

Effect of taxon sampling in morphological phylogenetic analyses: insights from three fly taxa with different diversification rates



Apioceridae: *Apiocera* sp. © J. Hort



Asilidae: *Prytanomyia albida*



Mydidae: *Miltinus minutus* © J. Hort

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Taxon sampling in cladistic studies

- ◊ integral and important component -> **data + taxa**
- ◊ too often data have priority while taxa are “neglected”
 - › morphology – based on “**unlimited**” number of taxa in natural history collections
 - › traditional molecular – based on more recently collected, **limited** number of taxa (95% ethanol)
 - › genome molecular – based on newly collected, **very limited** number of taxa (RNAlater, DNAgard)
- ◊ taxon sampling examined in two morphological studies -> **exclude or include?**

Taxon sampling in cladistic studies

- ◊ *a posteriori* taxon exclusion
 - › Was the addition of taxa “necessary” to obtain the same hypothesis of relationships?
 - › Does one need to include more than one species per genus?
 - › example: two small families with dense generic sampling

- ◊ *a posteriori* taxon inclusion
 - › Would the addition of taxa corroborate the postulated hypothesis of relationships?
 - › Does the inclusion of additional species of a genus alter its position?
 - › example: a very diverse group with limited generic sampling

Taxa

- ◊ Apioceridae
 - › 143 species
 - › rarely collected
 - › Australia, Chile, western North America, South Africa
- ◊ Mydidae
 - › 473 species
 - › rarely collected
 - › world-wide primarily in arid regions
- ◊ Asilidae
 - › > 7,500 species
 - › collected by specialists and non-specialists alike
 - › speciose world-wide



Apiocera (Apiocera) pica © J. Hort



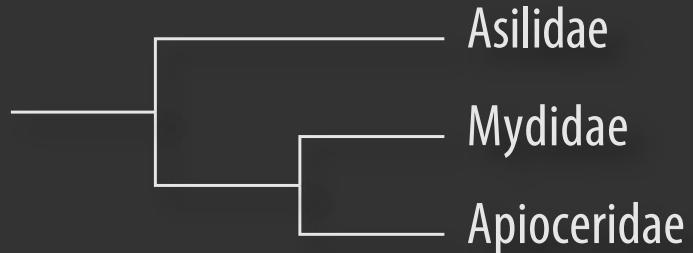
Eremomidas arabicus © D. Gardner



Scleropogon duncani

Minimum ages + relationships

- ◊ Crato Formation, Brazil
 - › Cretaceous: Aptian – Albian
 - › ≈ 112 myo
 - › Asilidae: †*Araripogon axelrodi*
 - › Mydidae: †*Cretomydas santanensis*



Asilidae: †*Araripogon axelrodi*



Mydidae: †*Cretomydas santanensis*

Overview

- ◊ Methods + data-sets
- ◊ *a posteriori* taxon exclusion
 - › Apioceridae biogeography
 - › Mydidae female ovipositor morphology
- ◊ *a posteriori* taxon inclusion
 - › Asilidae: Bathypogoninae position



Trichardis picta

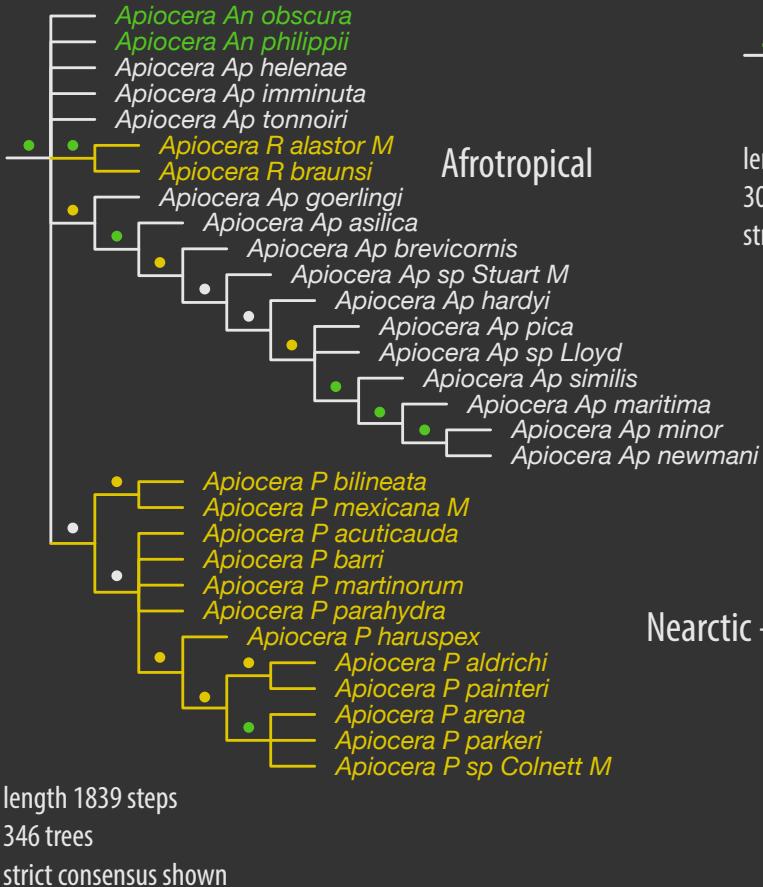


Prysotomyia albida

Methods + data-sets

- ◊ Mesquite 2.75
- ◊ TNT 1.1 (January 2013)
- ◊ exhaustive search (Mac mini 2.3 GHz quad-core Intel Core i7, 16 GB RAM)
 - › mult1000; xmult=rss hits 20 fuse 2 drift 3 ratchet 10 multiply consense 10;

