Uncertain Lines: Explaining phenotype of *Apistogramma species*

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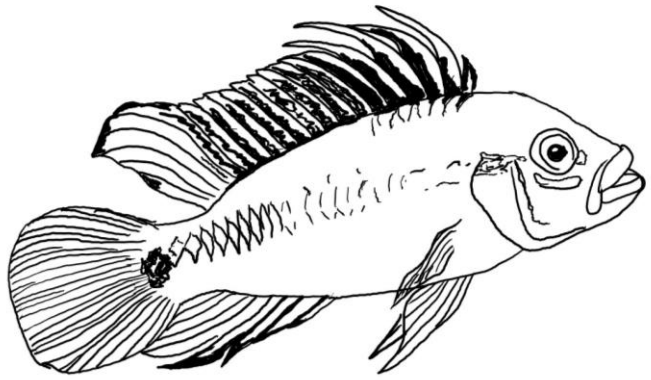
EEB313

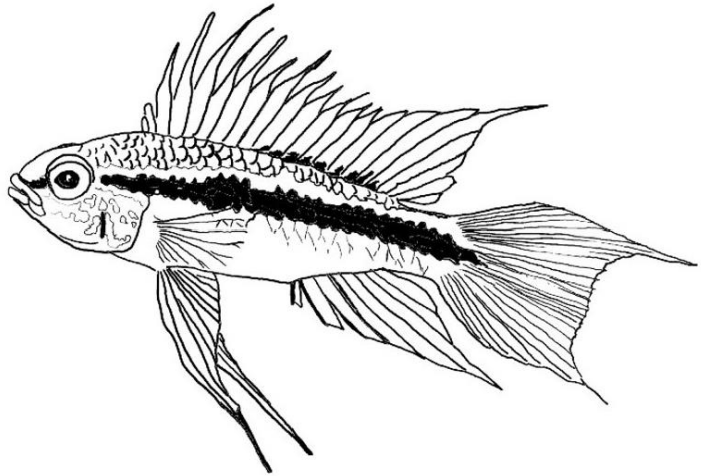
Apistogramma:

‘uncertain line’

Wide geographic range
Morphology varies
Degree of dimorphism varies
Complexity of pattern varies



