

Supplementary Information

Amazonia as the origin and diversification area of Didelphidae (Mammalia, Metatheria), and a review of the fossil record of the clade

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1. Supplementary Tables

Table S1: Statistical results from all DEC models, including those from sensitivity analyses (M2-5).

Models	LnL	numparams	d	e
DEC M0	-220.441	2	0.032168	0.039751
DEC M2	-258.509	2	0.097499	0.063237
DEC M3	-220.681	2	0.021059	0.036422
DEC M4	-222.532	2	0.047468	0.047067
DEC M5	-220.267	2	0.025254	0.037397

Table S2: Statistical tests between nested models (DEC M0 and M1; DIVALIKE M0 and M1).
Abbreviations: Alt, alternative model; LnL Alt, log-likelihood of the alternative model; LnL Null, log-likelihood of the null model; pval, *p* value.

Alt	Null	LnL Alt	LnL Null	pval	test
DEC M1	DEC M0	-245.7	-220.4	1	chi-squared
DIVALIKE M1	DIVALIKE M0	-245.7	-227.5	1	chi-squared

2. Input distance multiplier matrices for biogeographic analyses

Standard distance multiplier matrices:

Time bin 1:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	1	0.5	0.5	0.0001	0.0001	0.0001	0.0001	0.0001
1	1	0.5	0.5	0.0001	0.0001	0.0001	0.5	0.0001
0.5	0.5	1	0.5	0.0001	0.0001	0.5	0.5	0.5
0.5	0.5	0.5	1	0.0001	0.0001	0.5	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.5	1
0.0001	0.0001	0.0001	0.0001	1	1	1	0.5	0.5
0.0001	0.0001	0.5	0.5	1	1	1	1	1
0.0001	0.5	0.5	1	0.5	0.5	1	1	0.5
0.0001	0.0001	0.5	0.0001	1	0.5	1	0.5	1

Time bin 2:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	0.5	0.5	0.0001	0.0001	0.0001	0.5	0.0001
0.0001	0.5	1	0.5	0.0001	0.0001	0.5	0.5	0.5
0.0001	0.5	0.5	1	0.0001	0.0001	0.5	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.5	1
0.0001	0.0001	0.0001	0.0001	1	1	1	0.5	0.5
0.0001	0.0001	0.5	0.5	1	1	1	1	1
0.0001	0.5	0.5	1	0.5	0.5	1	1	0.5
0.0001	0.0001	0.5	0.0001	1	0.5	1	0.5	1

Time bin 3:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	1	1	0.0001	0.0001	0.0001	0.5	0.0001
0.0001	1	1	1	0.0001	0.0001	0.5	1	0.5
0.0001	1	1	1	0.0001	0.0001	0.5	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.5	0.5
0.0001	0.0001	0.0001	0.0001	1	1	1	0.5	0.0001
0.0001	0.0001	0.5	0.5	1	1	1	1	1
0.0001	0.5	1	1	0.5	0.5	1	1	0.5
0.0001	0.0001	0.5	0.0001	0.5	0.0001	1	0.5	1

Time bin 4:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	0.0001	1	1	0.0001	0.0001	0.5	1	1
0.0001	0.0001	1	1	0.0001	0.0001	0.5	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.5	0.5
0.0001	0.0001	0.0001	0.0001	1	1	1	0.5	0.0001
0.0001	0.0001	0.5	0.5	1	1	1	1	1
0.0001	0.0001	1	1	0.5	0.5	1	1	0.5
0.0001	0.0001	1	0.0001	0.5	0.0001	1	0.5	1

Harsh distance multiplier matrices:

Time bin 1:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
1	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	0.0001	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	0.0001	0.0001	1	0.0001	0.0001	0.0001	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.0001	1
0.0001	0.0001	0.0001	0.0001	1	1	1	0.0001	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	1	1
0.0001	0.0001	0.0001	1	0.0001	0.0001	1	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	0.0001	1	0.0001	1

Time bin 2:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	0.0001	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	0.0001	0.0001	1	0.0001	0.0001	0.0001	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.0001	1
0.0001	0.0001	0.0001	0.0001	1	1	1	0.0001	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	1	1
0.0001	0.0001	0.0001	1	0.0001	0.0001	1	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	0.0001	1	0.0001	1

Time bin 3:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	1	1	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	1	1	0.0001	0.0001	0.0001	1	0.0001
0.0001	1	1	1	0.0001	0.0001	0.0001	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.0001	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.0001	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	1	1
0.0001	0.0001	1	1	0.0001	0.0001	1	1	0.0001
0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	1	0.0001	1

Time bin 4:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	0.0001	1	1	0.0001	0.0001	0.0001	1	1
0.0001	0.0001	1	1	0.0001	0.0001	0.0001	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.0001	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.0001	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	1	1
0.0001	0.0001	1	1	0.0001	0.0001	1	1	0.0001
0.0001	0.0001	1	0.0001	0.0001	0.0001	1	0.0001	1

Not-so-harsh distance multiplier matrices:

Time bin 1:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	1	0.25	0.25	0.0001	0.0001	0.0001	0.0001	0.0001
1	1	0.25	0.25	0.0001	0.0001	0.0001	0.25	0.0001
0.25	0.25	1	0.25	0.0001	0.0001	0.25	0.25	0.25
0.25	0.25	0.25	1	0.0001	0.0001	0.25	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.25	1
0.0001	0.0001	0.0001	0.0001	1	1	1	0.25	0.25
0.0001	0.0001	0.25	0.25	1	1	1	1	1
0.0001	0.25	0.25	1	0.25	0.25	1	1	0.25
0.0001	0.0001	0.25	0.0001	1	0.25	1	0.25	1

Time bin 2:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	0.25	0.25	0.0001	0.0001	0.0001	0.25	0.0001
0.0001	0.25	1	0.25	0.0001	0.0001	0.25	0.25	0.25
0.0001	0.25	0.25	1	0.0001	0.0001	0.25	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.25	1
0.0001	0.0001	0.0001	0.0001	1	1	1	0.25	0.25
0.0001	0.0001	0.25	0.25	1	1	1	1	1
0.0001	0.25	0.25	1	0.25	0.25	1	1	0.25
0.0001	0.0001	0.25	0.0001	1	0.25	1	0.25	1

Time bin 3:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	1	1	0.0001	0.0001	0.0001	0.25	0.0001
0.0001	1	1	1	0.0001	0.0001	0.25	1	0.25
0.0001	1	1	1	0.0001	0.0001	0.25	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.25	0.25
0.0001	0.0001	0.0001	0.0001	1	1	1	0.25	0.0001
0.0001	0.0001	0.25	0.25	1	1	1	1	1
0.0001	0.25	1	1	0.25	0.25	1	1	0.25
0.0001	0.0001	0.25	0.0001	0.25	0.0001	1	0.25	1

Time bin 4:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	0.0001	1	1	0.0001	0.0001	0.25	1	1
0.0001	0.0001	1	1	0.0001	0.0001	0.25	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.25	0.25
0.0001	0.0001	0.0001	0.0001	1	1	1	0.25	0.0001
0.0001	0.0001	0.25	0.25	1	1	1	1	1
0.0001	0.0001	1	1	0.25	0.25	1	1	0.25
0.0001	0.0001	1	0.0001	0.25	0.0001	1	0.25	1

Not-so-relaxed distance multiplier matrices:

Time bin 1:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	1	0.75	0.75	0.0001	0.0001	0.0001	0.0001	0.0001
1	1	0.75	0.75	0.0001	0.0001	0.0001	0.75	0.0001
0.75	0.75	1	0.75	0.0001	0.0001	0.75	0.75	0.75
0.75	0.75	0.75	1	0.0001	0.0001	0.75	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.75	1
0.0001	0.0001	0.0001	0.0001	1	1	1	0.75	0.75
0.0001	0.0001	0.75	0.75	1	1	1	1	1
0.0001	0.75	0.75	1	0.75	0.75	1	1	0.75
0.0001	0.0001	0.75	0.0001	1	0.75	1	0.75	1

Time bin 2:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	0.75	0.75	0.0001	0.0001	0.0001	0.75	0.0001
0.0001	0.75	1	0.75	0.0001	0.0001	0.75	0.75	0.75
0.0001	0.75	0.75	1	0.0001	0.0001	0.75	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.75	1
0.0001	0.0001	0.0001	0.0001	1	1	1	0.75	0.75
0.0001	0.0001	0.75	0.75	1	1	1	1	1
0.0001	0.75	0.75	1	0.75	0.75	1	1	0.75
0.0001	0.0001	0.75	0.0001	1	0.75	1	0.75	1

Time bin 3:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	1	1	0.0001	0.0001	0.0001	0.75	0.0001
0.0001	1	1	1	0.0001	0.0001	0.75	1	0.75
0.0001	1	1	1	0.0001	0.0001	0.75	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.75	0.75
0.0001	0.0001	0.0001	0.0001	1	1	1	0.75	0.0001
0.0001	0.0001	0.75	0.75	1	1	1	1	1
0.0001	0.75	1	1	0.75	0.75	1	1	0.75
0.0001	0.0001	0.75	0.0001	0.75	0.0001	1	0.75	1

Time bin 4:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	0.0001	1	1	0.0001	0.0001	0.75	1	1
0.0001	0.0001	1	1	0.0001	0.0001	0.75	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	0.75	0.75
0.0001	0.0001	0.0001	0.0001	1	1	1	0.75	0.0001
0.0001	0.0001	0.75	0.75	1	1	1	1	1
0.0001	0.0001	1	1	0.75	0.75	1	1	0.75
0.0001	0.0001	1	0.0001	0.75	0.0001	1	0.75	1

Relaxed distance multiplier matrices:

Time bin 1:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	1	1	1	0.0001	0.0001	0.0001	0.0001	0.0001
1	1	1	1	0.0001	0.0001	0.0001	1	0.0001
1	1	1	1	0.0001	0.0001	1	1	1
1	1	1	1	0.0001	0.0001	1	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	1	1
0.0001	0.0001	0.0001	0.0001	1	1	1	1	1
0.0001	0.0001	1	1	1	1	1	1	1
0.0001	1	1	1	1	1	1	1	1
0.0001	0.0001	1	0.0001	1	1	1	1	1

Time bin 2:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	1	1	0.0001	0.0001	0.0001	1	0.0001
0.0001	1	1	1	0.0001	0.0001	1	1	1
0.0001	1	1	1	0.0001	0.0001	1	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	1	1
0.0001	0.0001	0.0001	0.0001	1	1	1	1	1
0.0001	0.0001	1	1	1	1	1	1	1
0.0001	1	1	1	1	1	1	1	1
0.0001	0.0001	1	0.0001	1	1	1	1	1

Time bin 3:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	1	1	0.0001	0.0001	0.0001	1	0.0001
0.0001	1	1	1	0.0001	0.0001	1	1	1
0.0001	1	1	1	0.0001	0.0001	1	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	1	1
0.0001	0.0001	0.0001	0.0001	1	1	1	1	0.0001
0.0001	0.0001	1	1	1	1	1	1	1
0.0001	1	1	1	1	1	1	1	1
0.0001	0.0001	1	0.0001	1	0.0001	1	1	1

Time bin 4:

Cn	Nw	An	V	P	Af	Dd	Am	St
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
0.0001	0.0001	1	1	0.0001	0.0001	1	1	1
0.0001	0.0001	1	1	0.0001	0.0001	1	1	0.0001
0.0001	0.0001	0.0001	0.0001	1	1	1	1	1
0.0001	0.0001	0.0001	0.0001	1	1	1	1	0.0001
0.0001	0.0001	1	1	1	1	1	1	1
0.0001	0.0001	1	1	1	1	1	1	1
0.0001	0.0001	1	0.0001	1	0.0001	1	1	1

3. Input distance multiplier matrices for biogeographic analyses

Time bin 1:

[illegible]

Time bin 2:

[illegible]

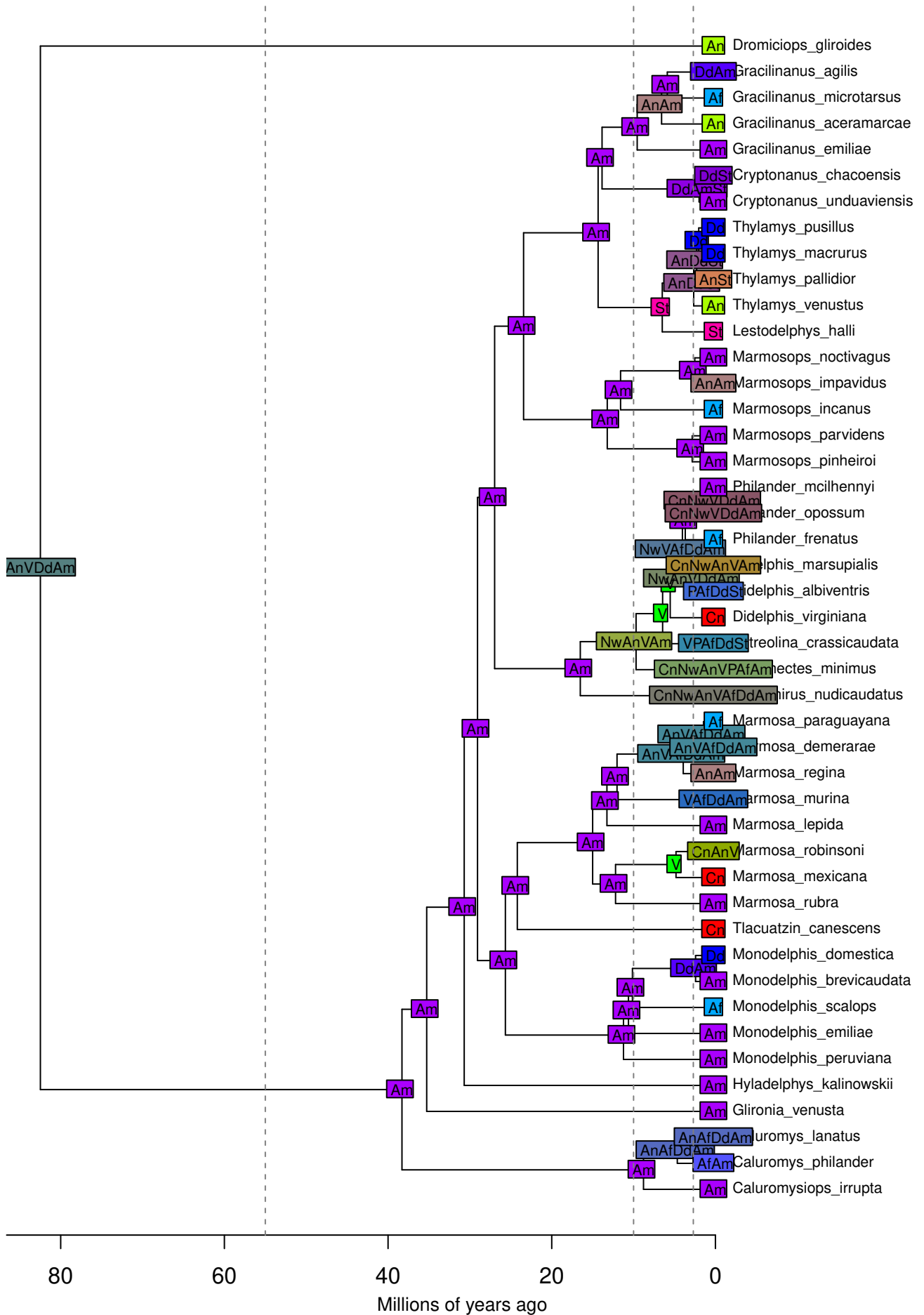
Time bin 3:

[illegible]

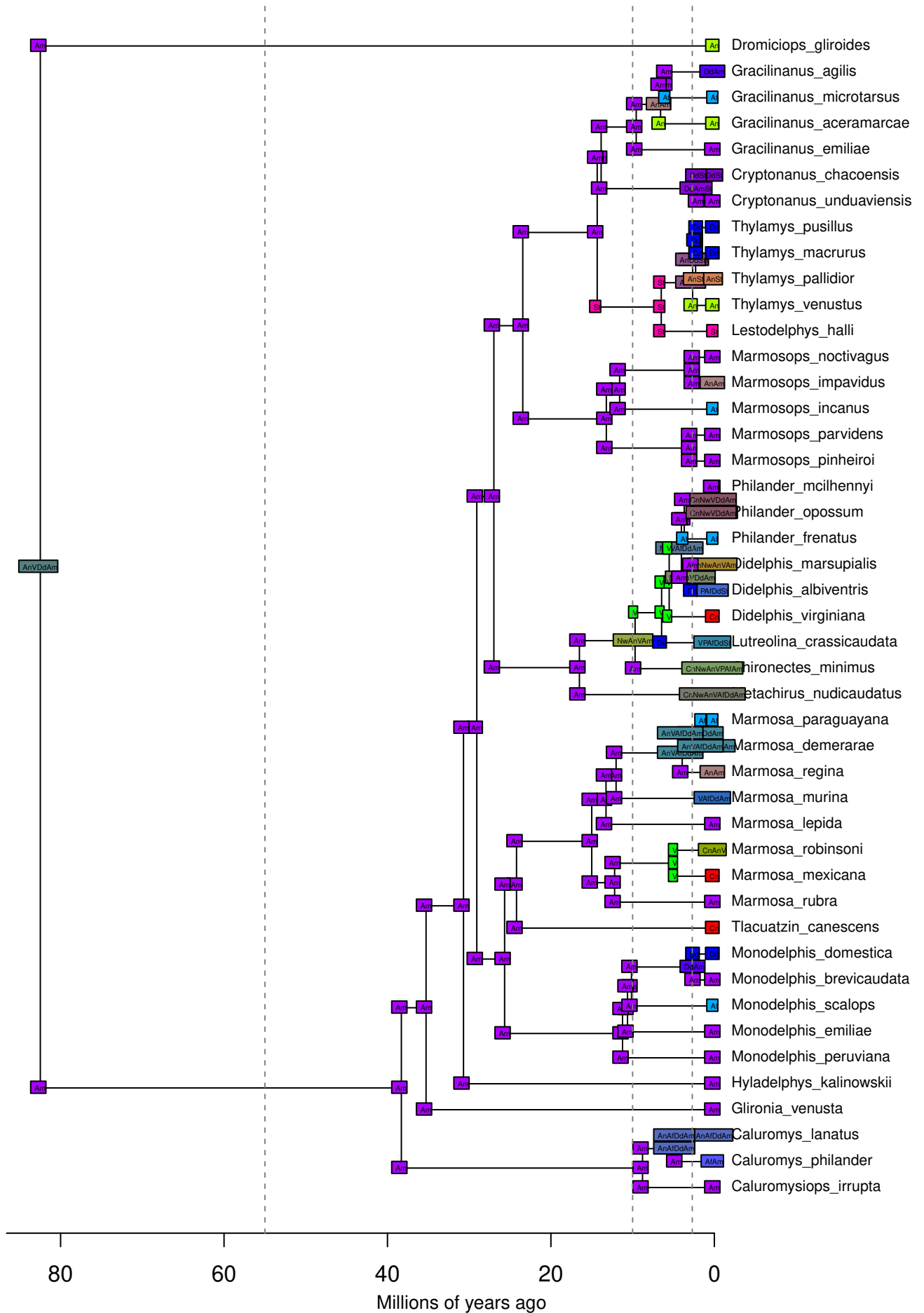
Time bin 4:

[illegible]