taxon	# species in analysis	# genera in analysis
Apioceridae all	30	21.7 %
Apioceridae 1	4	2.9 %
Apioceridae 2	8	5.8 %
Apioceridae 5	14	10.1 %
Mydidae all	135	28.4 %
Mydidae 1	49	10.4 %
Mydidae 2	80	16.9 %
Mydidae 5	117	24.7 %
Asilidae all	158	2.1 %
<i>Bathypogon</i> 2	159	2.1 %
<i>Bathypogon</i> 4	161	2.1 %

Apioceridae all**Apioceridae 1**

● *Apiocera An philippii*
Apiocera Ap pica
Apiocera P arena
Apiocera R braunsi

length 1787 steps
306 trees
strict consensus shown

Apioceridae 2

● *Apiocera An obscura*
Apiocera An philippii
Apiocera Ap minor
Apiocera Ap pica
Apiocera P arena
● *Apiocera P bilineata*
● *Apiocera R alastor M*
Apiocera R braunsi

length 1807 steps
376 trees
strict consensus shown

Apioceridae 5

● *Apiocera An obscura*
Apiocera An philippii
Apiocera Ap tonnoiri
● *Apiocera R alastor M*
Apiocera R braunsi
Apiocera Ap hardyi
Apiocera Ap maritima
Apiocera Ap minor
Apiocera Ap pica
● *Apiocera P acuticauda*
Apiocera P arena
Apiocera P parkeri
Apiocera P bilineata
Apiocera P mexicana M

length 1819 steps
345 trees
strict consensus shown

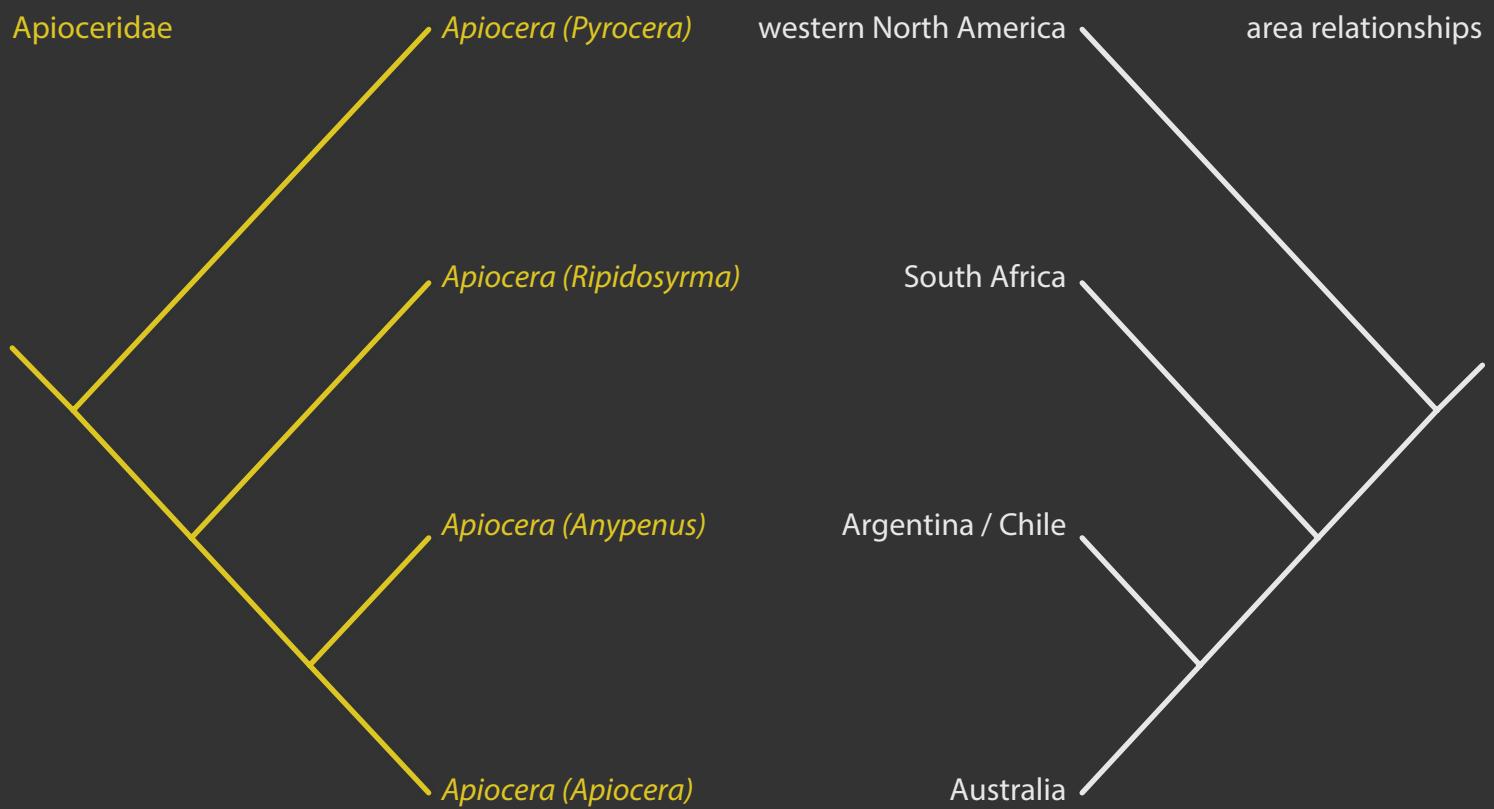
Nearctic + Neotropical (Mexico: Veracruz)