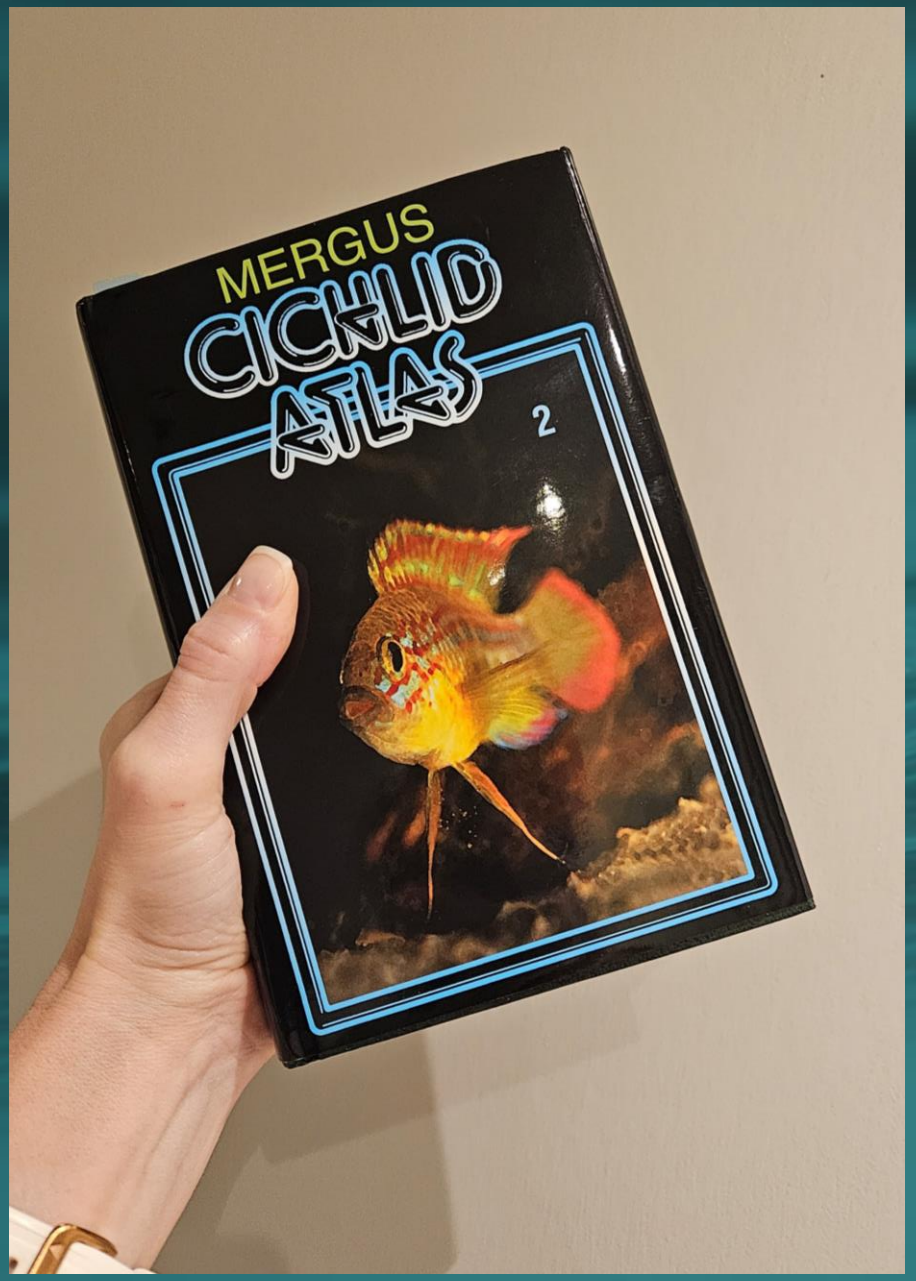
A. atahualpa



A. bitaeniata

My hypothesis is that the visual conditions where the fish live are responsible for the phenotype of the species that evolve.

I predict that analysis will cluster species best by water type rather than evolutionary history.



PLOS ONE

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Tempo and rates of diversification in the South American cichlid genus *Apistogramma* (Teleostei: Perciformes: Cichlidae)

Christelle Tougard, Carmen R. García Dávila, Uwe Römer, Fabrice Duponchelle, Frédérique Cerqueira, Emmanuel Paradis, Bruno Guinand, Carlos Angulo Chávez, Vanessa Salas, Sophie Quérouil, Susana Sirvas, Jean-François Renno

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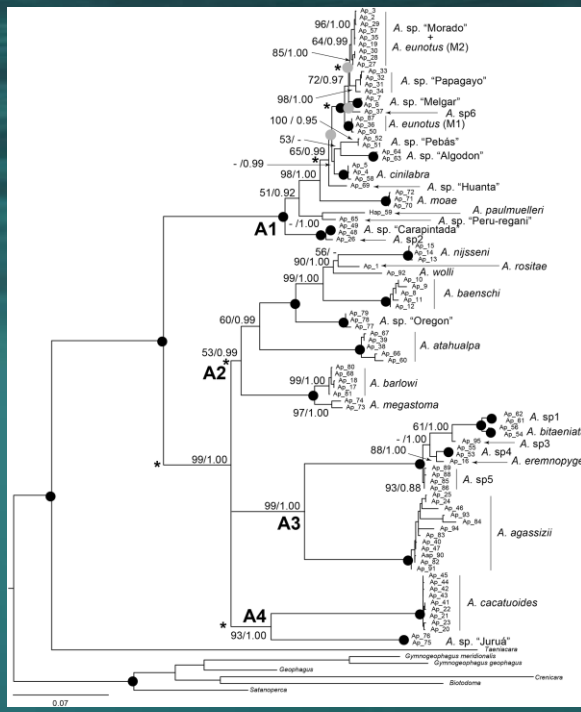
The Sources



The Data

Eco data - (Römer 2006) categorical ecological data, including water body type, water type, habitat type, and river system, for 102 species of *Apistogramma*

Character data - (Römer 2006) 51 phenotype traits including colour pattern, body shape, and dentition for 102 species of *Apistogramma*

Lineage data - (Tougard *et al*) – lineage 1-4 as a categorical trait for 31 species of *Apistogramma*

