Evaluating the impact of inter-dataset differences on the support for alternative early dinosaur phylogenies

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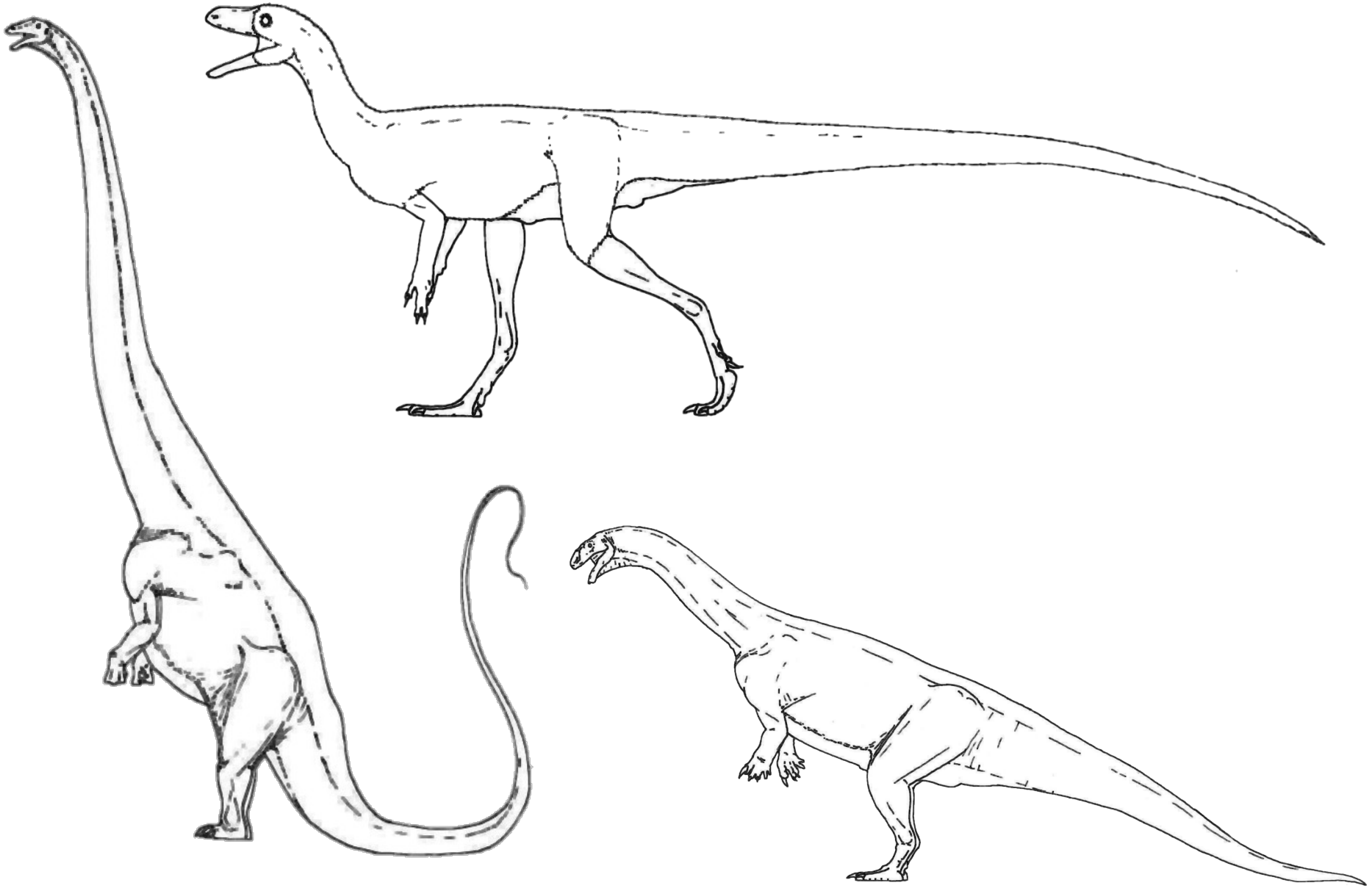
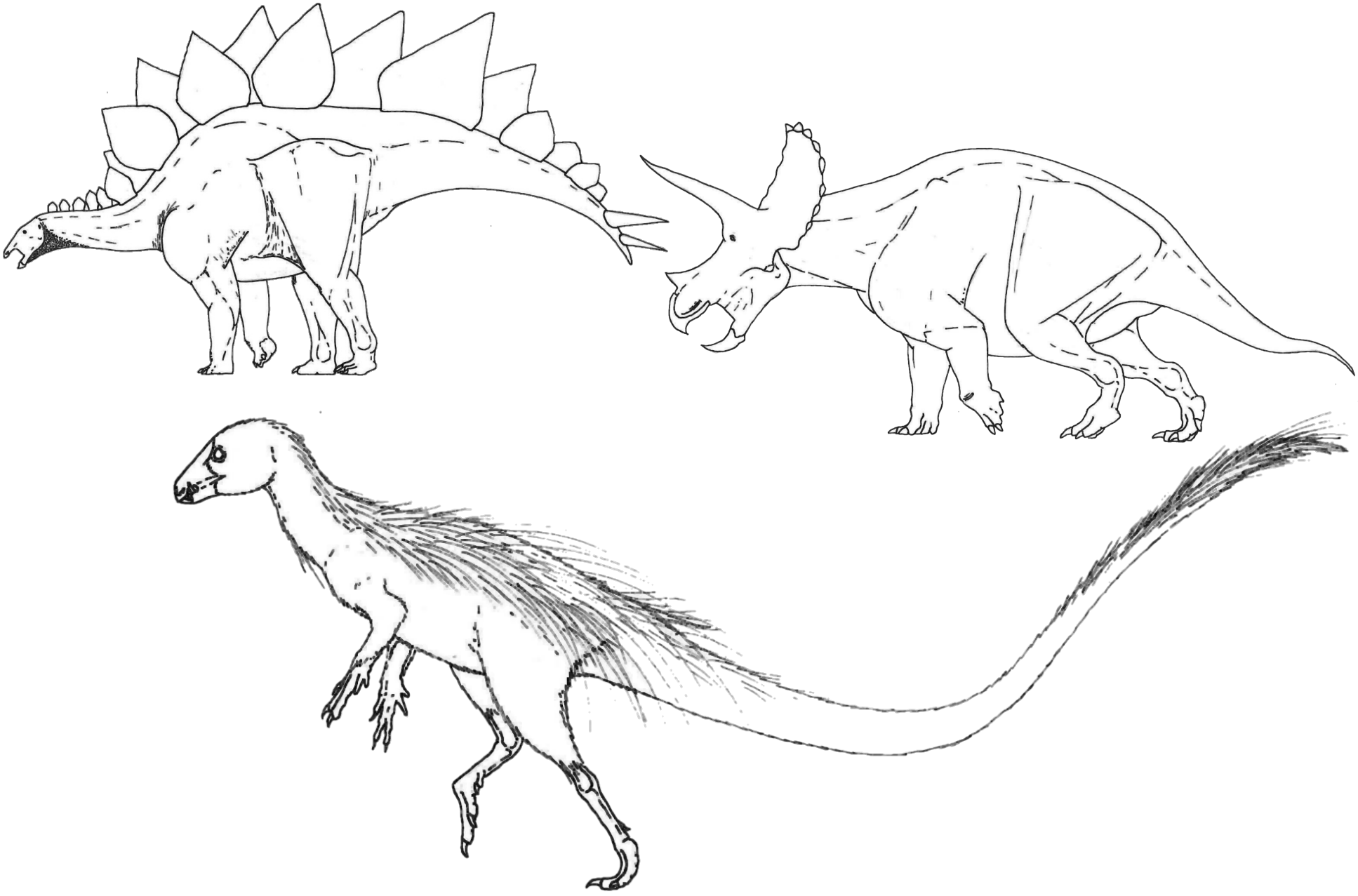
With artwork by Moritz Dukatz