monophyletic subgenus

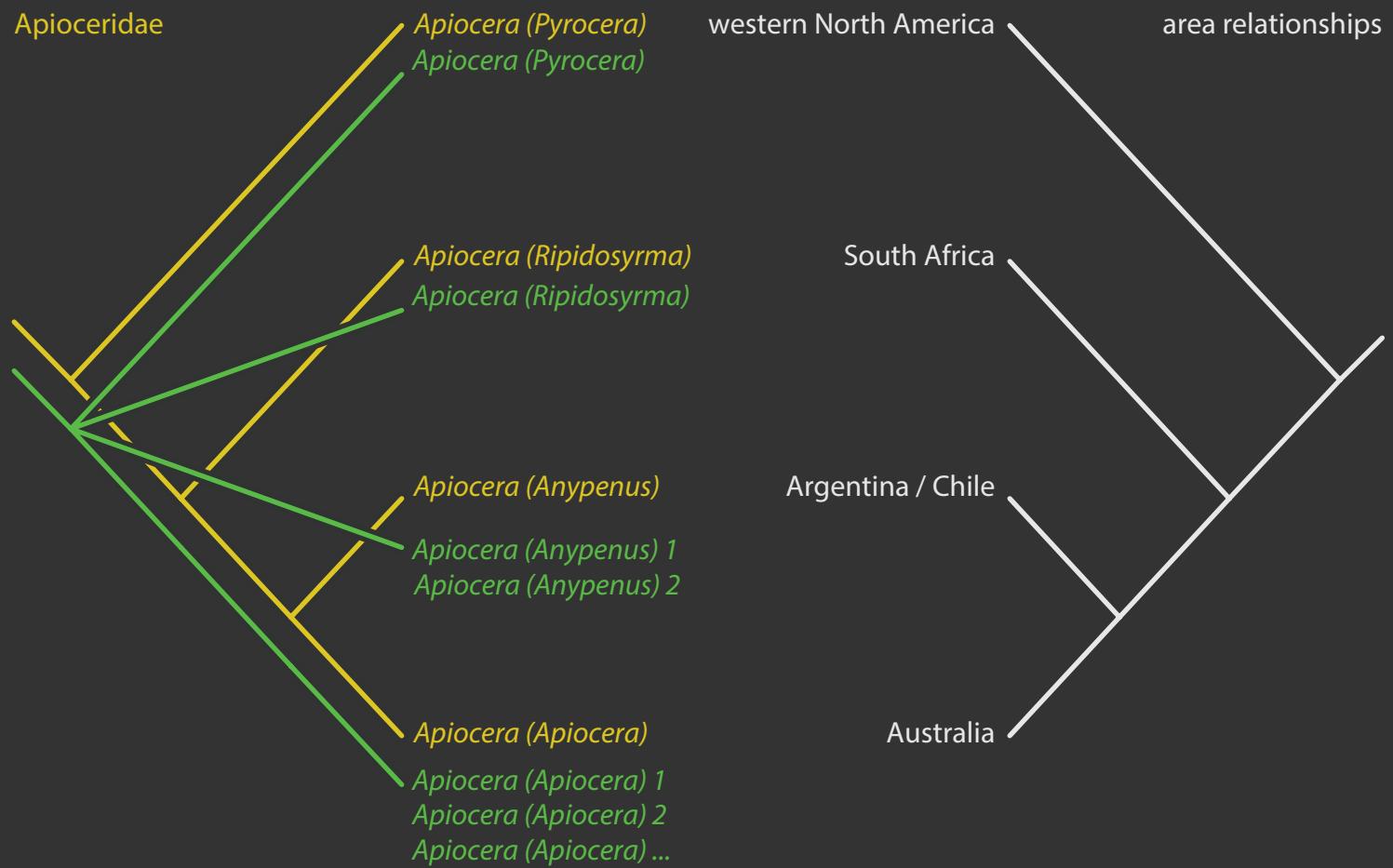
Chilean *Apiocera*

- = Bremer ≥ 8
- = Bremer 3–7
- = Bremer 1–2

Apioceridae – Yeates & Irwin 1996

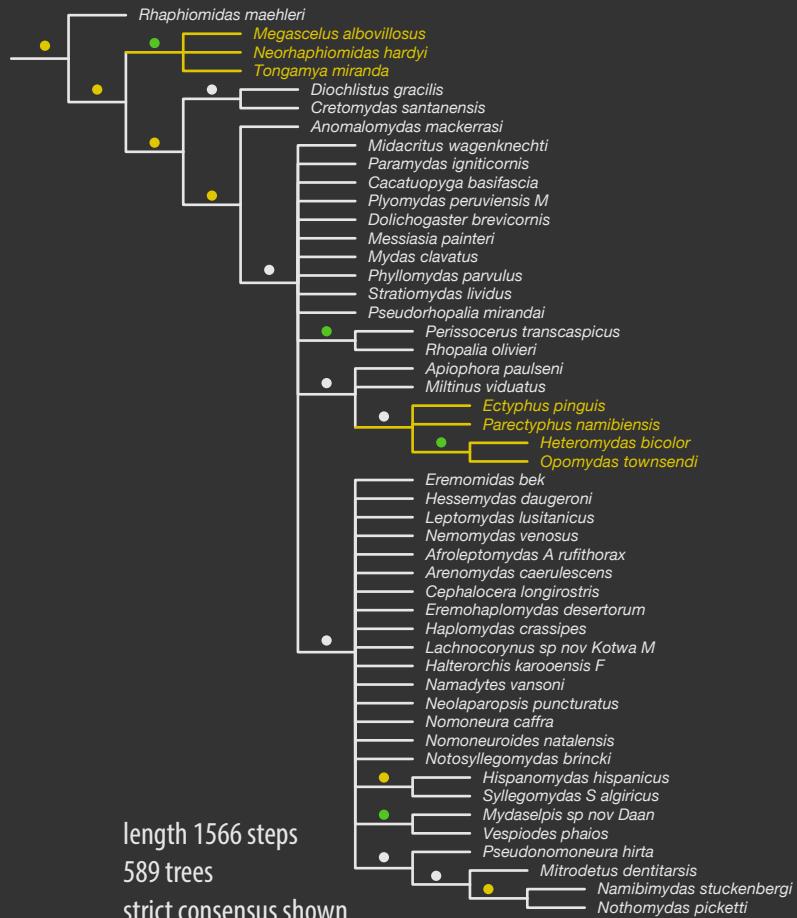


Apioceridae – current hypothesis