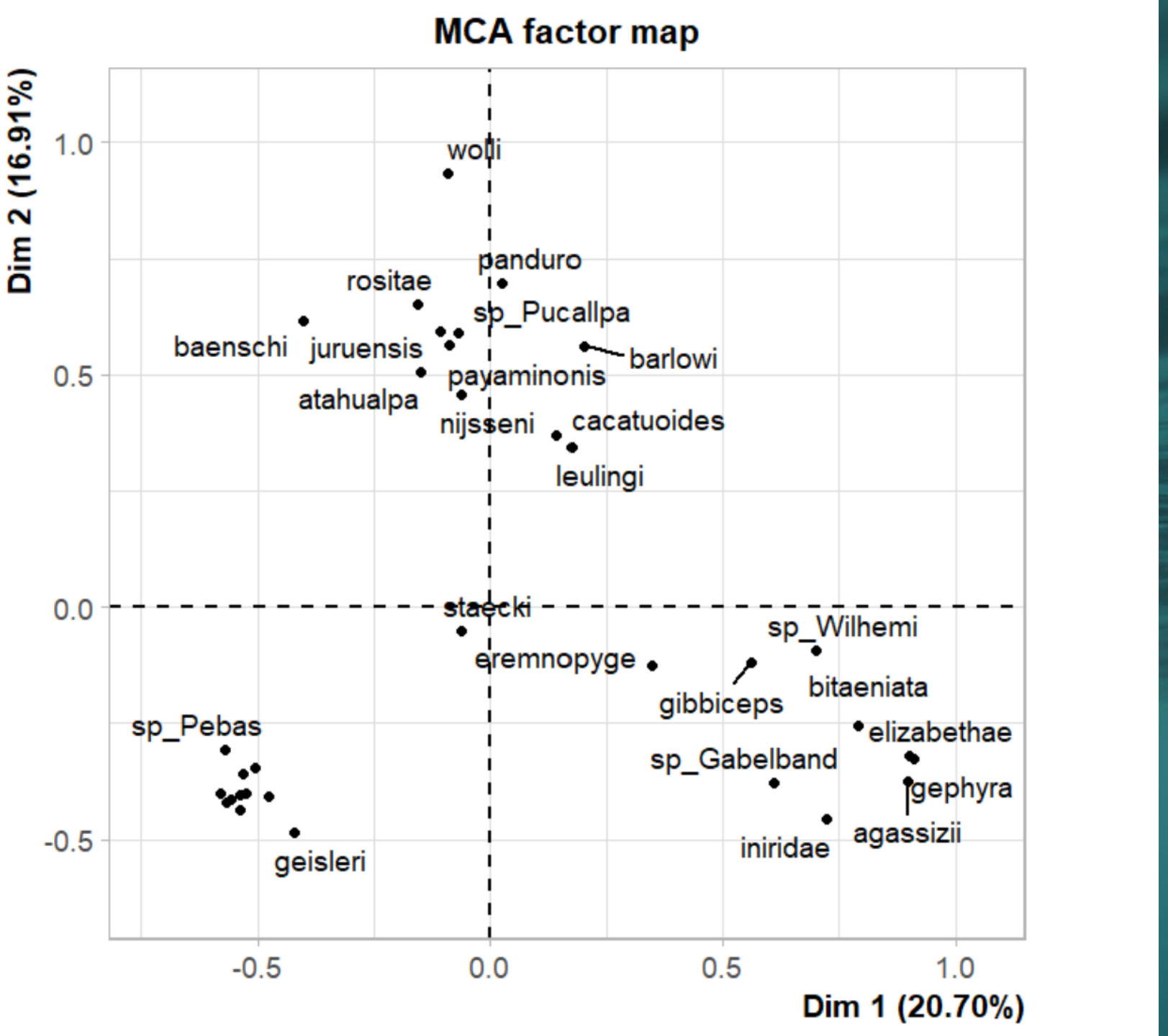
Data preparation

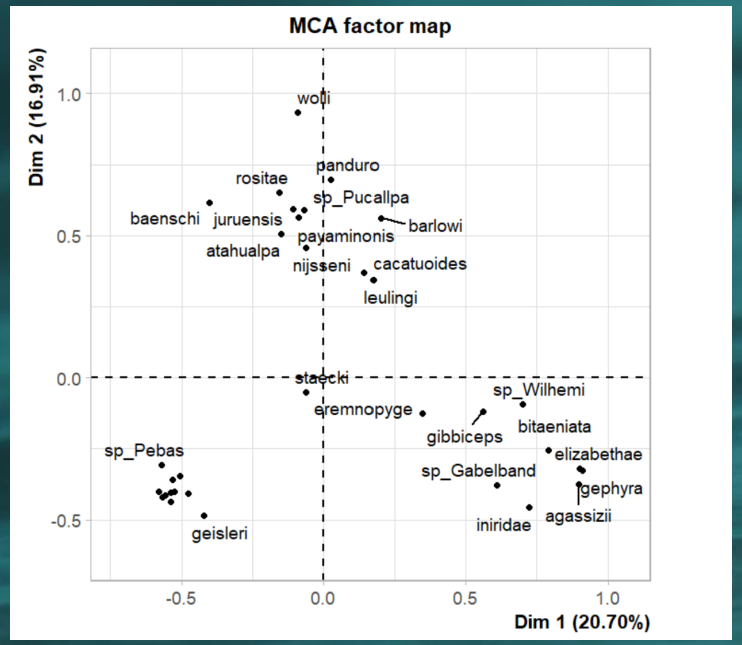
Species names – updated taxonomic changes since 2006 (many)
Character data – omitted context-dependent behavioural traits