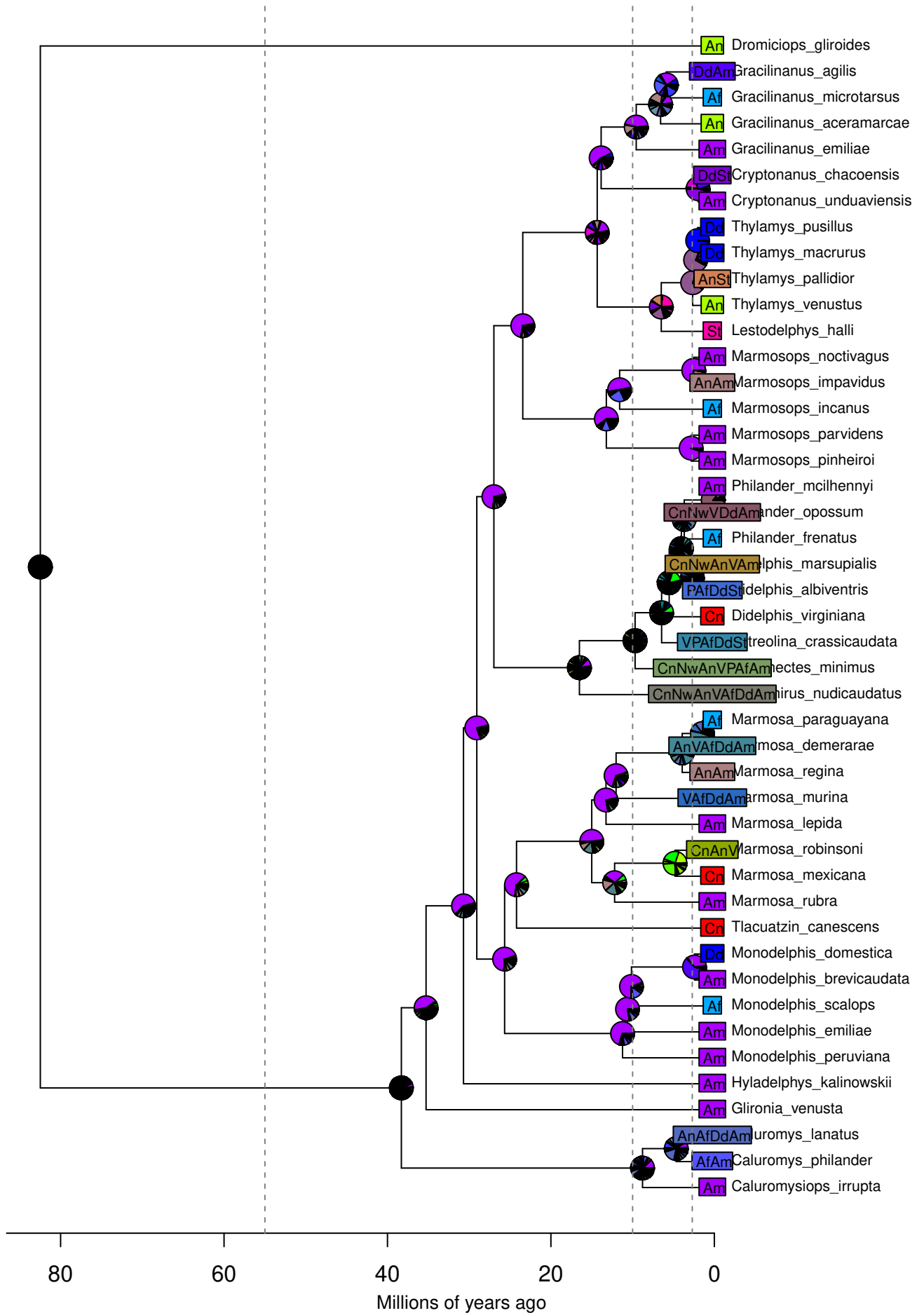
DEC M0 (w=1) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0322; e=0.0398; w=1; LnL=-220.44



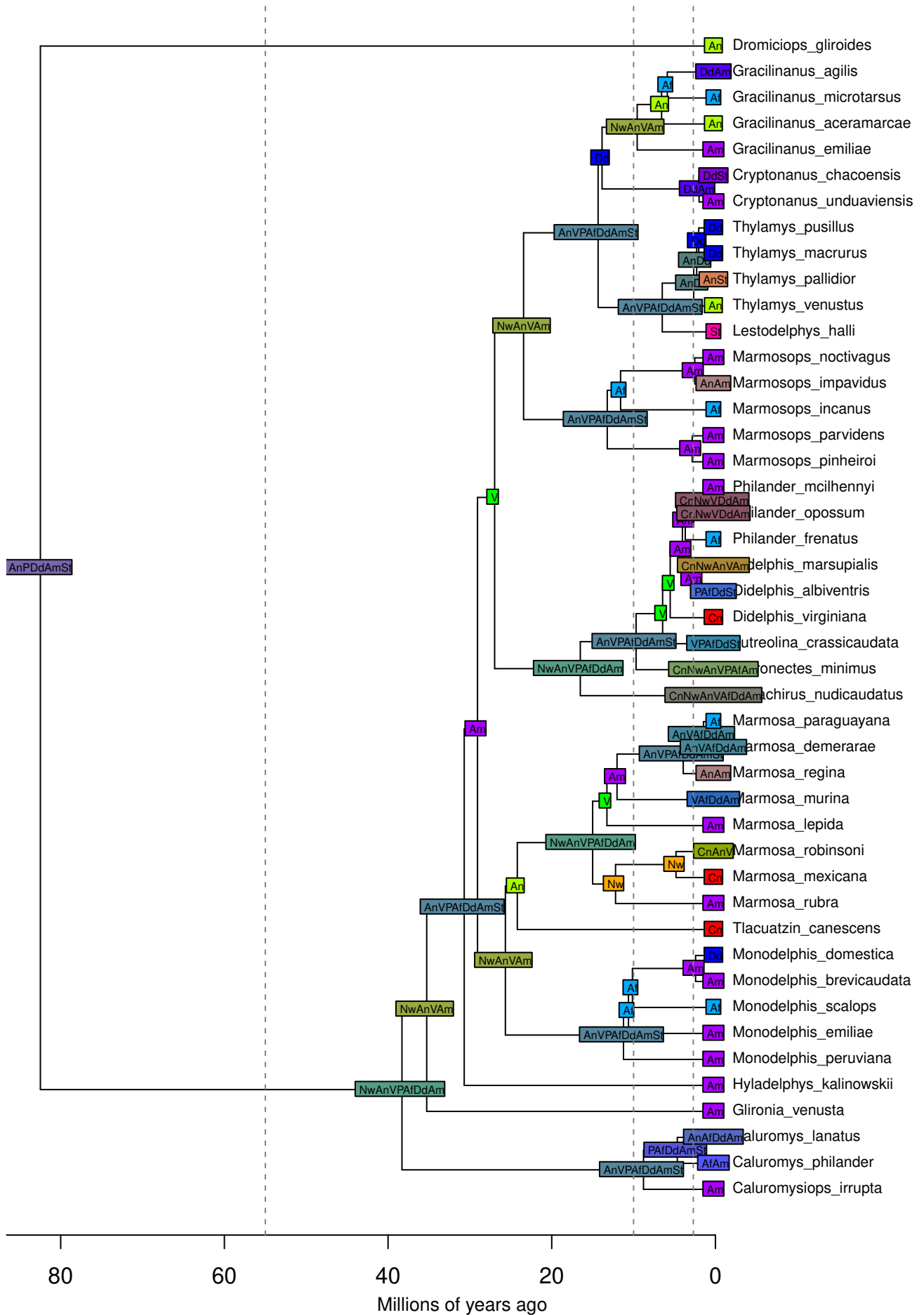
DEC M0 (w=1) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0322; e=0.0398; w=1; LnL=-220.44



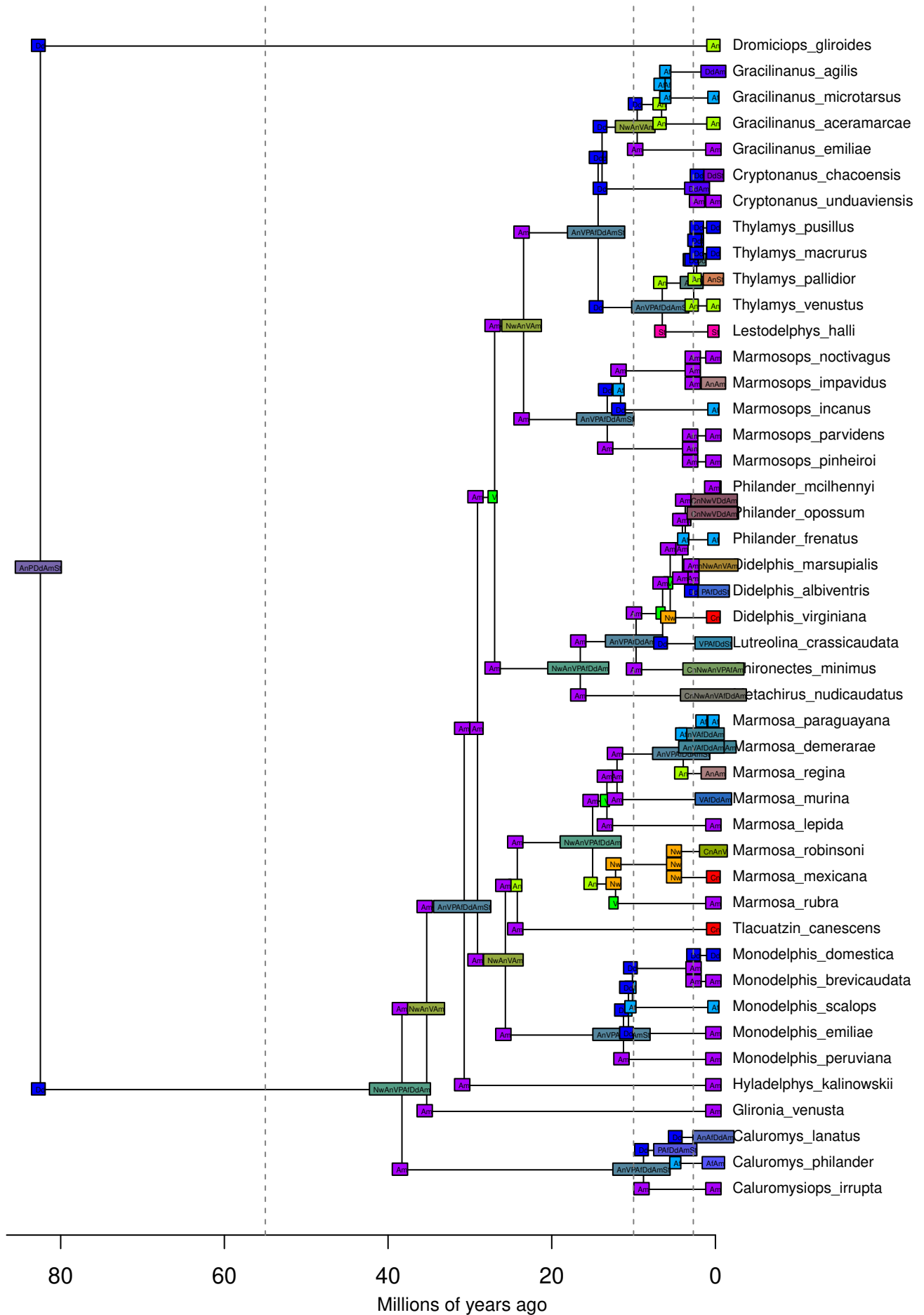
DEC M0 (w=1) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0322; e=0.0398; w=1; LnL=-220.44