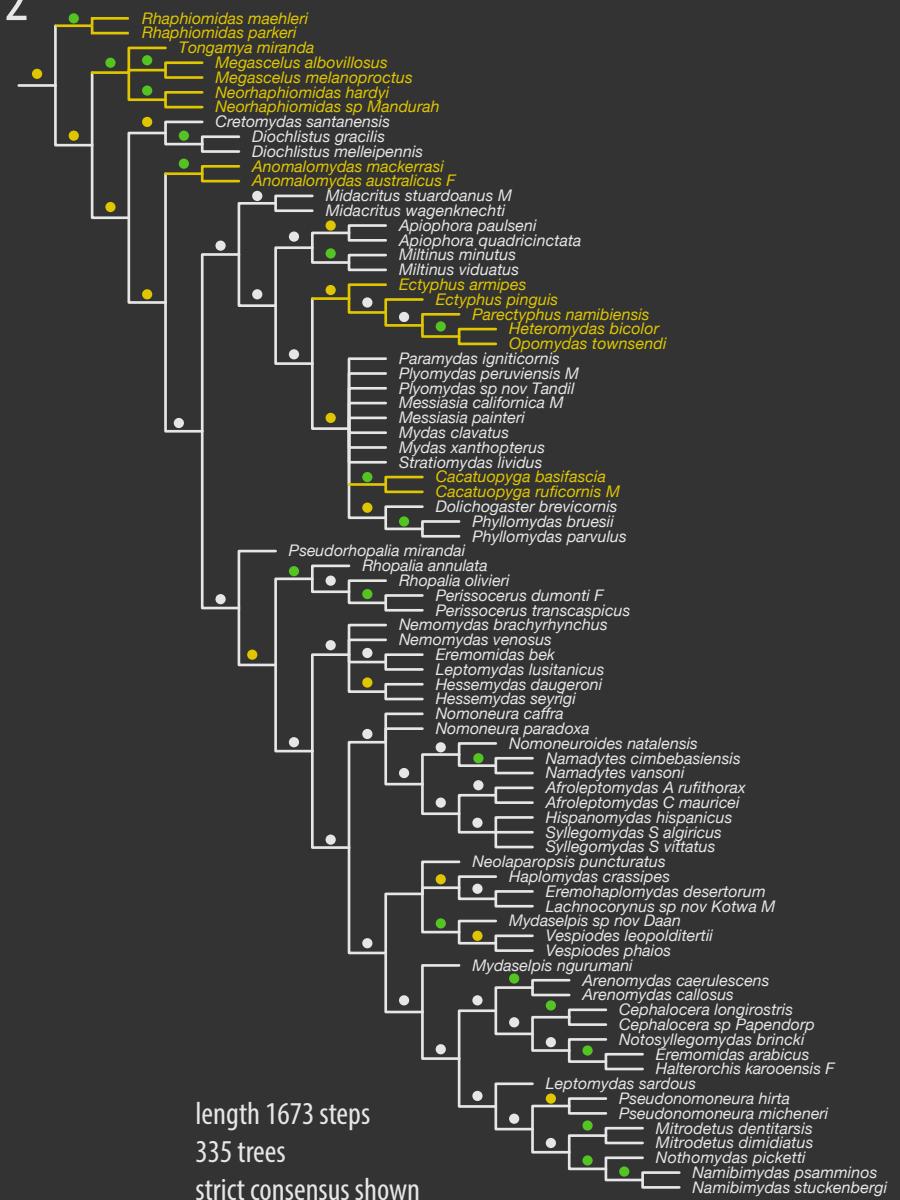


Yeates & Irwin 1996
current hypothesis

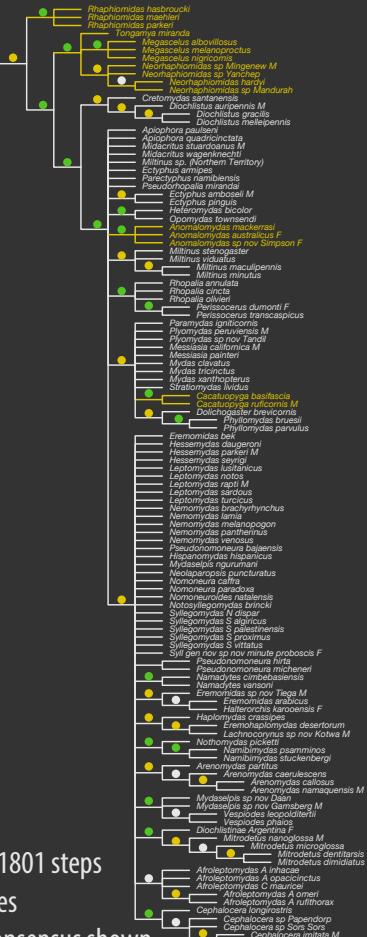
Mydidae 1



Mydidae 2



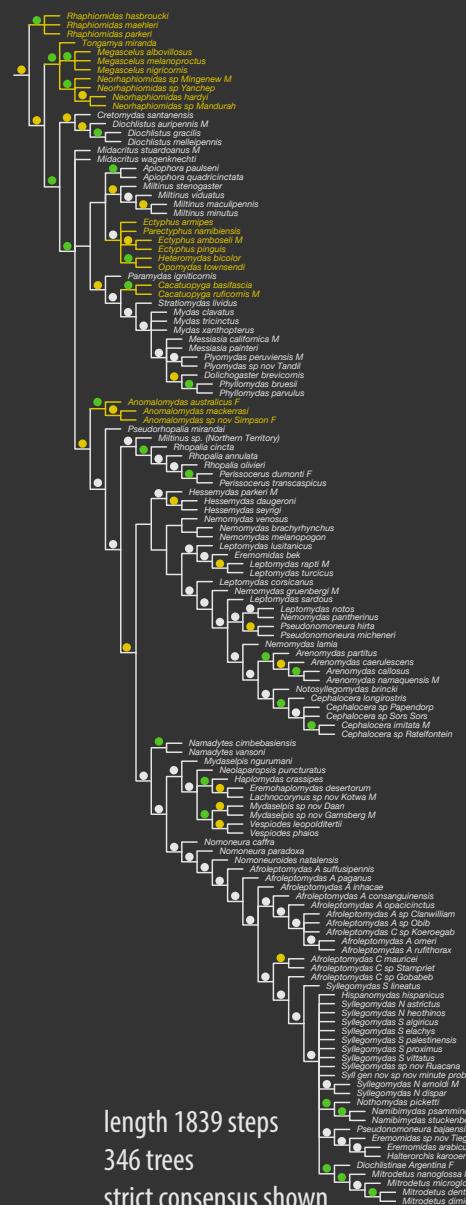
Mydidae 5



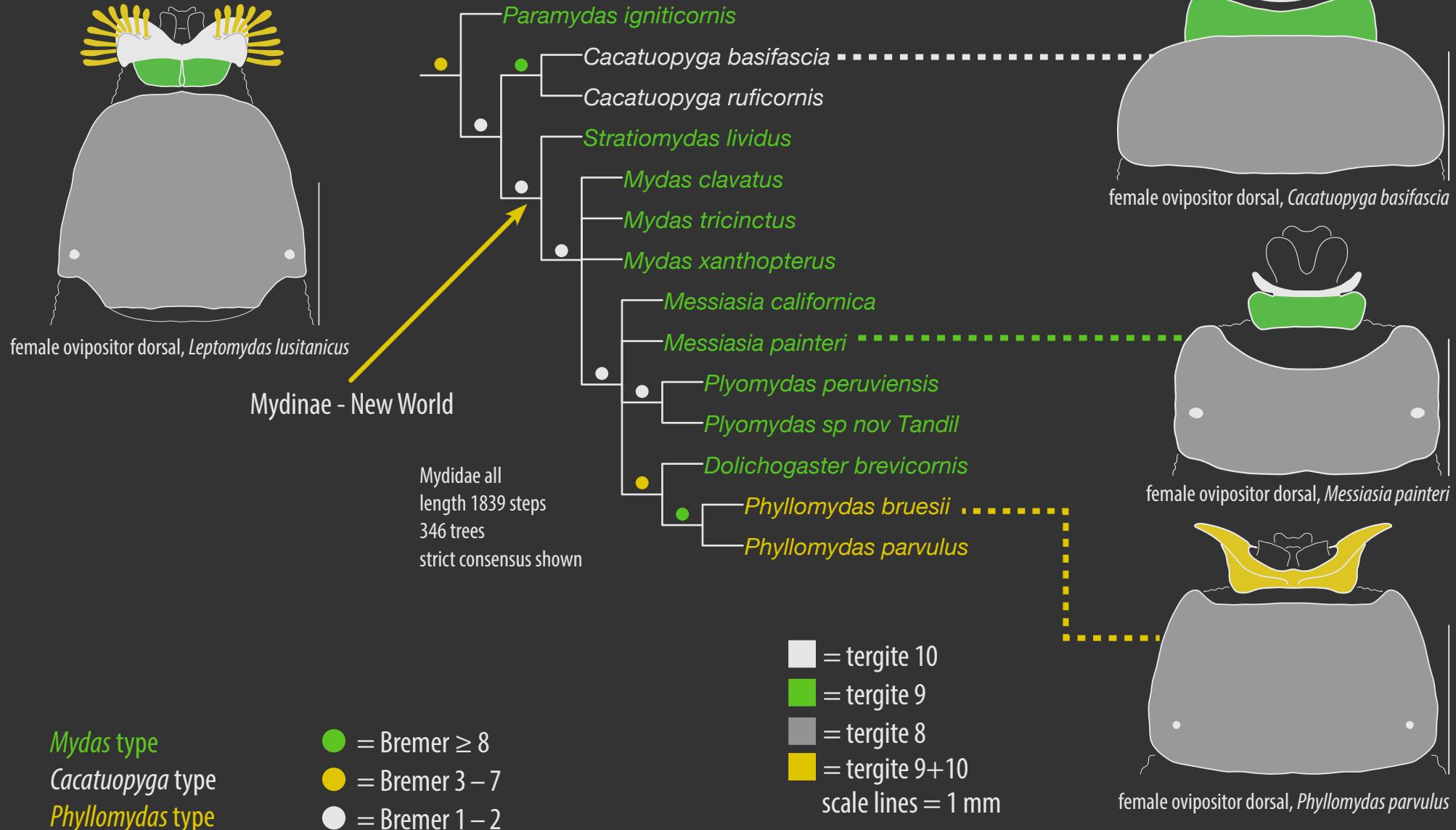
