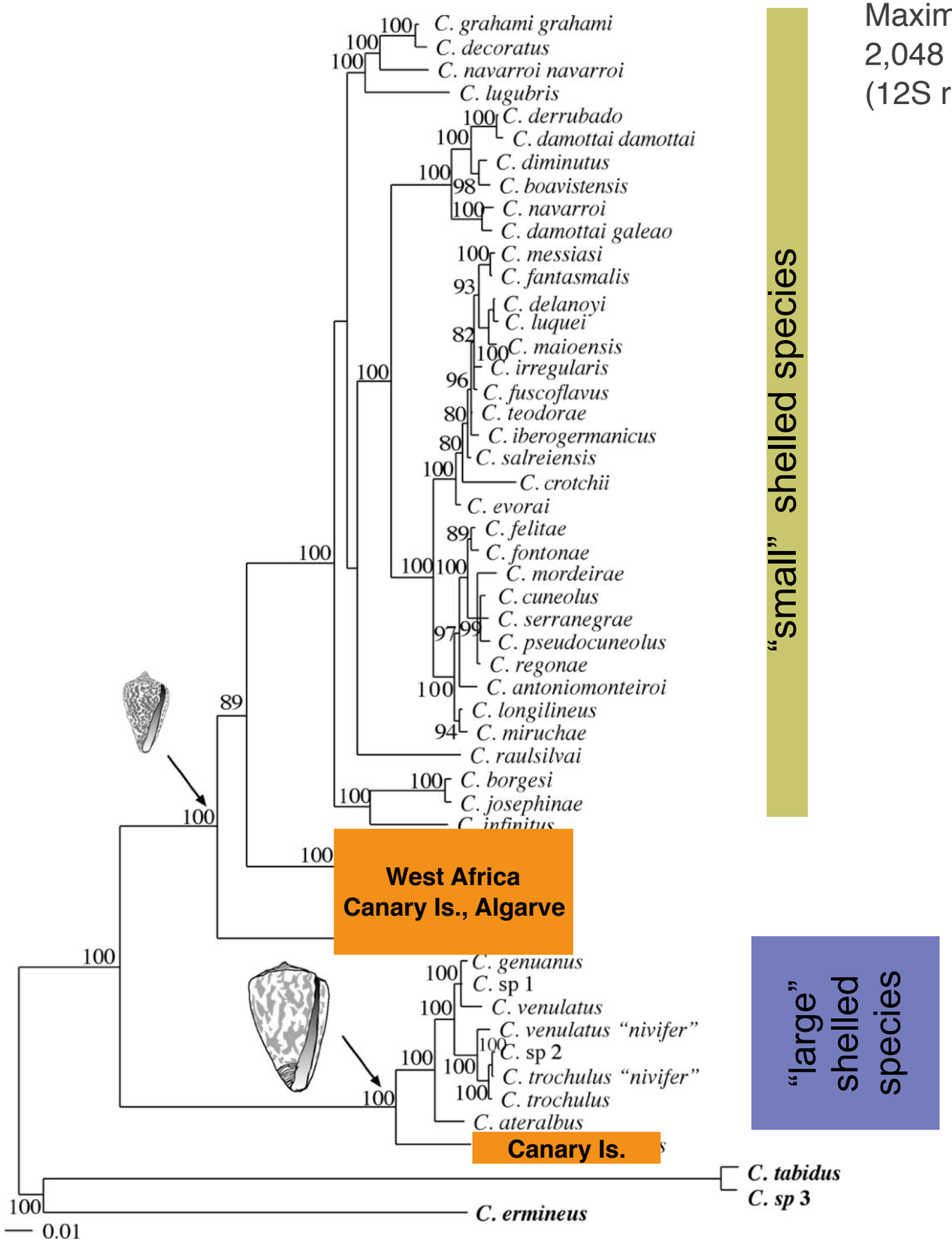
02




Maximum likelihood tree
2,048 bp mtDNA