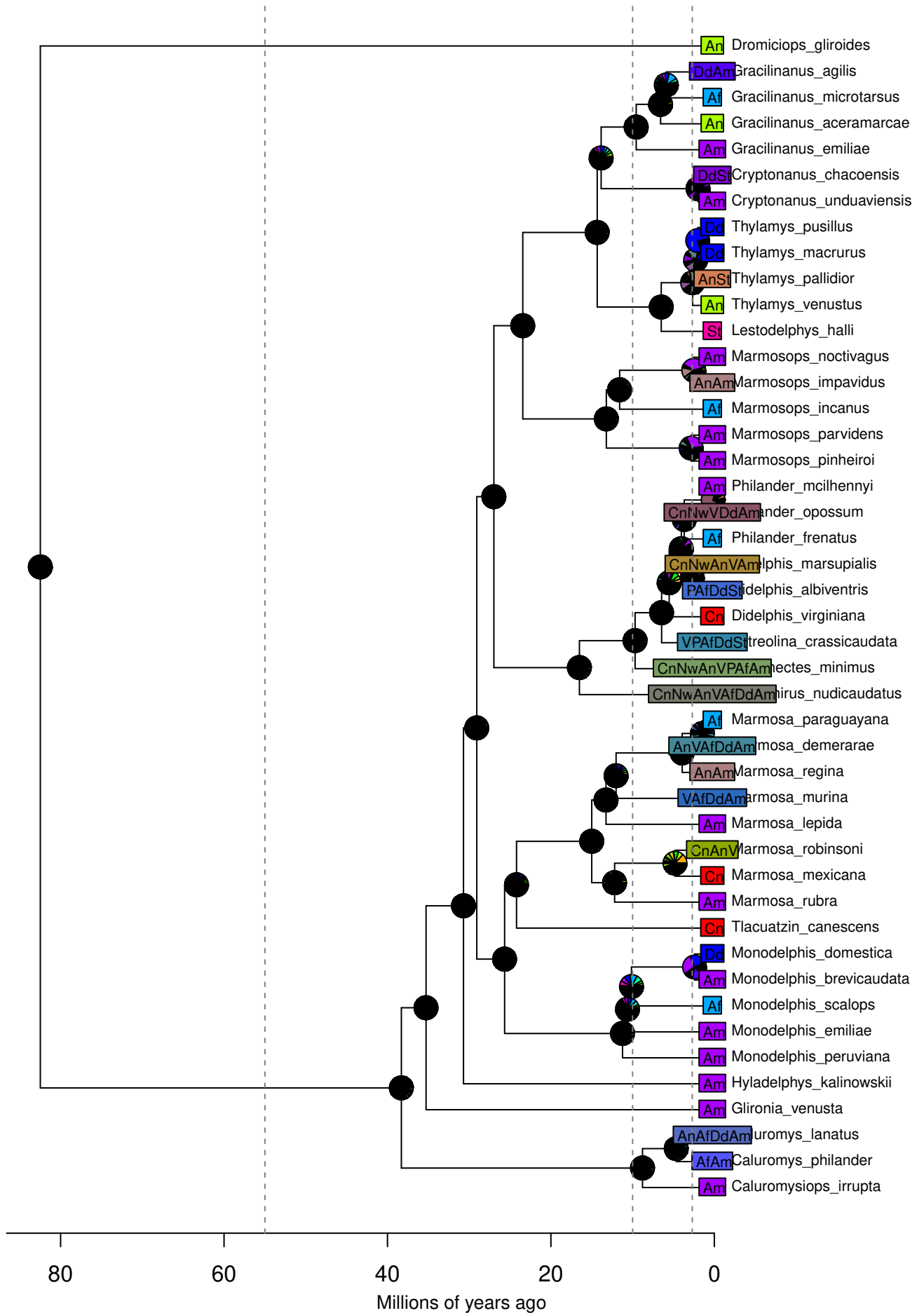
DEC M1 (w=free) Didelphidae
ancstates: global optim, 7 areas max. d=0.1986; e=0.2208; w=1.2208; LnL=-245.75



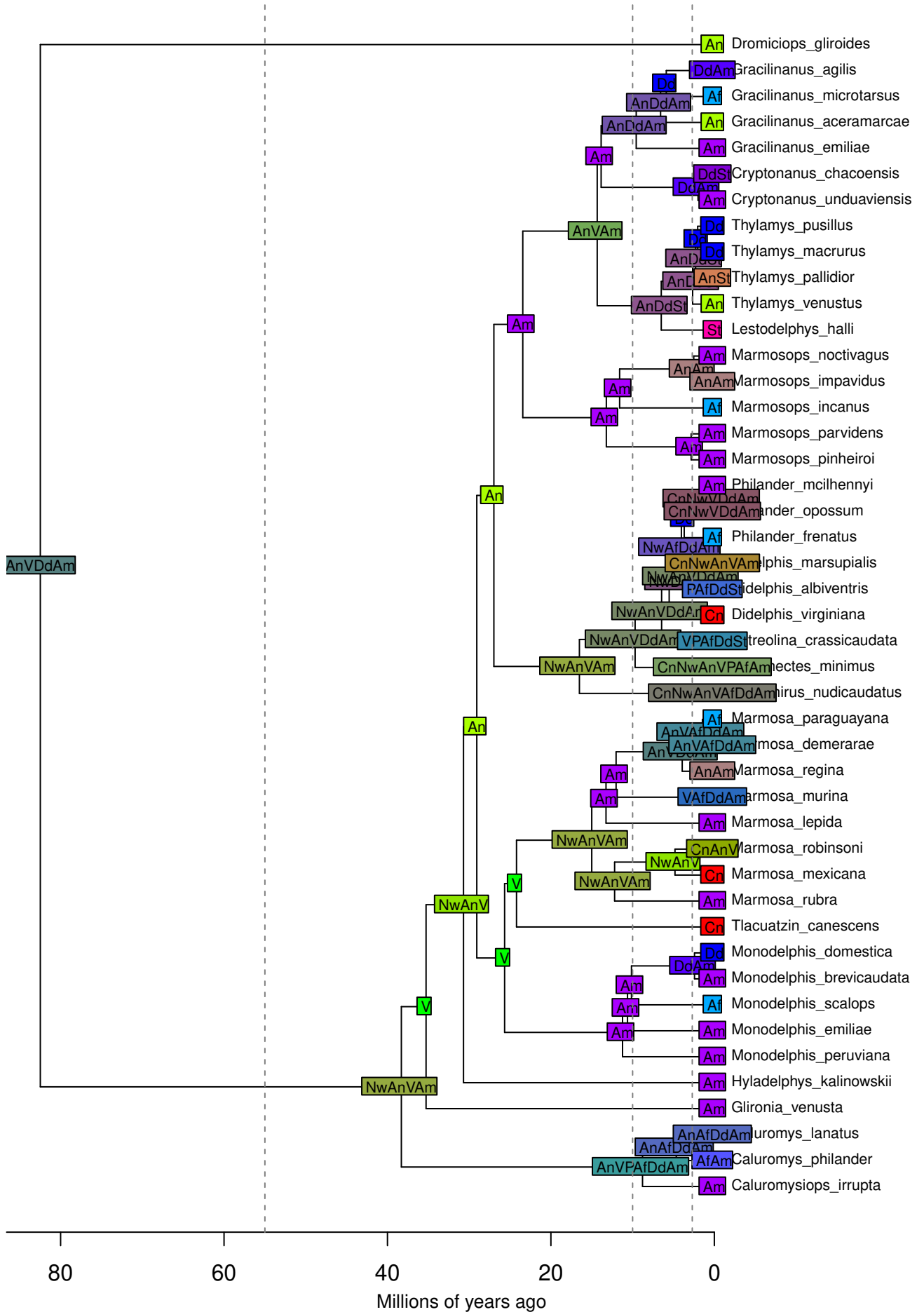
DEC M1 (w=free) Didelphidae
ancstates: global optim, 7 areas max. d=0.1986; e=0.2208; w=1.2208; LnL=-245.75