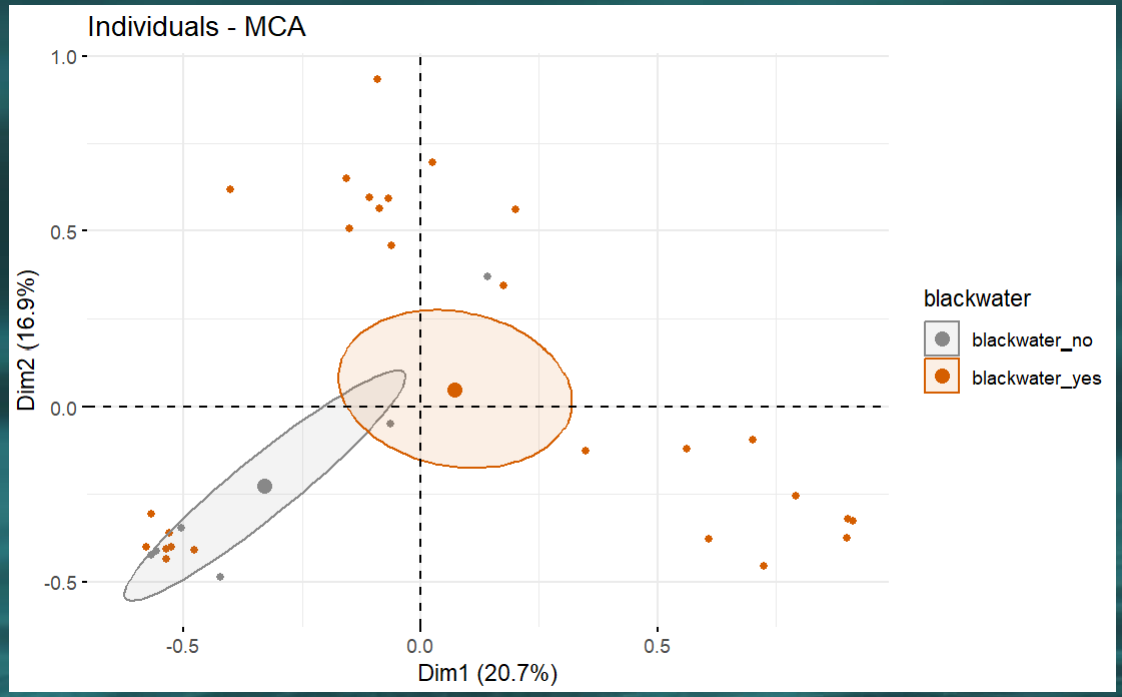
Joined datasets by species

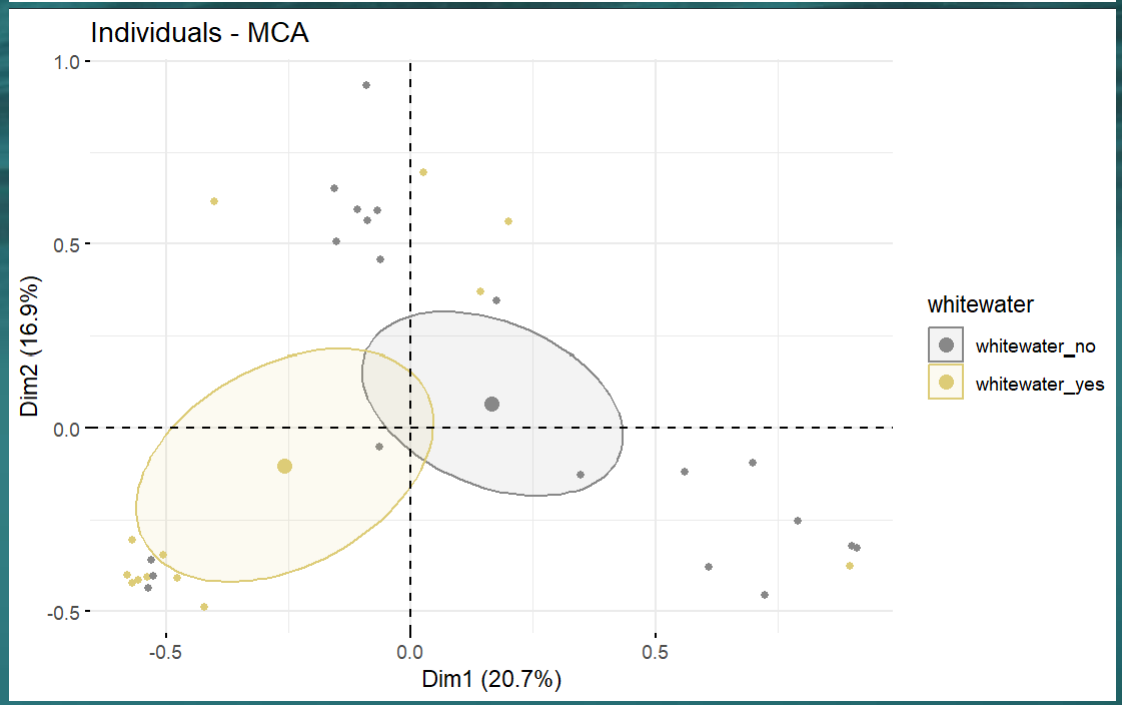
“?” -> NA
“occasionally” -> yes

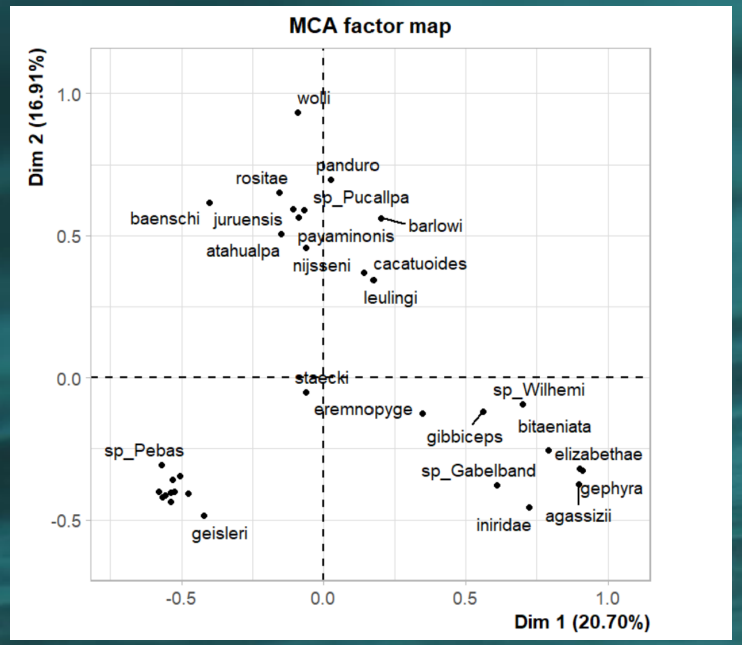
Filtered out rows with missing data
Filtered out columns with only one level

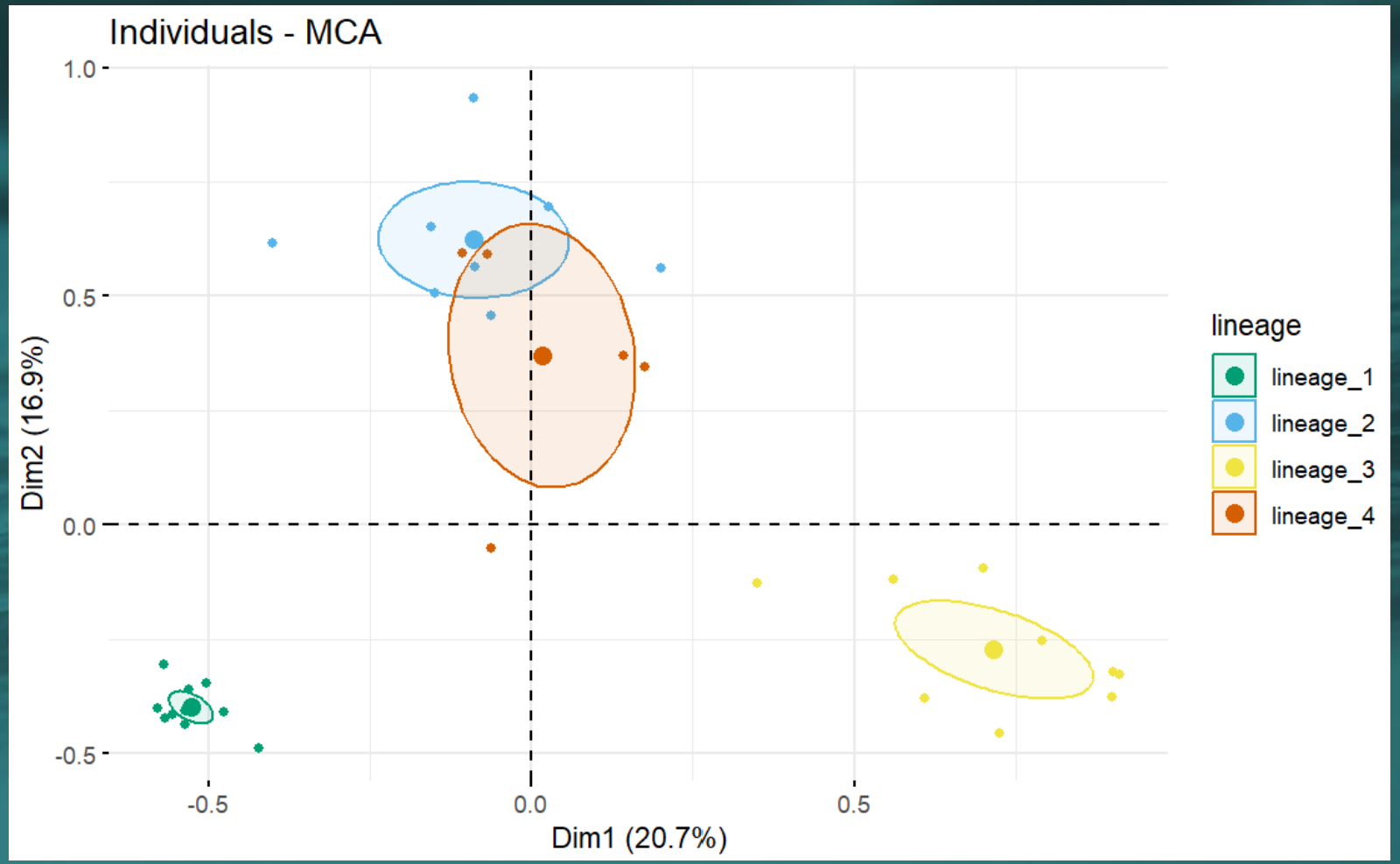

MCA factor map
Dim 2 (16.91%)
Dim 1 (20.70%)
1.0
0.5
0.0
-0.5
-0.5
0.0
0.5
1.0
woodi
panduro
rositae
sp_Pucallpa
baenschi
juruensis
barlowi
payaminonis
atahualpa
nijsseni
cacatuoides
leulingi
staecki
sp_Wilhemi
eremnopyge
gibbiceps
bitaeniata
sp_Pebas
elizabethae
sp_Gabelband
gephyra
agassizii
iniridae
geisleri