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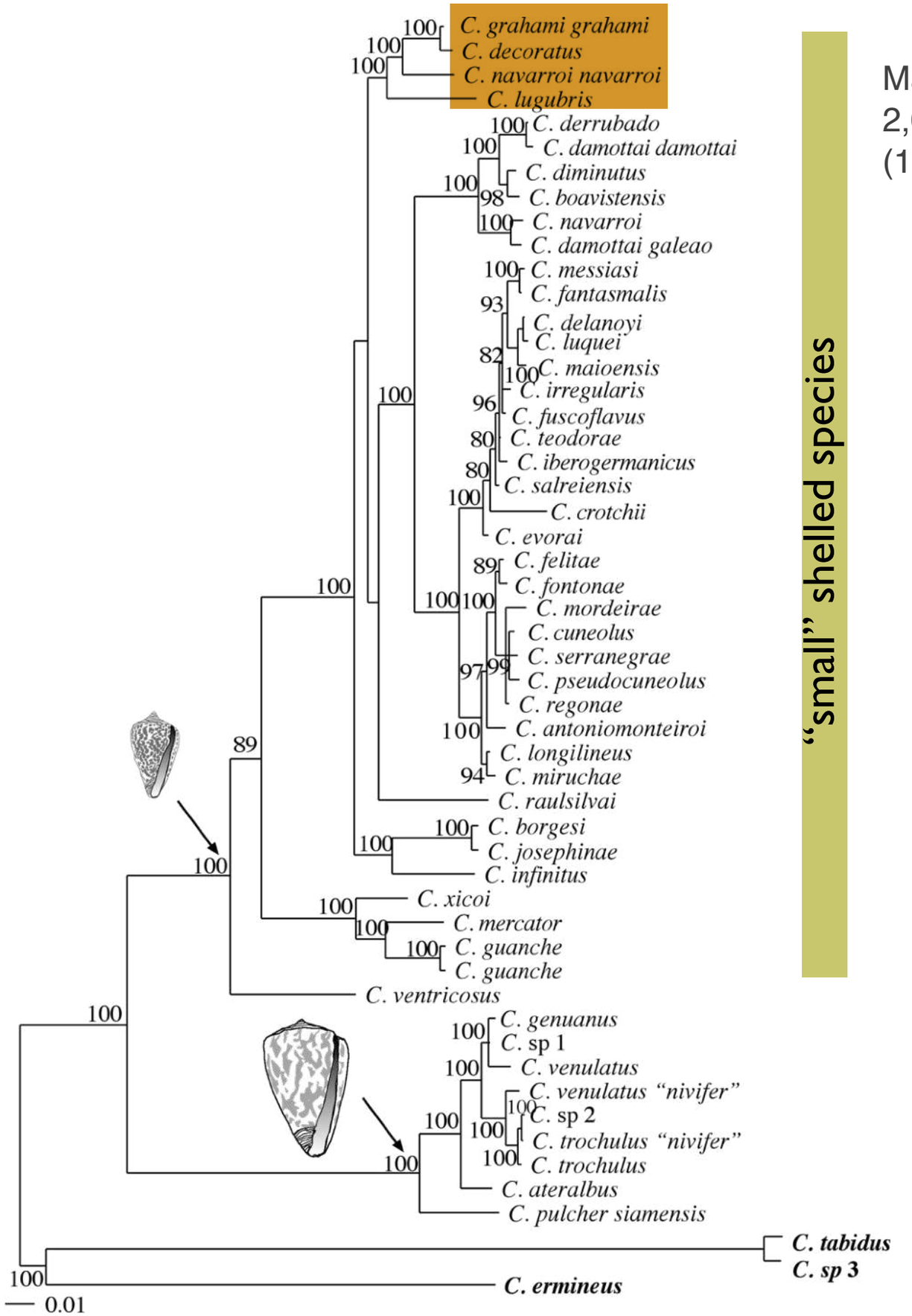
02