monophyletic higher taxon

- = Bremer ≥ 8
- = Bremer 3 – 7
- = Bremer 1 – 2

Mydidae all

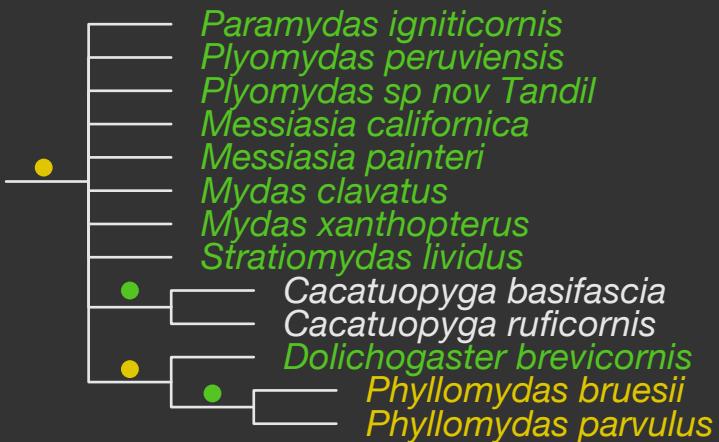


Female oviposition strategy



Female oviposition strategy – Mydinae

Mydidae 2 (13 species)