Theropoda

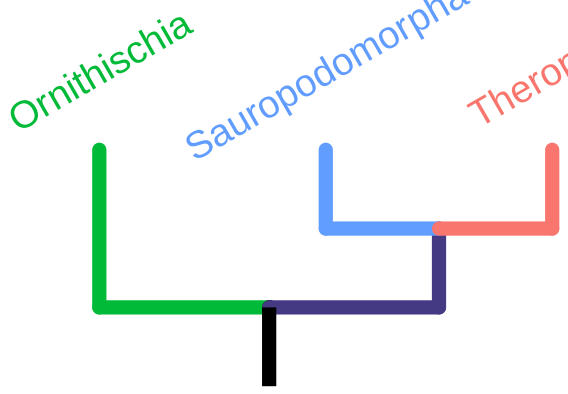
Sauropodomorpha



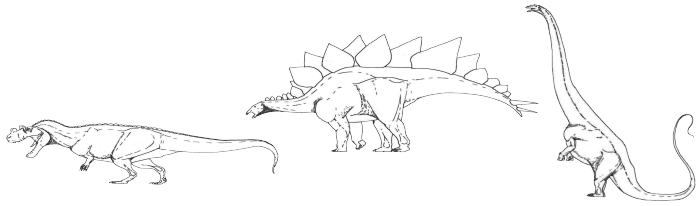
Ornithischia

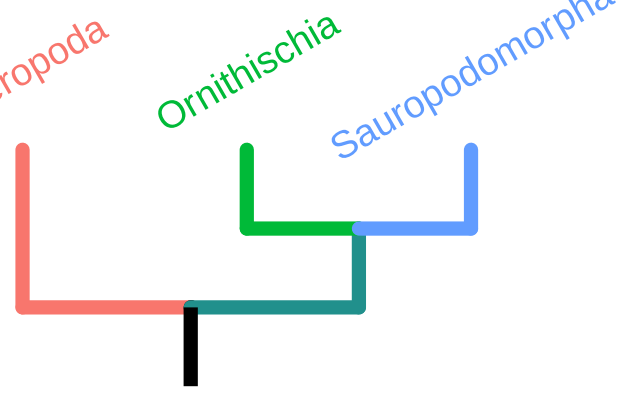


Saurischia

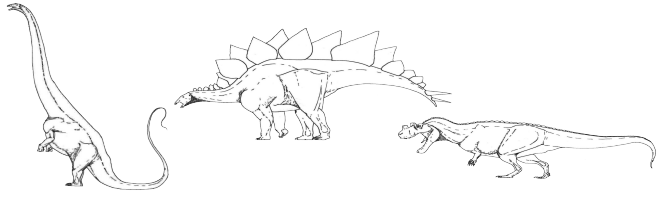


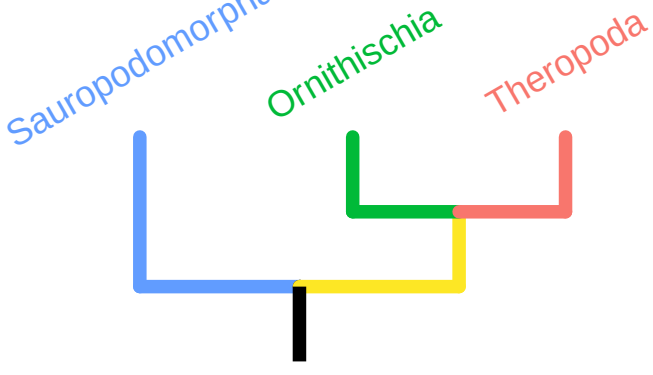
Ornithischiformes

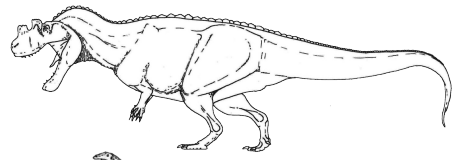


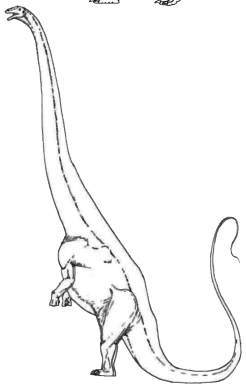


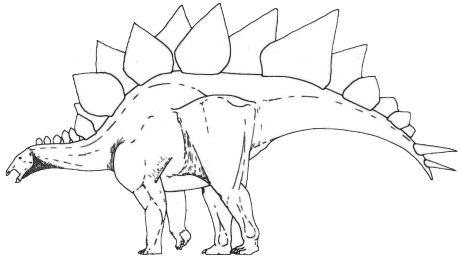
Ornithoscelida









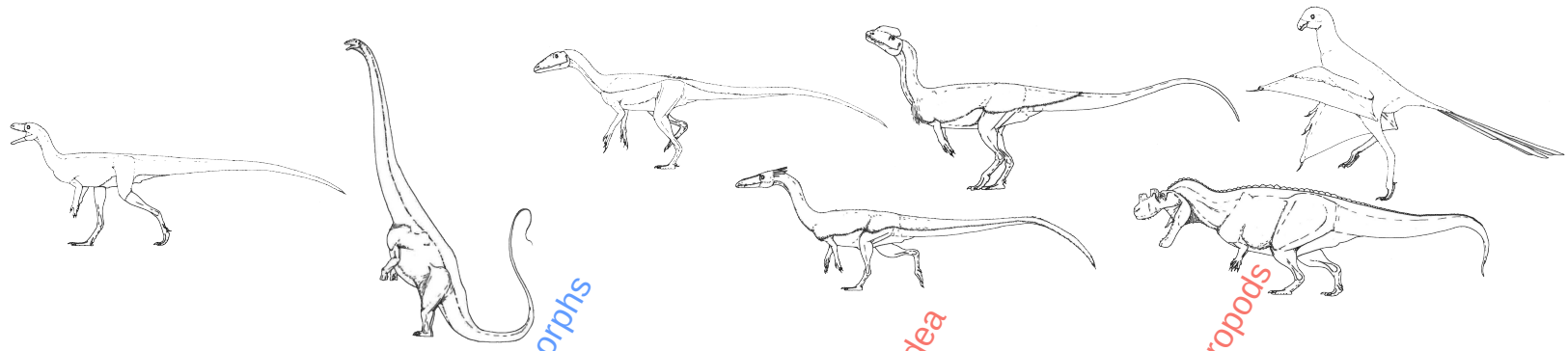


Theropoda

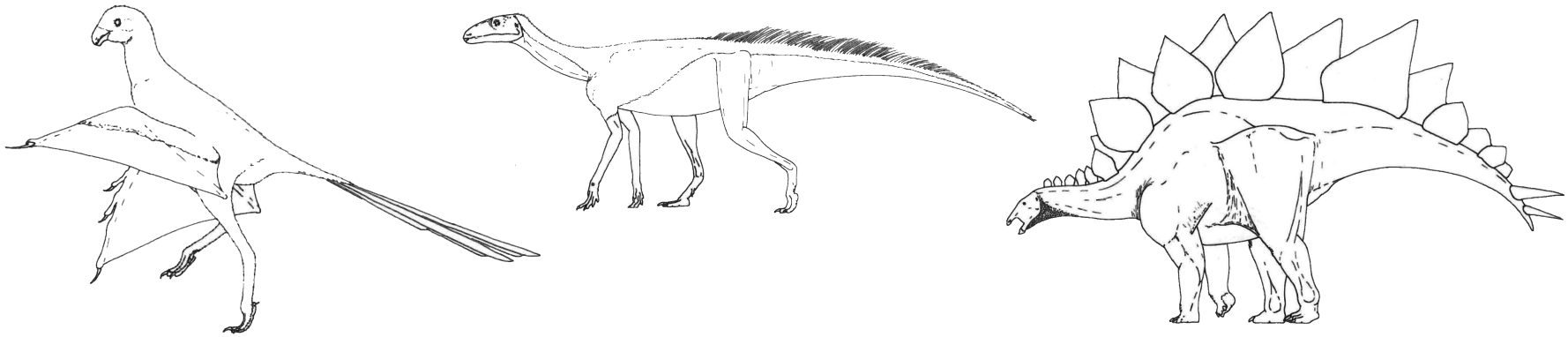
Sauropodomorpha

Ornithischia

LT			EJ			MJ	LJ			EC				LC					Pal		E