S.Vicente

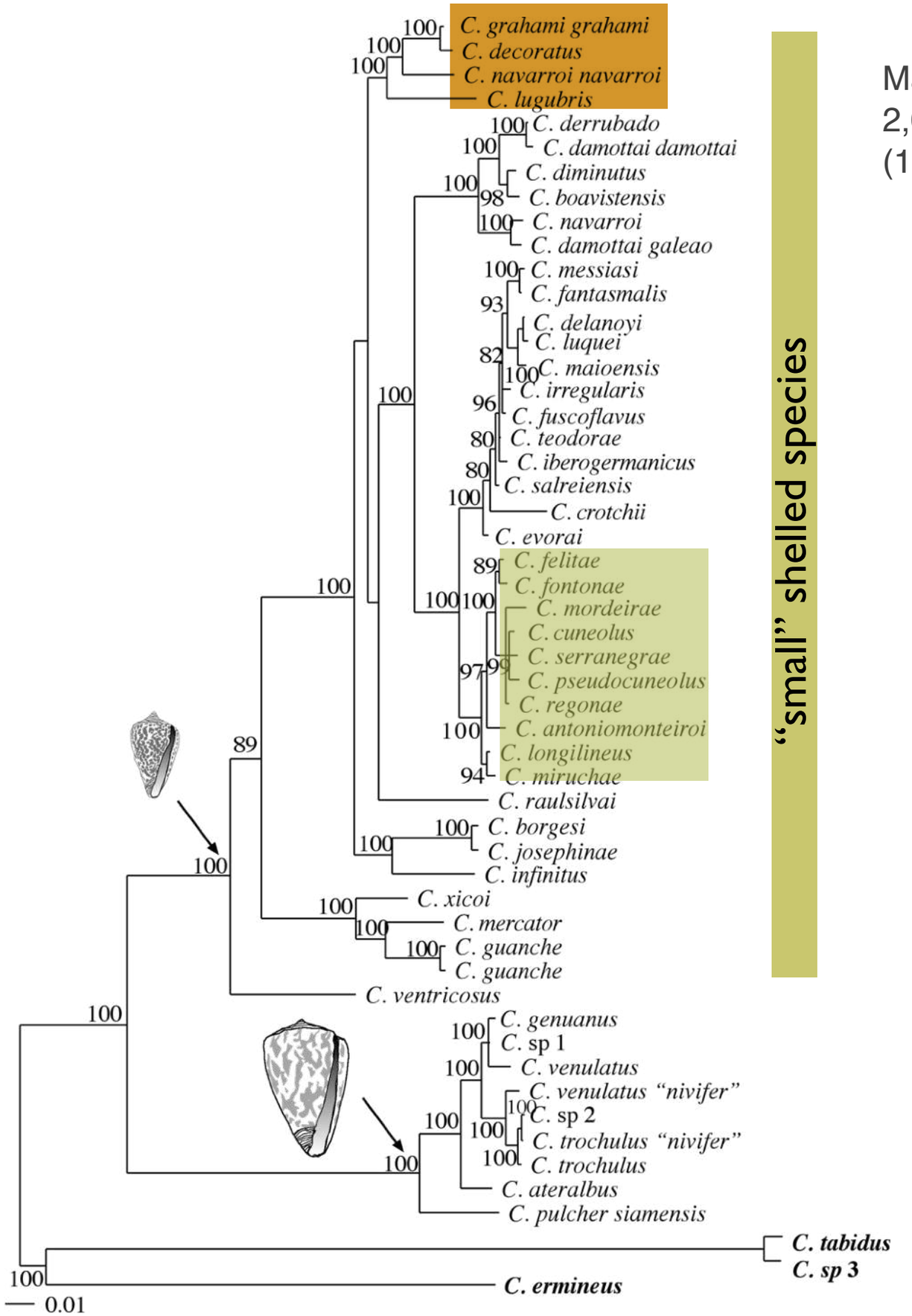



Maximum likelihood tree
2,048 bp mtDNA
(12S rRNA; 16S rRNA, cyt b)