Mydas type

● = Bremer ≥ 8

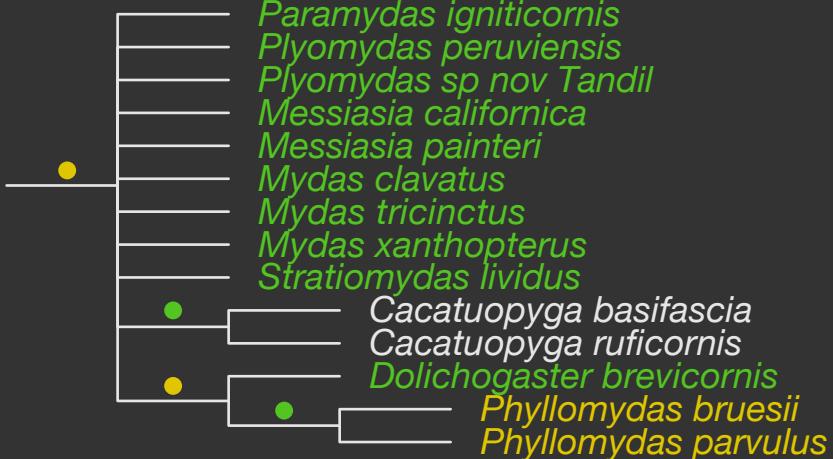
Cacatuopyga type

● = Bremer 3 – 7

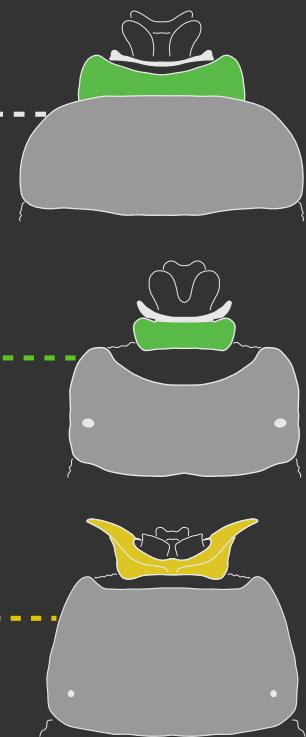
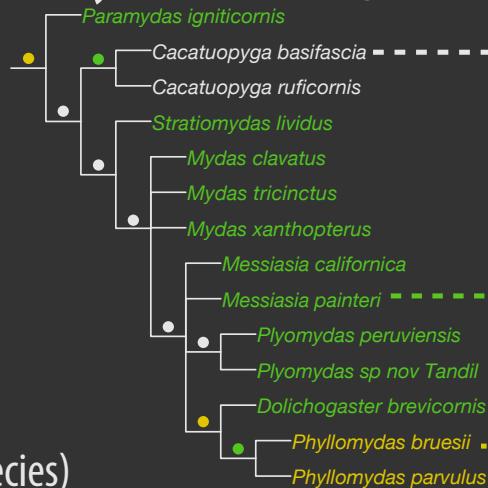
Phyllomydas type

● = Bremer 1 – 2

Mydidae 5 (14 species)



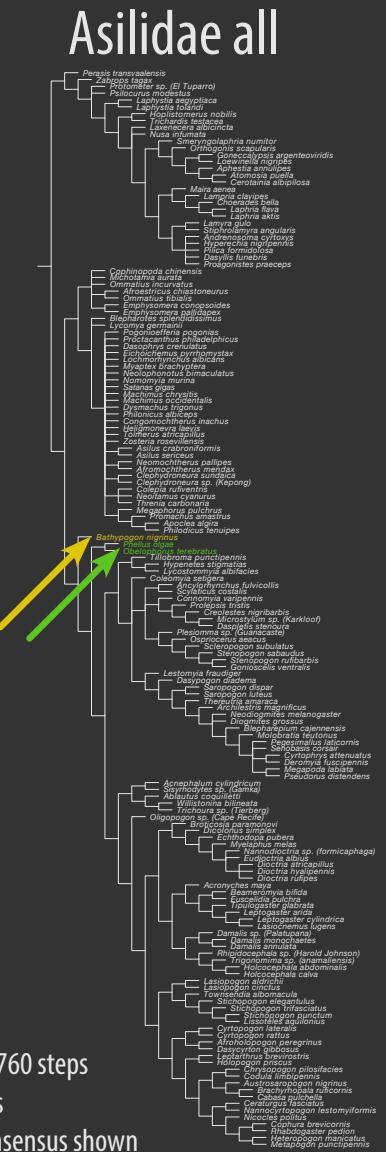