MCA factor map
Dim 2 (16.91%)
Dim 1 (20.70%)
1.0
0.5
0.0
-0.5
-0.5
0.0
0.5
1.0
woti
panduro
rositae
sp_Pucallpa
baenschi
juruensis
barlowi
payaminonis
atahualpa
nijsseni
cacatuoides
leulingi
staecki
sp_Wilhemi
eremnopyge
gibbiceps
bitaeniata
sp_Pebas
elizabethae
sp_Gabelband
gephyra
agassizii
iniridae
geisleri

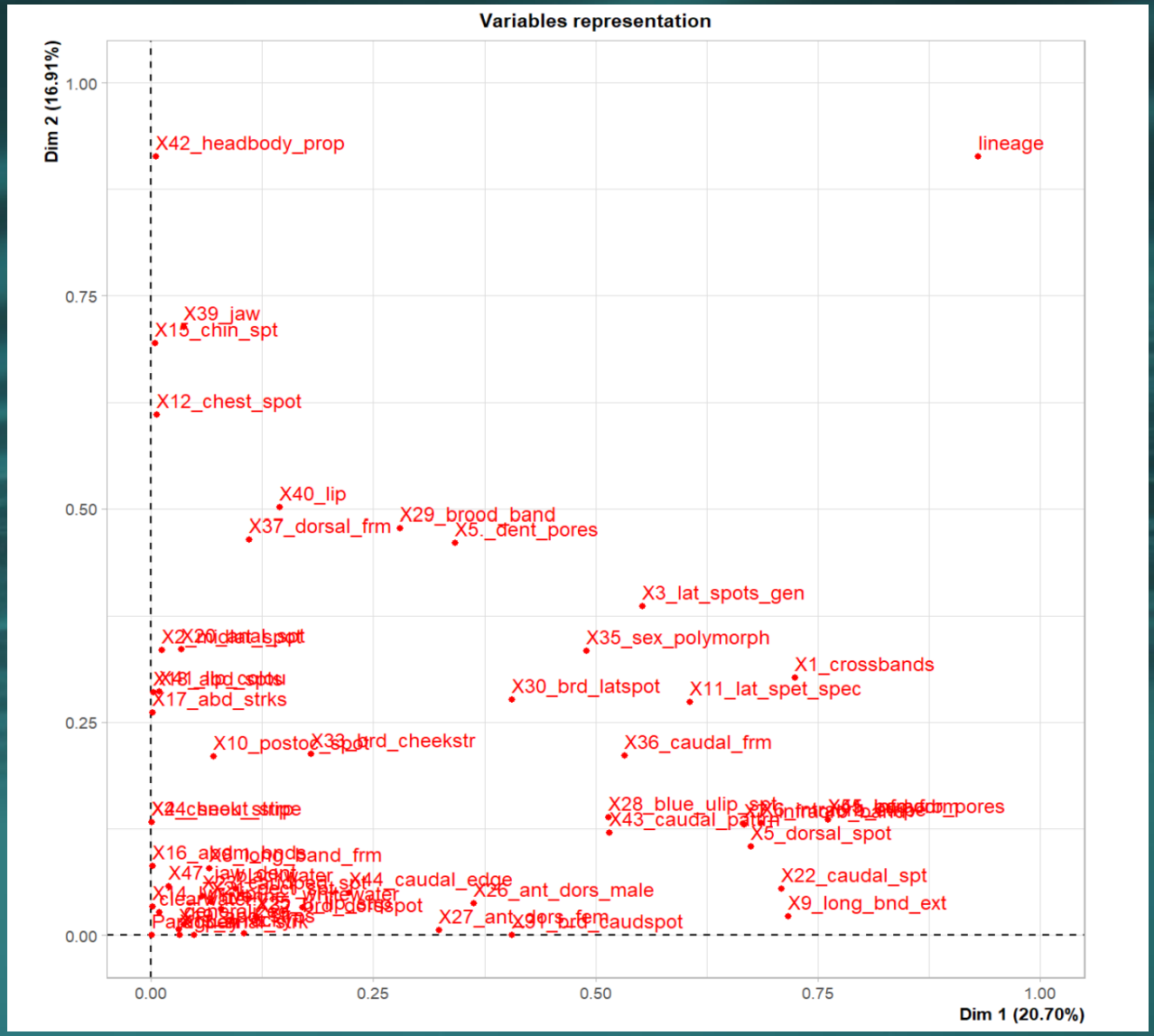

Individuals - MCA
Dim2 (16.9%)
Dim1 (20.7%)
1.0
0.5
0.0
-0.5
-0.5
0.0
0.5
blackwater
blackwater_no
blackwater_yes