02

S.Vicente

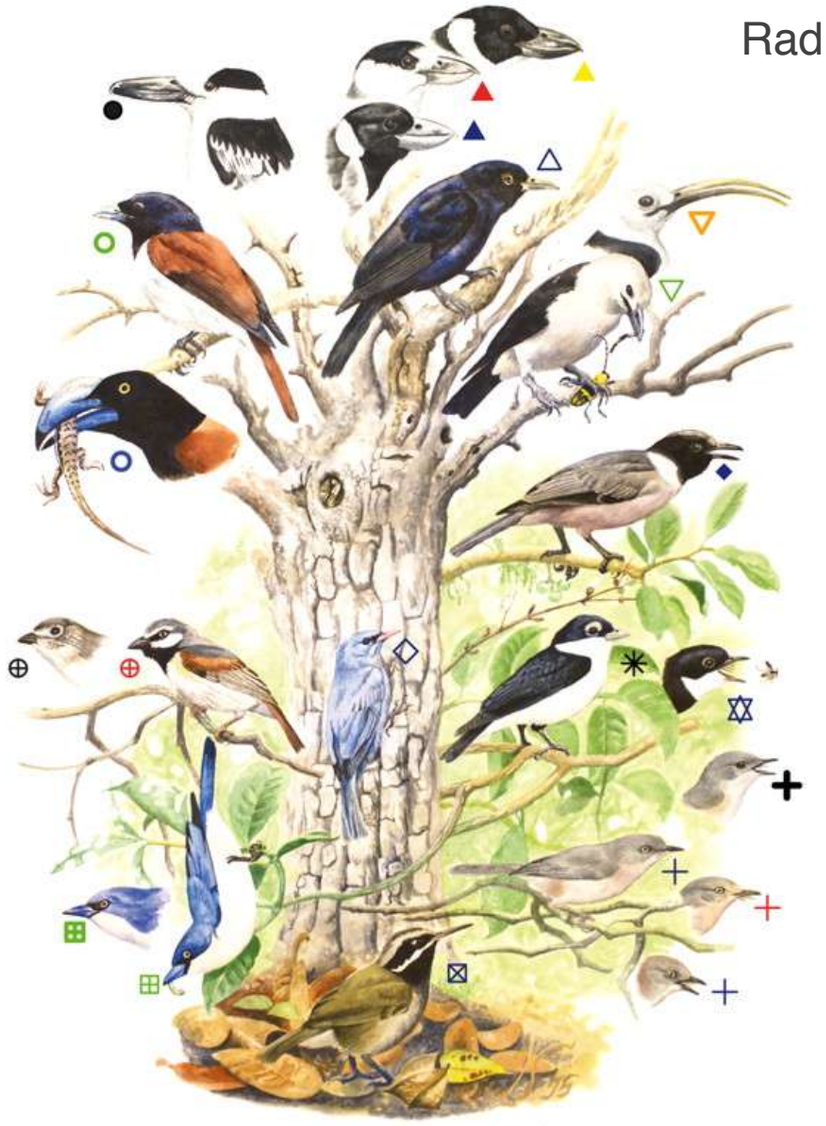
Sal

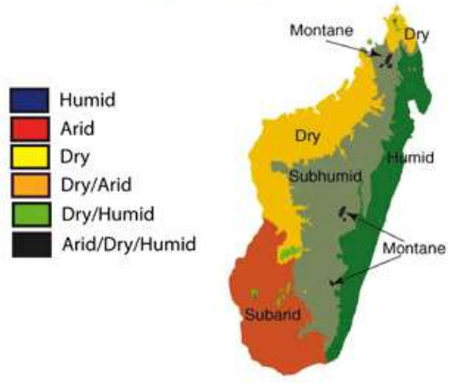


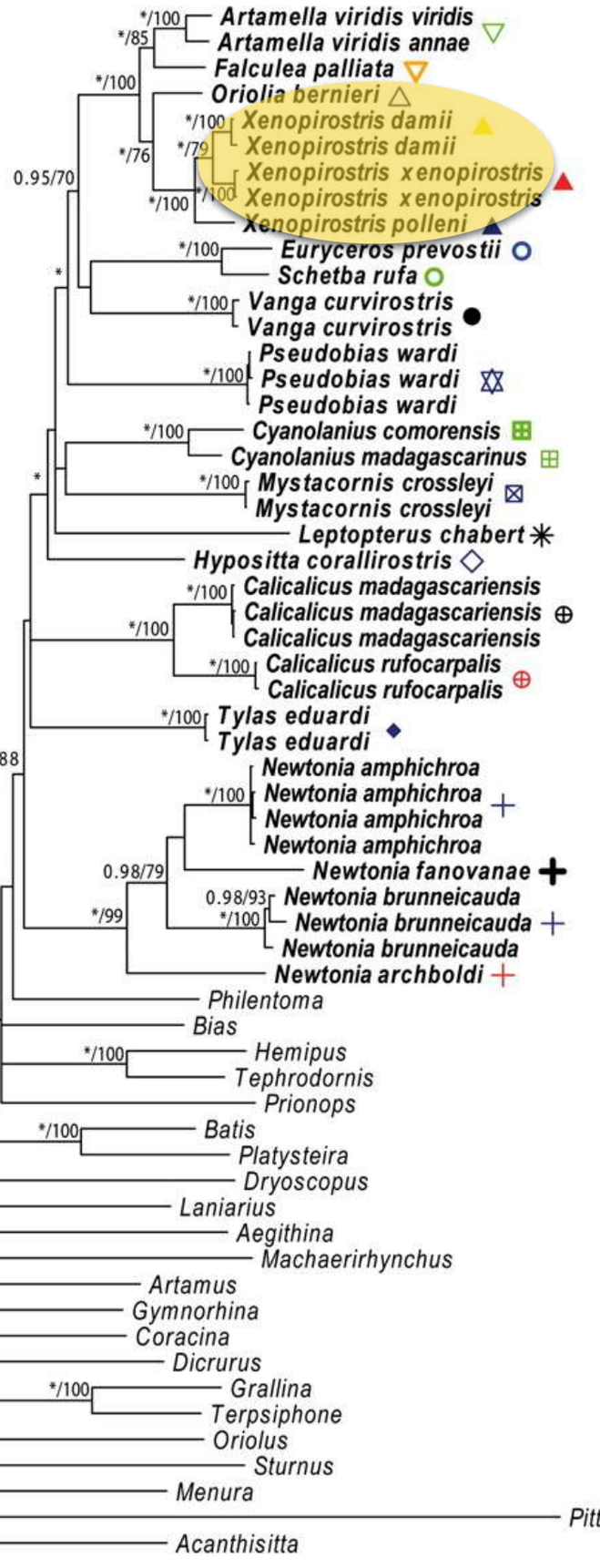

Maximum likelihood tree
2,048 bp mtDNA
(12S rRNA; 16S rRNA, cyt b)