Mydidae all (14 species)



Bathyopogoninae

- ◊ newly postulated because of unique position
 - › Australian *Bathypogon*
 - › originally only a single species included

length 2760 steps
460 trees
strict consensus shown



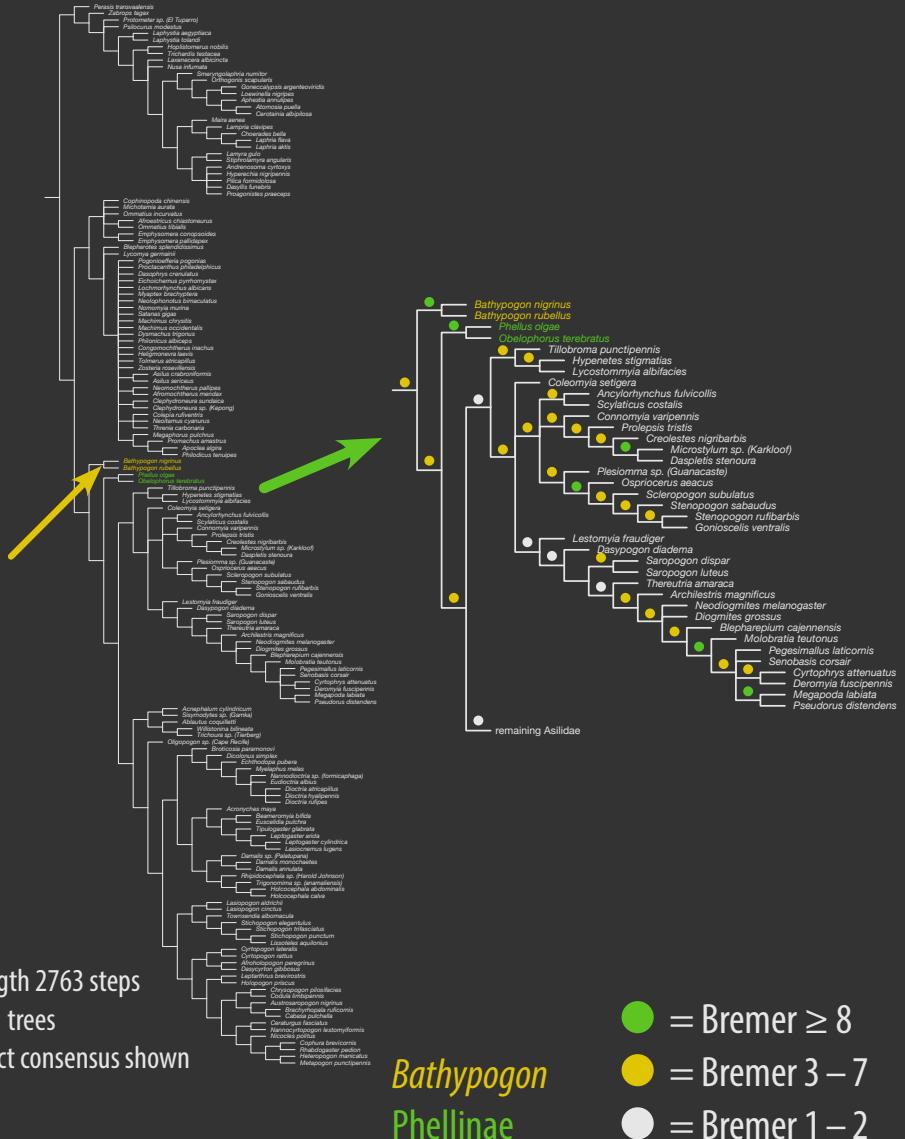
Bathyopogon sp.