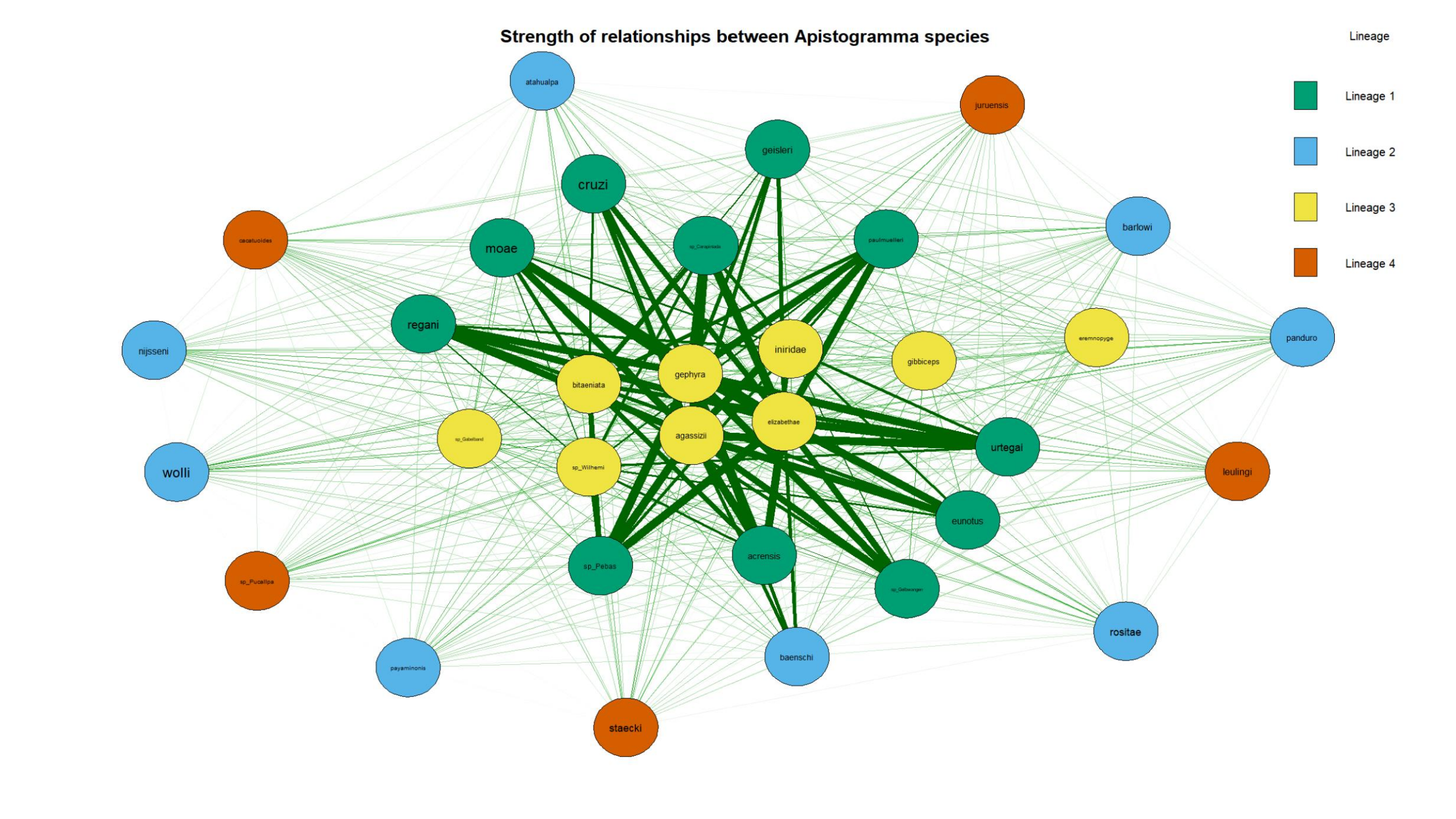

Individuals - MCA
Dim2 (16.9%)
Dim1 (20.7%)
1.0
0.5
0.0
-0.5
-0.5
0.0
0.5
whitewater
whitewater_no
whitewater_yes


MCA factor map
Dim 2 (16.91%)
Dim 1 (20.70%)
1.0
0.5
0.0
-0.5
-0.5
0.0
0.5
1.0
woti
panduro
rositae
sp_Pucallpa
baenschi
juruensis
barlowi
payaminonis
atahualpa
nijsseni
cacatuoides
leulingi
staecki
sp_Wilhemi
eremnopyge
gibbiceps
bitaeniata
sp_Pebas
elizabethae
sp_Gabelband
gephyra
agassizii
iniridae
geisleri