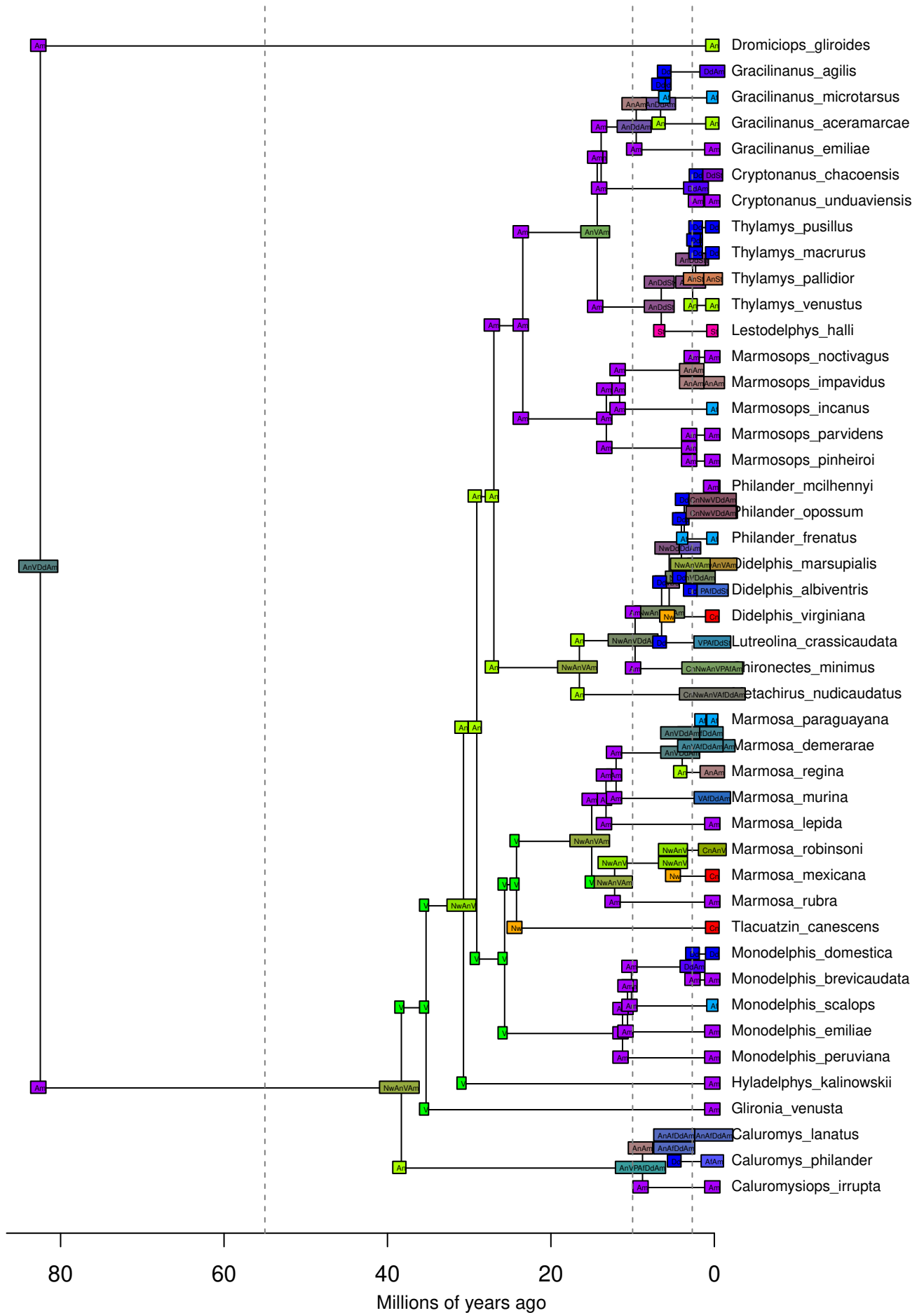
DEC M1 (w=free) Didelphidae
 ancstates: global optim, 7 areas max. d=0.1986; e=0.2208; w=1.2208; LnL=-245.75



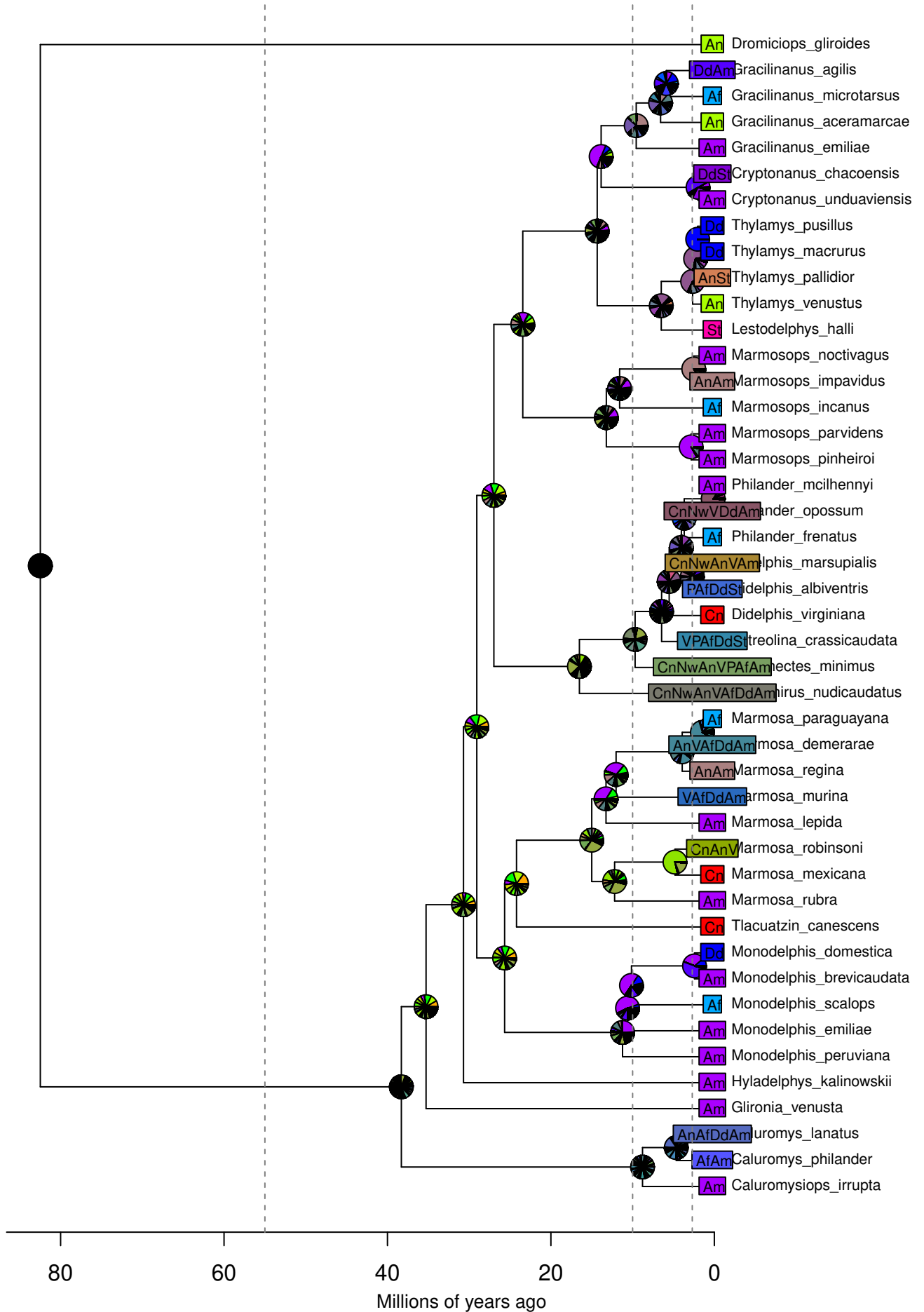
DEC M2 (harsh) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0975; e=0.0632; w=1; LnL=-258.51