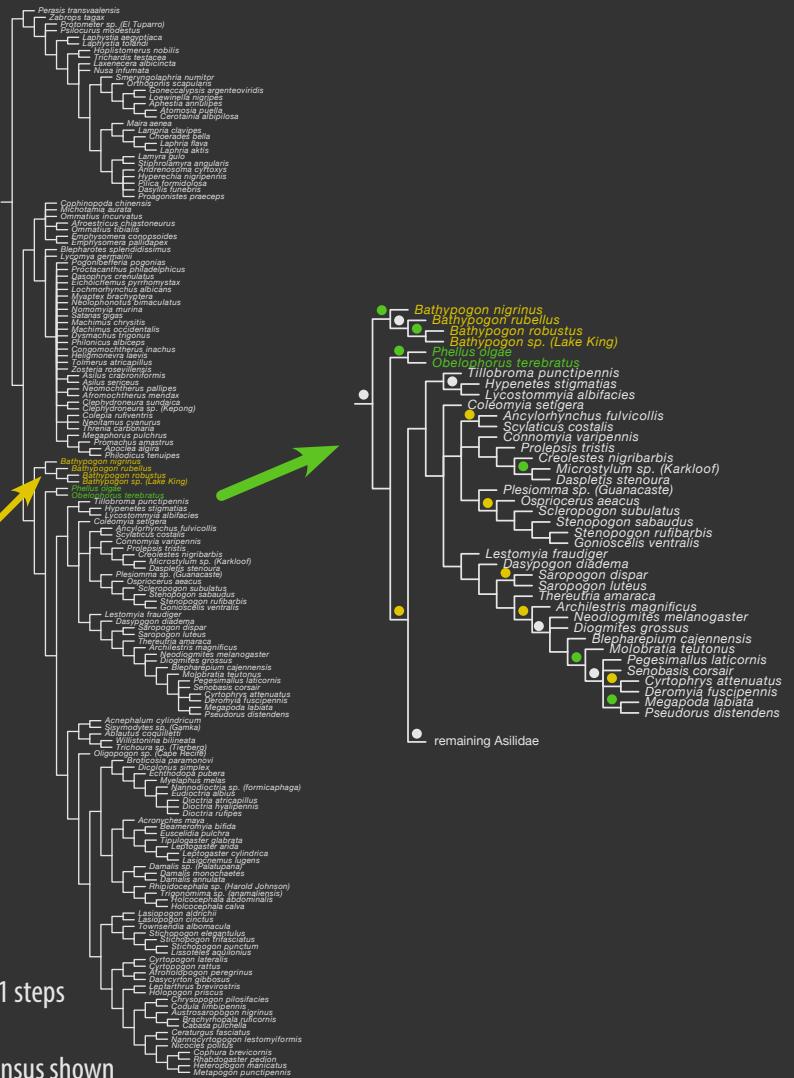
Bathypogon nigrinus

Bathypogon Phellinae

Bathyopogon 2



Bathyopogon 4

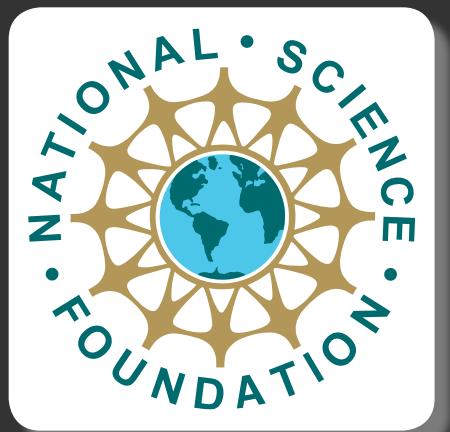


Conclusion

- ◊ strive to include as many taxa as feasible
- ◊ *Apioceridae*
 - › biogeographic hypothesis failed test
- ◊ *Mydidae*
 - › discussion of evolution of ovipositor only feasible with hypothesis derived from full data-set
 - › secondary signal (from elsewhere in the tree) emerges
- ◊ *Asilidae: Bathypogoninae*
 - › inclusion of one and three additional taxa corroborates unique position

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