02

# Radiation of Madagascar birds of the family Vangidae

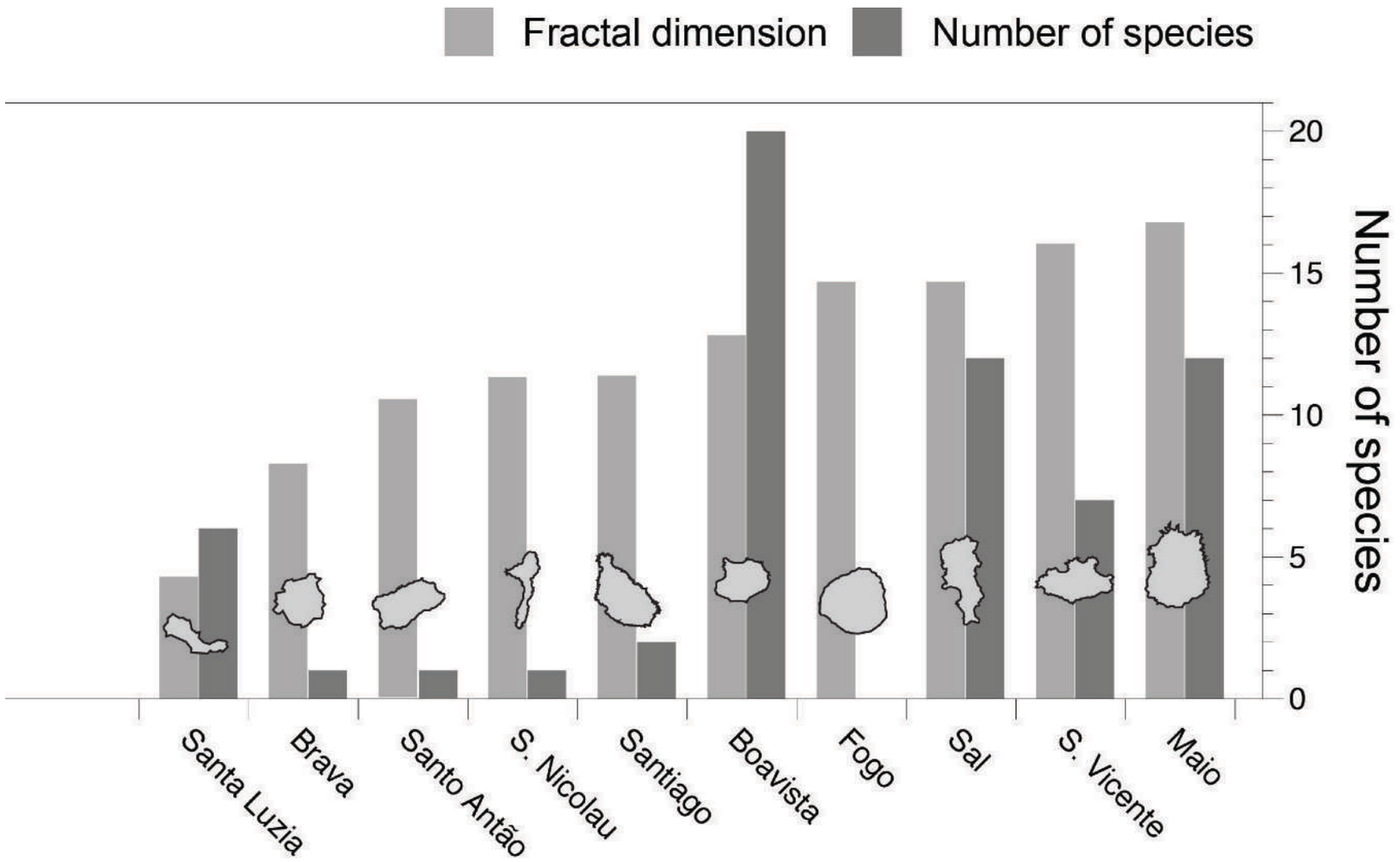





Jønsson et al., PNAS 