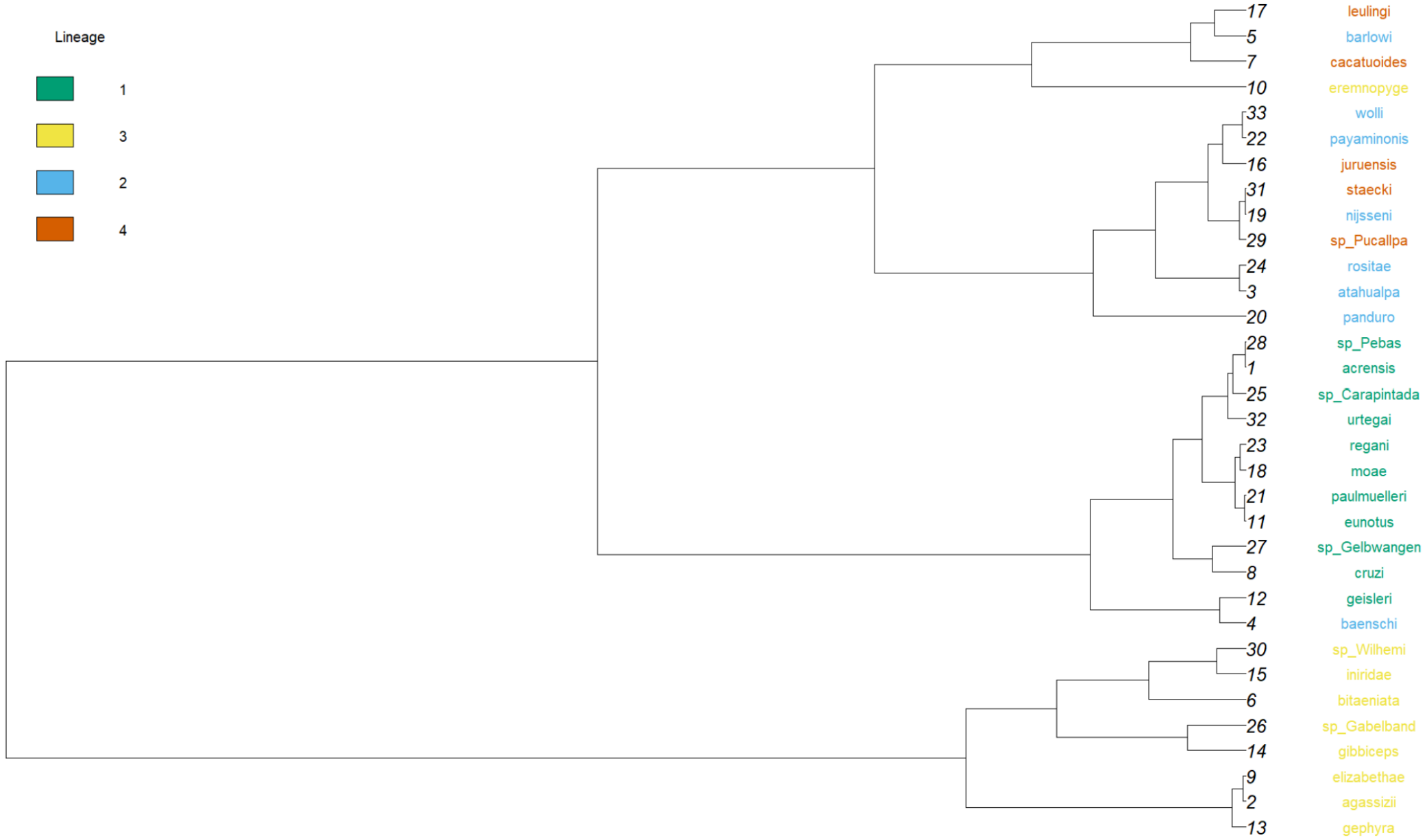

Individuals - MCA
Dim2 (16.9%)
Dim1 (20.7%)
1.0
0.5
0.0
-0.5
-0.5
0.0
0.5
lineage
lineage_1
lineage_2
lineage_3
lineage_4

Dimension 1	r2
Lineage	0.9304433
Body form	0.7619608
Infraorbital pores	0.7619608
Longitudinal band	0.7172129
Caudal spot	0.7093105
Dimension 2	**r2**
Head-body proportion	0.9139043
Lineage	0.9136878
Jaw spot	0.7130203
Chin spot	0.6938044
Chest spot	0.6105135




Strength of relationships between Apistogramma species
Lineage
Lineage 1
Lineage 2
Lineage 3
Lineage 4
atahualpa
juruensis
geisleri
cruzi
cacatuoides
moae
sp_Cerapinata
paulmuelleri
barlowi
regani
nijsseni
iniridae
eremnopyge
panduro
gibbiceps
gephyra
bitaeniata
elizabethae
sp_Gabelband
agassizii
urtegai
wolli
sp_Wilhemi
leulingi
eunotus
sp_Pucallpa
acrensis
sp_Pebas
sp_Gelbwangen
rositae
baenschi
payaminonis
staecki

Combined data tree with Tougard et al lineages, UPGMA method



References:

Römer U. 2006. Cichlid Atlas Volume 2. 1st Ed. Melle, Germany: Mergus.

Tougard C, García Dávila CR, Römer U, Duponchelle F, Cerqueira F, Paradis E, Guinand B, Angulo Chávez C, Salas V, Quérouil S, Sirvas S, Renno JF. 2017. Tempo and rates of diversification in the South American cichlid genus Apistogramma (Teleostei: Perciformes: Cichlidae). PLoS One. Sep 5;12(9):e0182618.