Cr	Nrn	Rht	Snm	Pl	Trc		Ox	Km	Tt	Brrs	Vl		Ap	Alb	Cnm		Cm	Mst	Dn		Y



Late Triassic
Sinemurian
Hettangian
Rhaetian
Norian
Carnian
Ladinian
Anisian
Ornithischia
Ornithischia
Ornithischia
Derived sauropodomorphs
Ornithischia
Early theropods
Ornithischia
Coelophysoidea
Ornithischia
Ornithischia
Early neotheropods
Ornithischia
Ceratosauria
Tetanurae
Saturnaliidae
Of2
Os2
Os3a
Os3b
Os1b
Os1a
Of1
Sau



Silesauridae

Saurischia

'Silesauridae'

Ornithischia

OrS

Hypothesis	Ornithischia sister to:	Includes silesaurids
Sau	(Theropoda + Sauropodomorpha)	No
Sau OrS	(Theropoda + Sauropodomorpha)	Yes
Of1	All sauropodomorphs	No
Of1 OrS	All sauropodomorphs	Yes
Of2	Non-saturnaliid sauropodomorphs	No
Of2 OrS	Non-saturnaliid sauropodomorphs	Yes
Os1	Most or all theropods	No
Os1 OrS	Most or all theropods	Yes
Os1a	All theropods	No
Os1a OrS	All theropods	Yes
Os1b	Neotheropoda	No
Os1b OrS	Neotheropoda	Yes
Os2	Coelophysoidea	No
Os2 OrS	Coelophysoidea	Yes
Os3	Most or all non-coelophysoid neotheropods	No
Os3 OrS	Most or all non-coelophysoid neotheropods	Yes
Os3a	All non-coelophysoid neotheropods	No
Os3a OrS	All non-coelophysoid neotheropods	Yes
Os3b	Averostra	No
Os3b OrS	Averostra	Yes