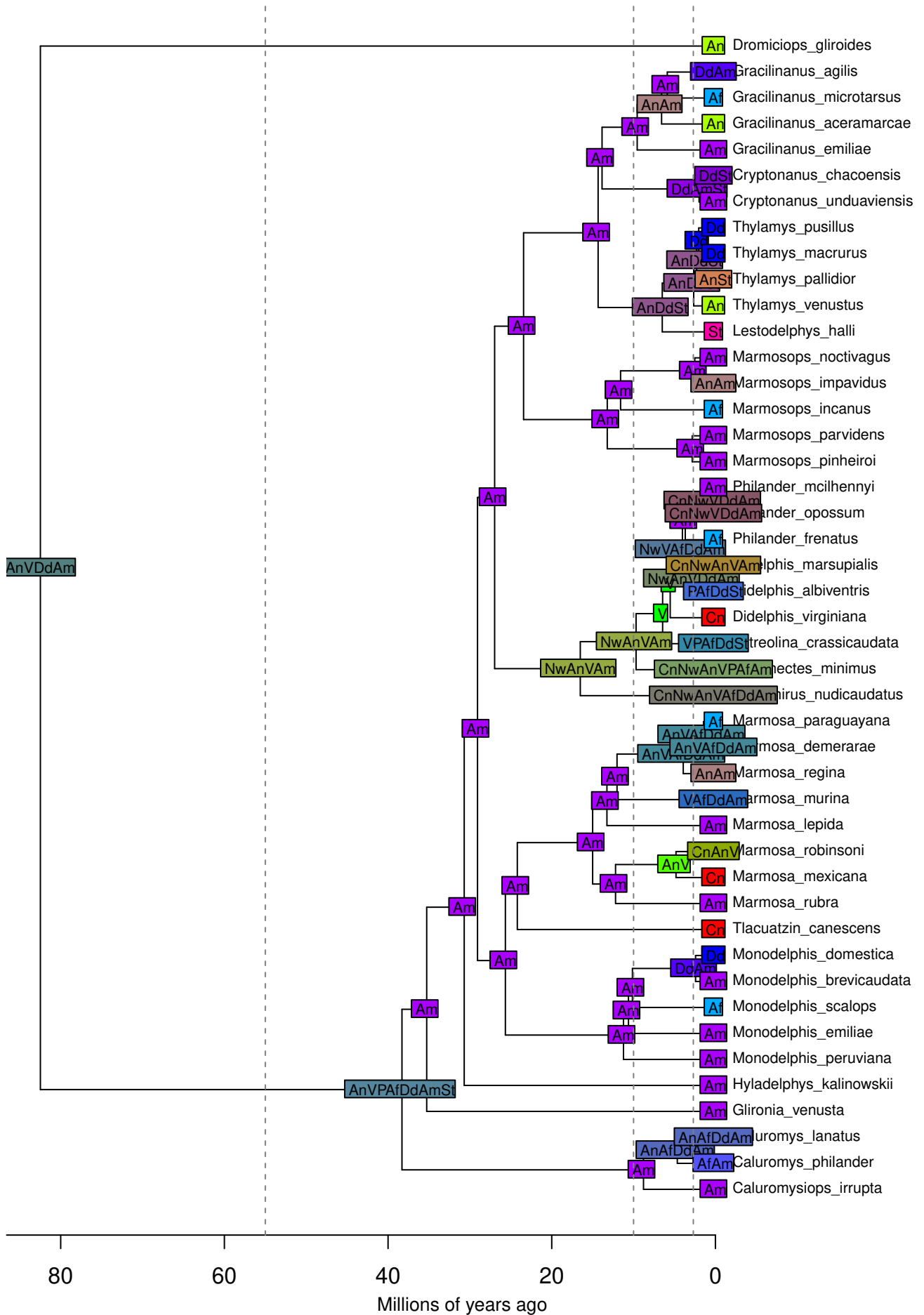
DEC M2 (harsh) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0975; e=0.0632; w=1; LnL=-258.51



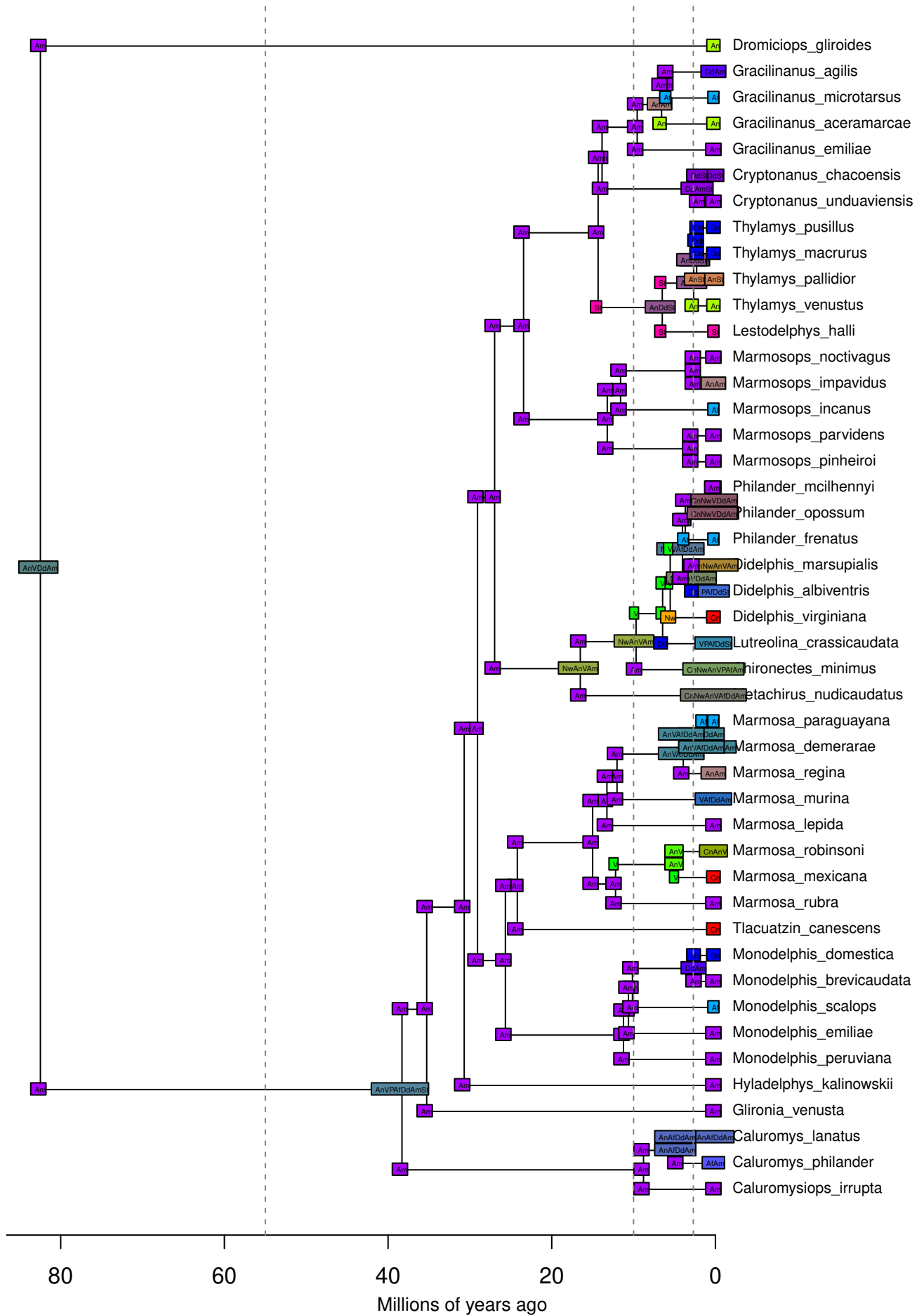
DEC M2 (harsh) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0975; e=0.0632; w=1; LnL=-258.51



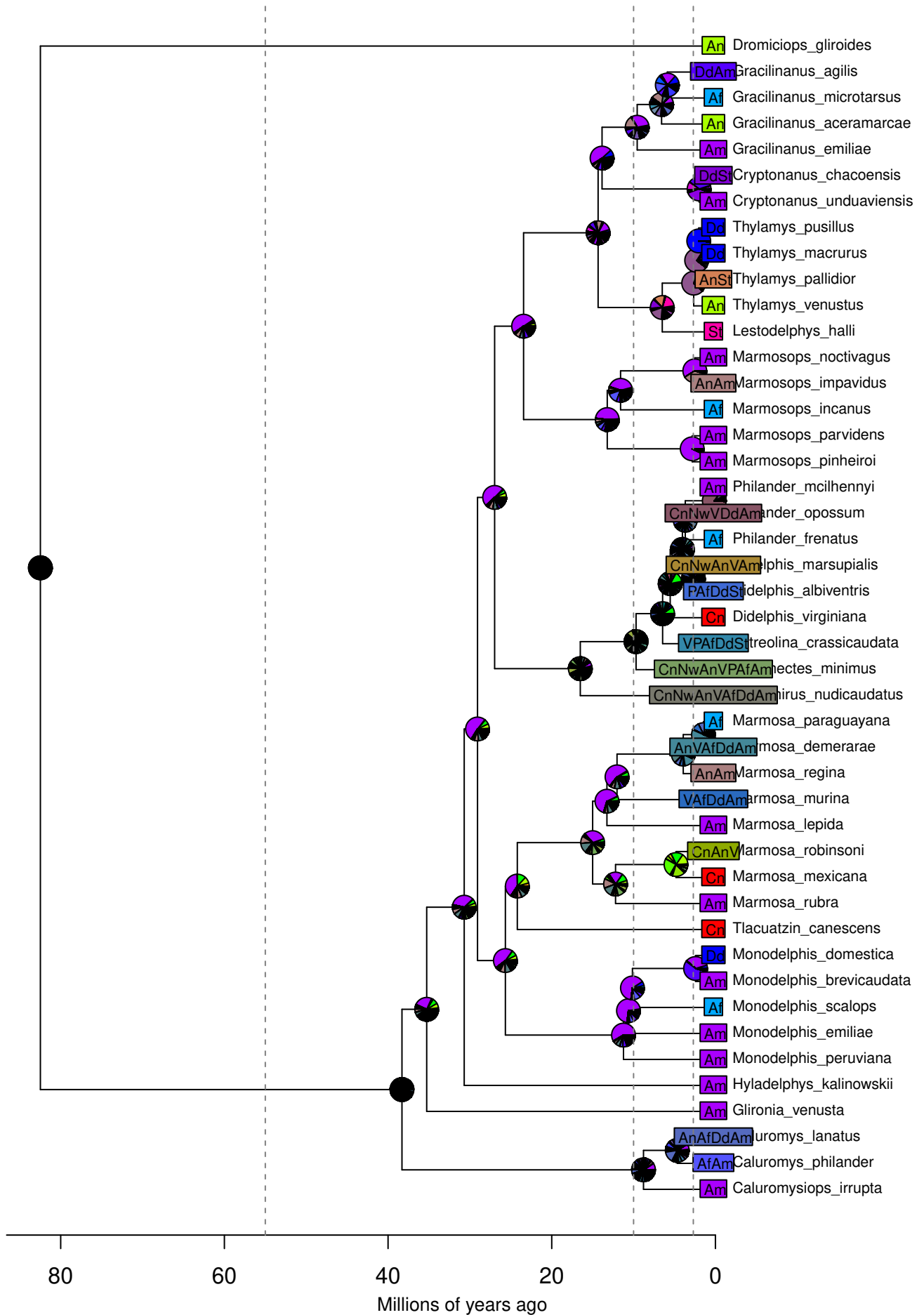
DEC M4 (not so harsh) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0475; e=0.0471; w=1; LnL=-222.53