2012 109 (17) 6620-6625

02




Cape Verde

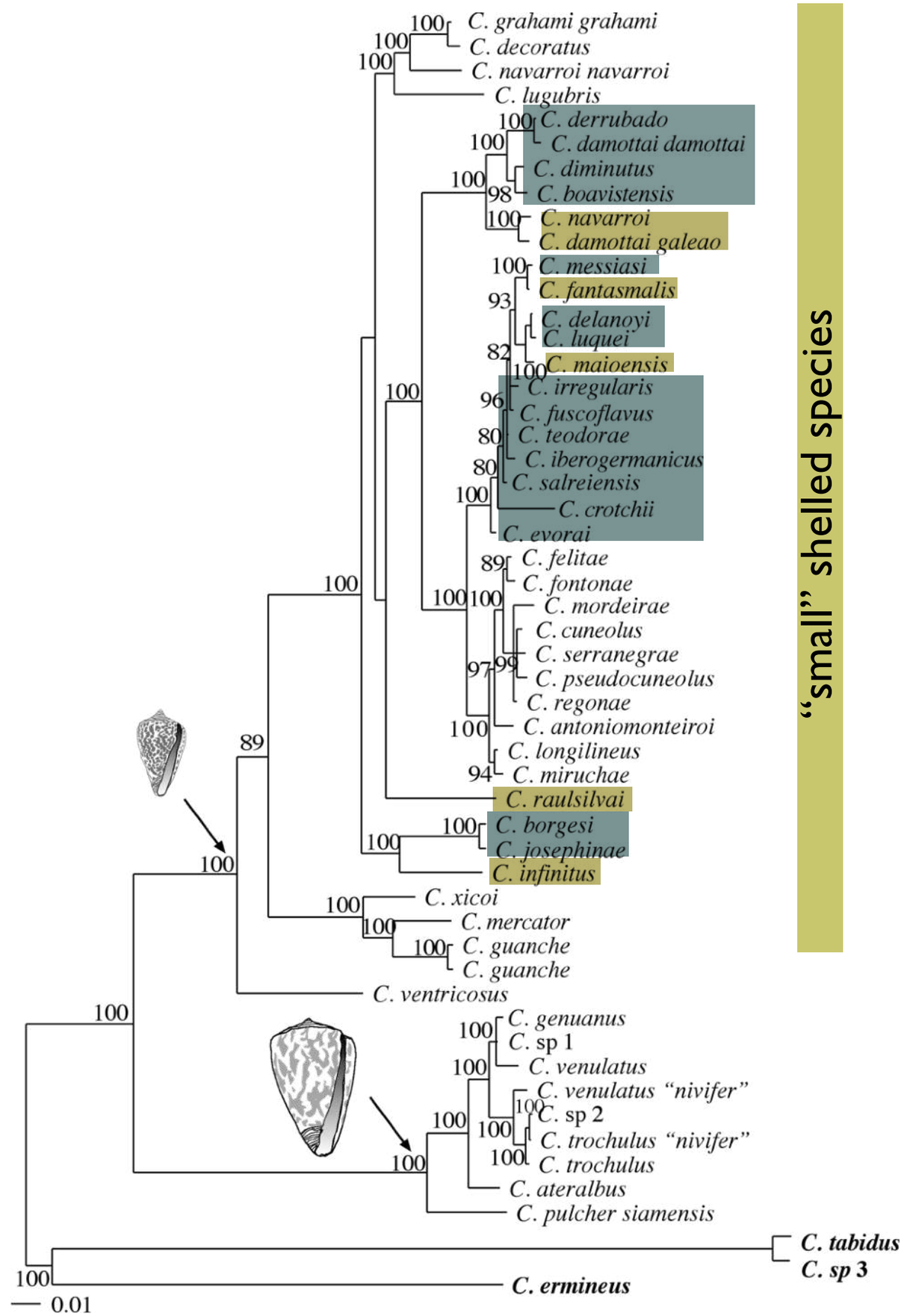
Average fractal dimension = 1.432 ± 0.075