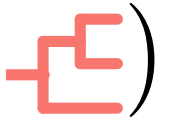
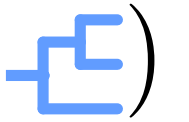
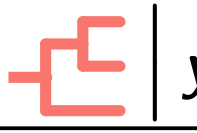
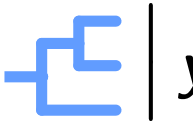
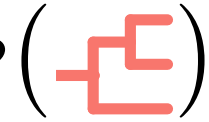
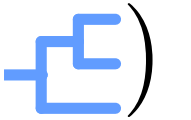
Hypothesis	Constraint	Datasets
Sau	(Si,((H,L),((E,P),(Co,D))))	B&W, LEA, M&G
Sau OrS	((Si,(H,L)),((E,P),(Co,D)))	B&W, LEA, M&G
Of1	(Si,((Co,D),((H,L),(Sa,(E,P)))))	B&W, LEA, M&G
Of1 OrS	((Co,D),((Si,(H,L)),(Sa,(E,P))))	B&W, LEA, M&G
Of2	(Si,((Co,D),(Sa,((H,L),(E,P)))))	B&W, LEA, M&G
Of2 OrS	((Co,D),(Sa,((Si,(H,L)),(E,P))))	B&W, LEA, M&G
Os1	(Si,((E,P),((H,L),(Co,D))))	M&G
Os1 OrS	((E,P),((Si,(H,L)),(Co,D)))	M&G
Os1a	(Si,((E,P),((H,L),(Ta,(Co,D)))))	B&W, LEA
Os1a OrS	((E,P),((Si,(H,L)),(Ta,(Co,D))))	B&W, LEA
Os1b	(Si,((E,P),(Ta,((H,L),(Co,D)))))	B&W, LEA
Os1b OrS	((E,P),(Ta,((Si,(H,L)),(Co,D))))	B&W, LEA
Os2	(Si,((E,P),(D,(Co,(H,L)))))	B&W, LEA, M&G
Os2 OrS	((E,P),(D,(Co,(Si,(H,L)))))	B&W, LEA, M&G
Os3	(Si,((E,P),(Co,(D,(H,L)))))	B&W, M&G
Os3 OrS	((E,P),(Co,(D,(Si,(H,L)))))	B&W, M&G
Os3a	(Si,((E,P),(Co,((H,L),(D,(Ce,A))))))	LEA
Os3a OrS	((E,P),(Co,((Si,(H,L)),(D,(Ce,A)))))	LEA
Os3b	(Si,((E,P),(Co,(D,((H,L),(Ce,A))))))	LEA
Os3b OrS	((E,P),(Co,(D,((Si,(H,L)),(Ce,A)))))	LEA

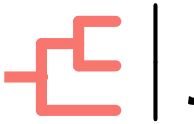
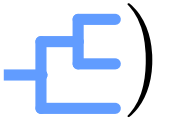
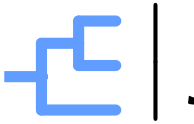
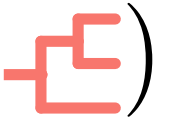
B&W =
Baron & Williams 2018