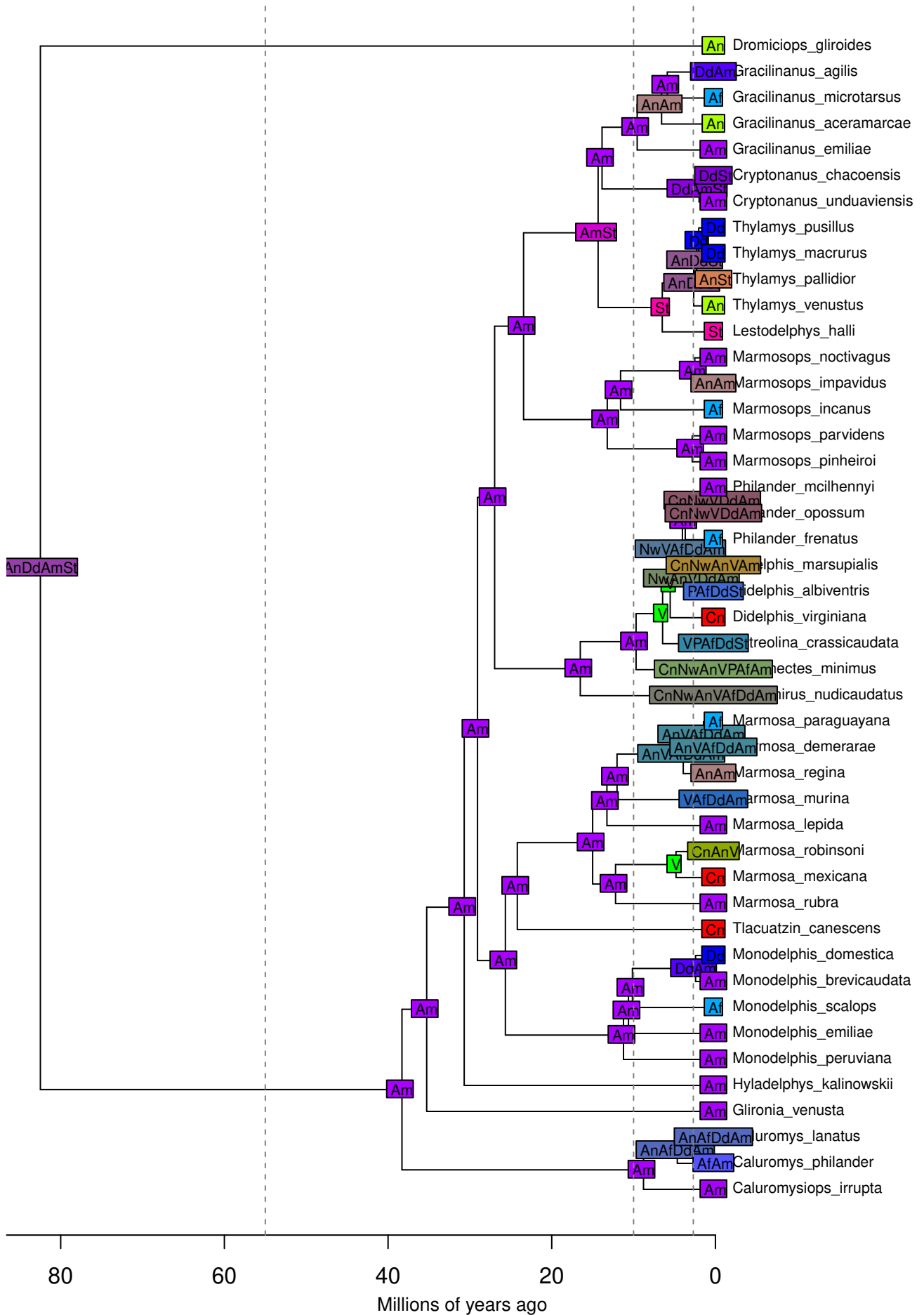
DEC M4 (not so harsh) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0475; e=0.0471; w=1; LnL=-222.53



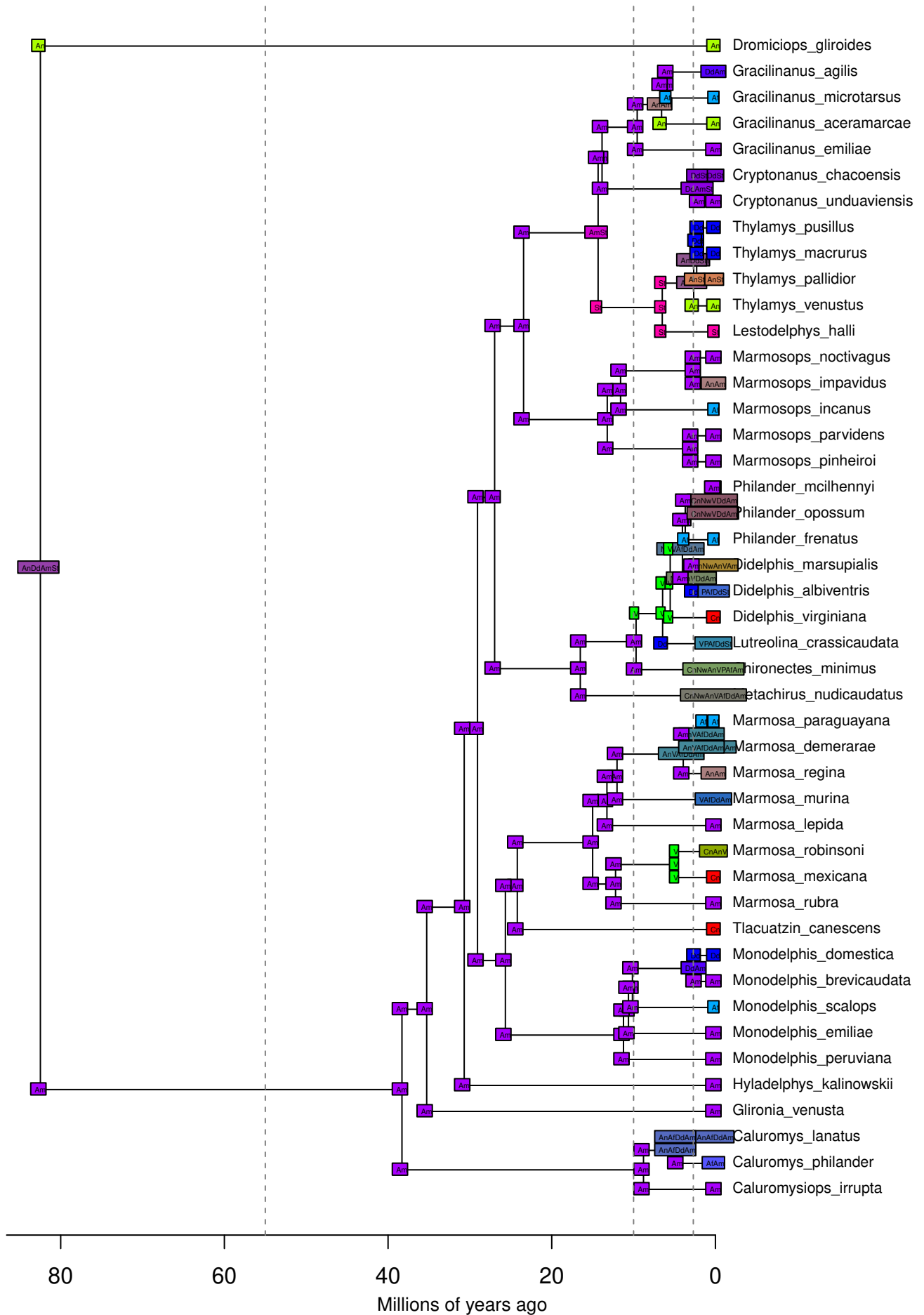
DEC M4 (not so harsh) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0475; e=0.0471; w=1; LnL=-222.53