02

Boavista

Maio

Maximum likelihood tree
2,048 bp mtDNA
(12S rRNA; 16S rRNA, cyt b



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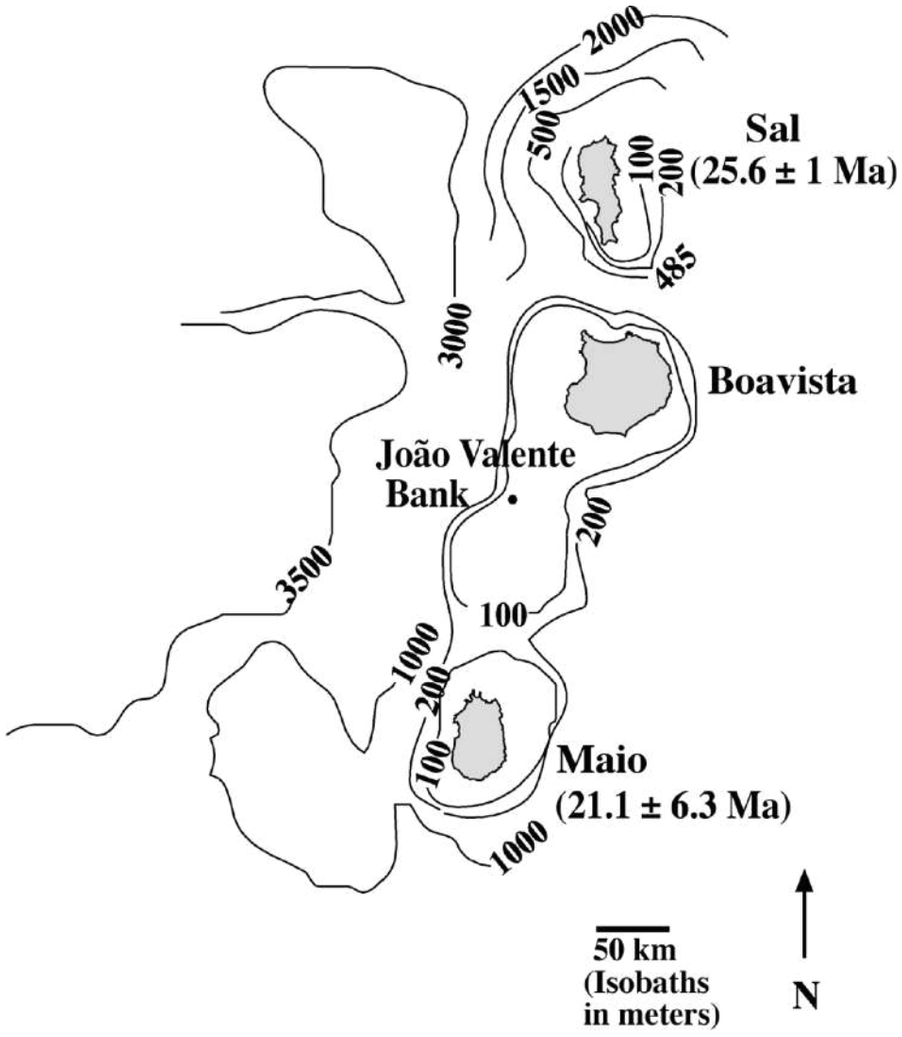
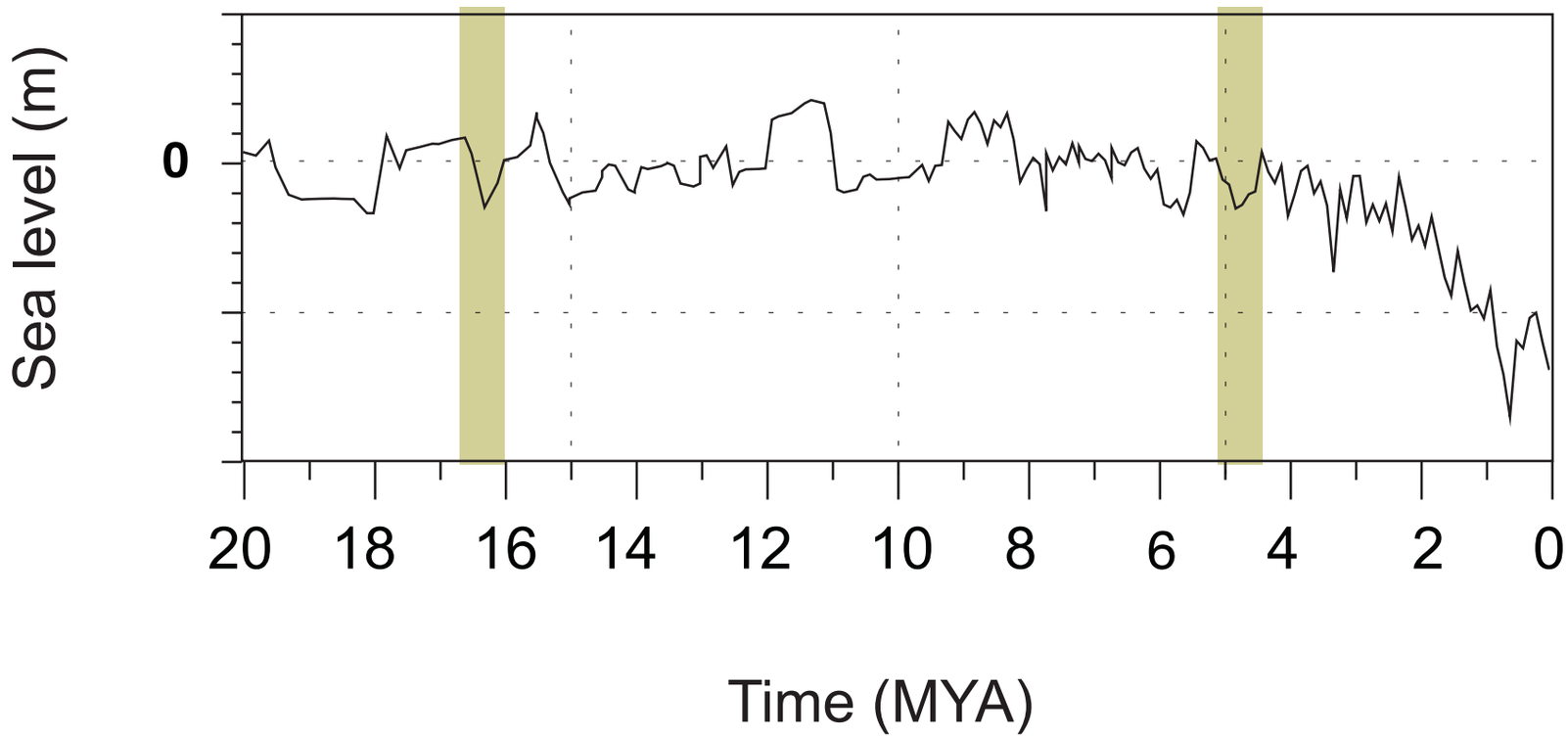