LEA =
Langer et al. 2017

M&G =
Müller & Garcia 2020

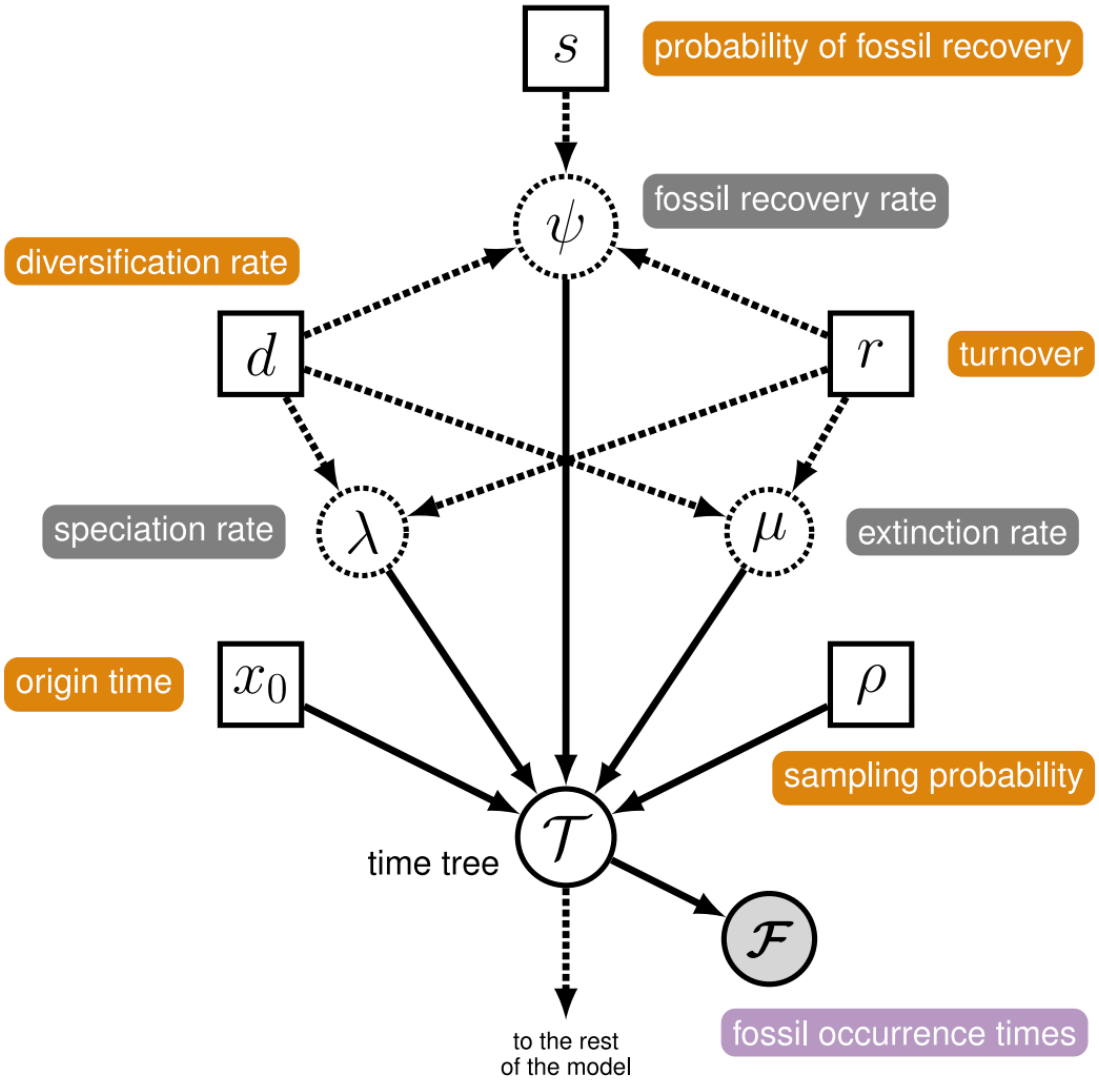
Bayes factors

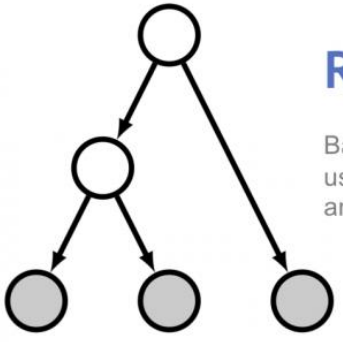
$$BF\left(\text{ }\right) = 2\log\frac{P\left(y \mid \text{  }\right)}{P\left(y \mid \text{  }\right)} = 2\log\frac{\frac{P\left(\text{  } \mid y\right)}{P\left(\text{  } \mid y\right)}}{\frac{P\left(\text{  }\right)}{P\left(\text{  }\right)}}$$

$$= 2\log\frac{P\left(\text{  } \mid y\right)\,P\left(\text{  }\right)}{P\left(\text{  } \mid y\right)\,P\left(\text{  }\right)}$$

Hypothesis	Baron & Williams	Langer et al.	Müller & Garcia
Sau	−12.36	−7.92	−7.37
Sau OrS	−28.44	−13.71	0
Of1	−9.68	−8.52	−10.07
Of1 OrS	−41.81	−29.16	−20.22
Of2	−7.61	0	−6.42
Of2 OrS	−52.18	−36.01	−21.71
Os1			13.24
Os1 OrS			23.93
Os1a	−5.78	−9.12	
Os1a OrS	−41.38	−30.79	
Os1b	0	−0.89	
Os1b OrS	−60.99	−39.90	
Os2	−4.72	−7.03	−17.11
Os2 OrS	−71.89	−61.60	−43.16
Os3	−6.31		−17.06
Os3 OrS	−74.20		−42.50
Os3a		−1.98	
Os3a OrS		−56.39	
Os3b		−1.46	
Os3b OrS		−60.84	

Next steps: tip dating in RevBayes





RevBayes

Bayesian phylogenetic inference
using probabilistic graphical models
and an interpreted language

Thank you!

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