2000
1500
500
100
200
485
Sal
(25.6 ± 1 Ma)
3000
Boavista
João Valente
Bank
200
3500
100
1000
200
100
Maio
(21.1 ± 6.3 Ma)
1000
50 km
(Isobaths
in meters)
N

02

## Eustatic sea level variations




Miller et al., 2005

02

**Dating analysis**
**2,048 bp mtDNA**
**(12S; 16S; cytB)**

Maio

Boavista

16.5 MYA

8.4 MYA

3.8 MYA

3.8 MYA

21.5 MYA

4.6 MYA

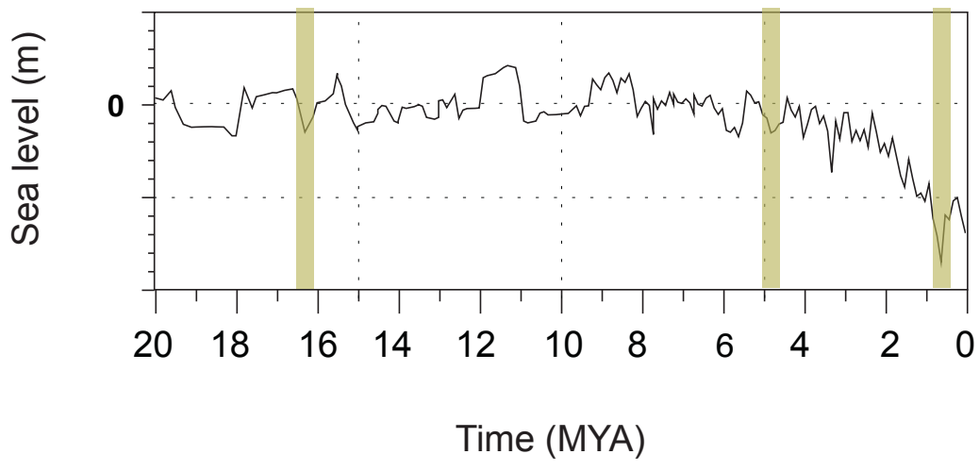
30 25 20 15 10 5 0 Million Years

Miocene

Pliocene

Pleistocene

## Eustatic sea level variations



# Why is Cape Verde so diverse?

## - Isolation

- Allopatric speciation promoted by the reduced dispersal ability of the larvae

*Syst. Biol.* 54(4):634–650, 2005

ISSN: 1063-5157 print / 1076-836X online
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# Patterns of Cladogenesis in the Venomous Marine Gastropod Genus *Conus* from the Cape Verde Islands

REGINA L. CUNHA,[1,2] RITA CASTILHO,[2] LUKAS RÜBER,[1] AND RAFAEL ZARDOYA[1]