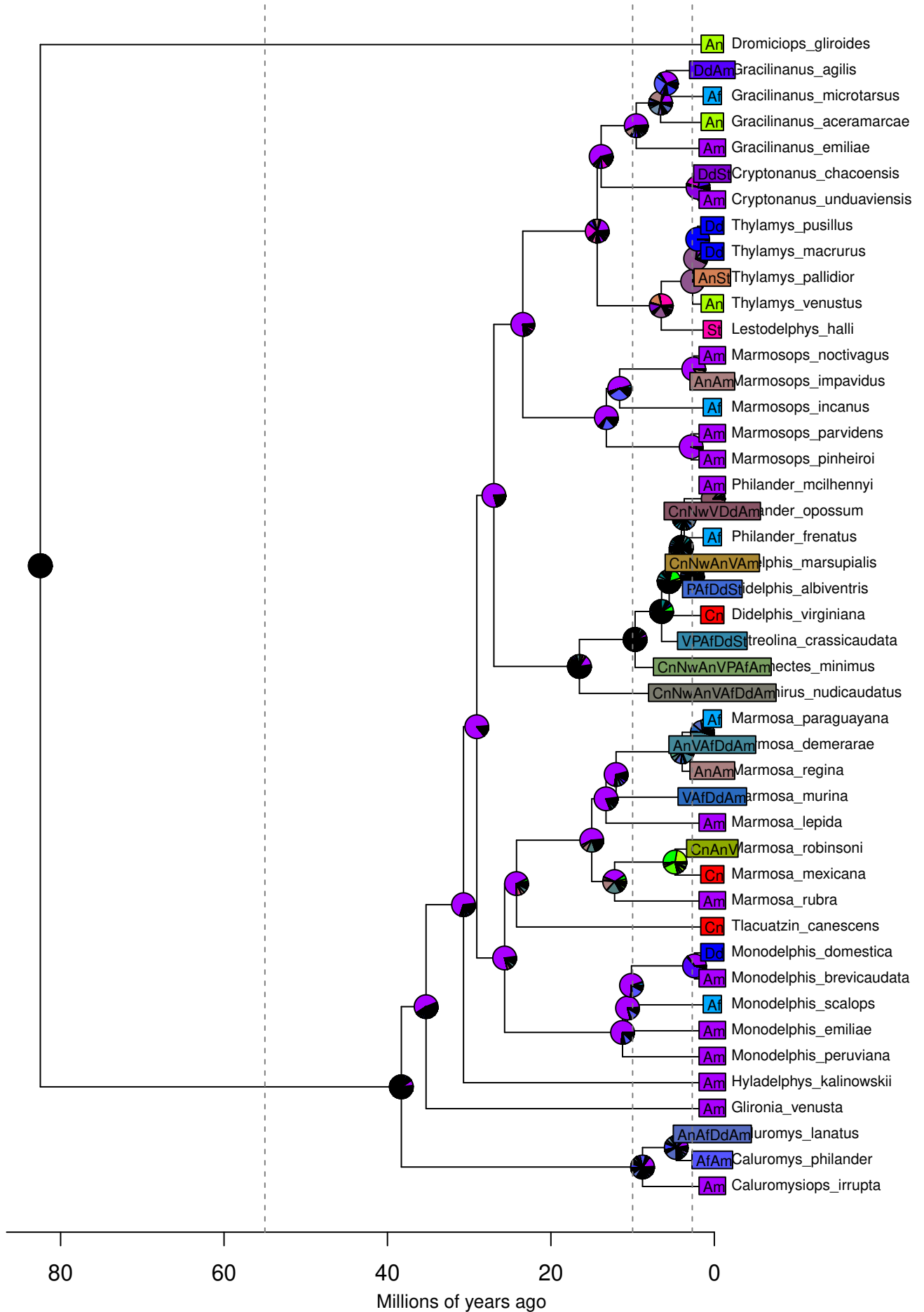
DEC M3 (relaxed) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0211; e=0.0364; w=1; LnL=-220.68



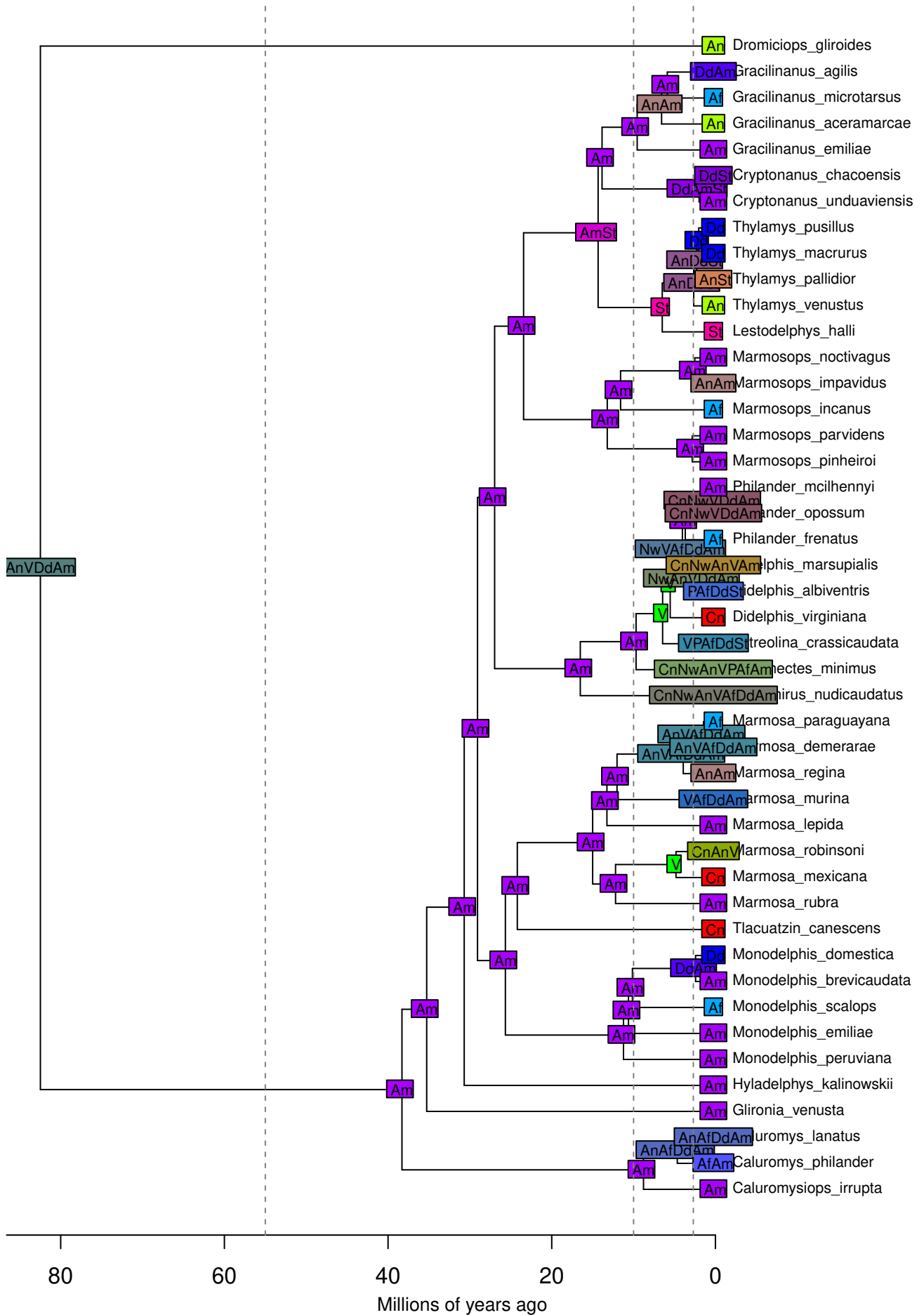
DEC M3 (relaxed) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0211; e=0.0364; w=1; LnL=-220.68



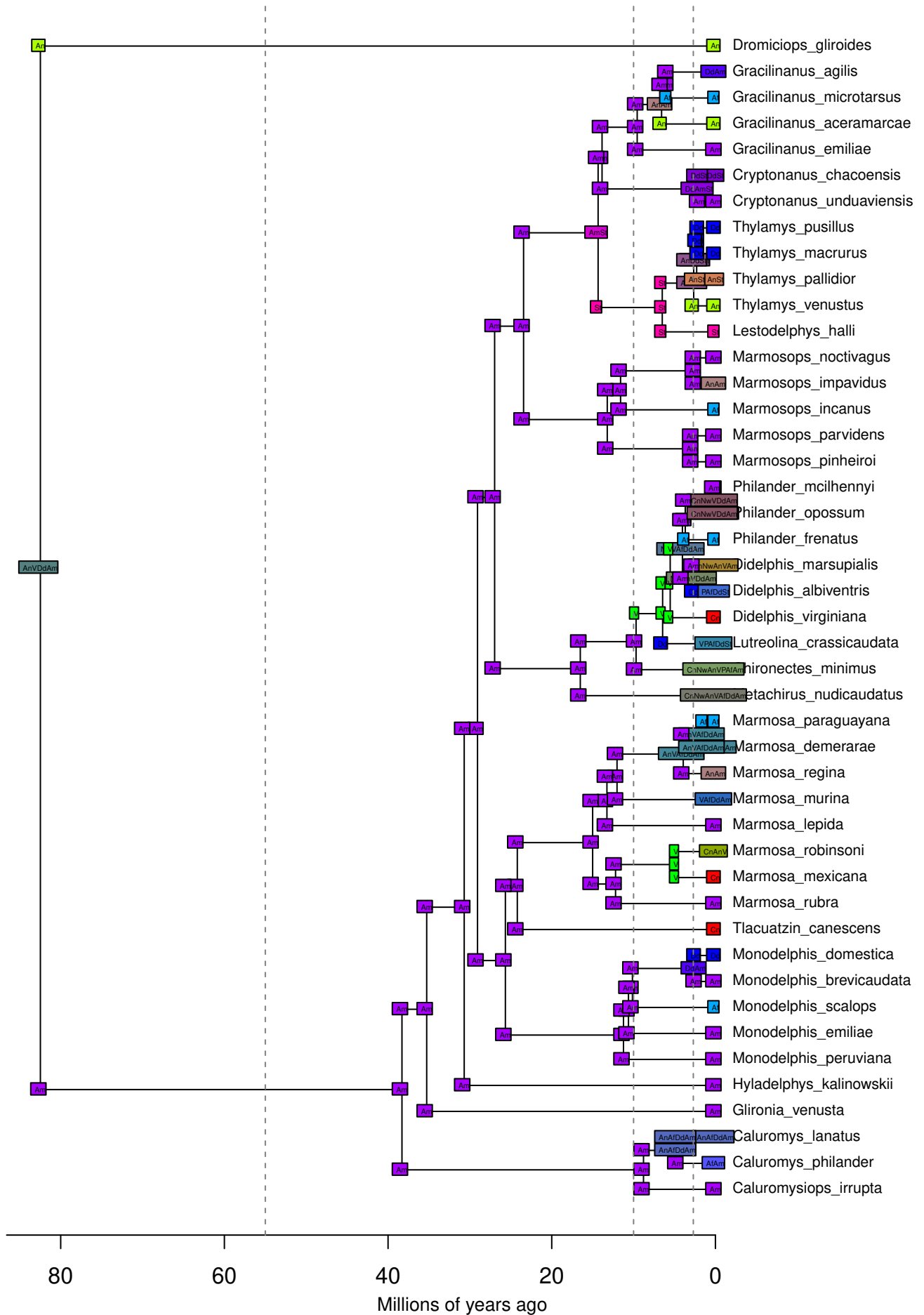
DEC M3 (relaxed) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0211; e=0.0364; w=1; LnL=-220.68



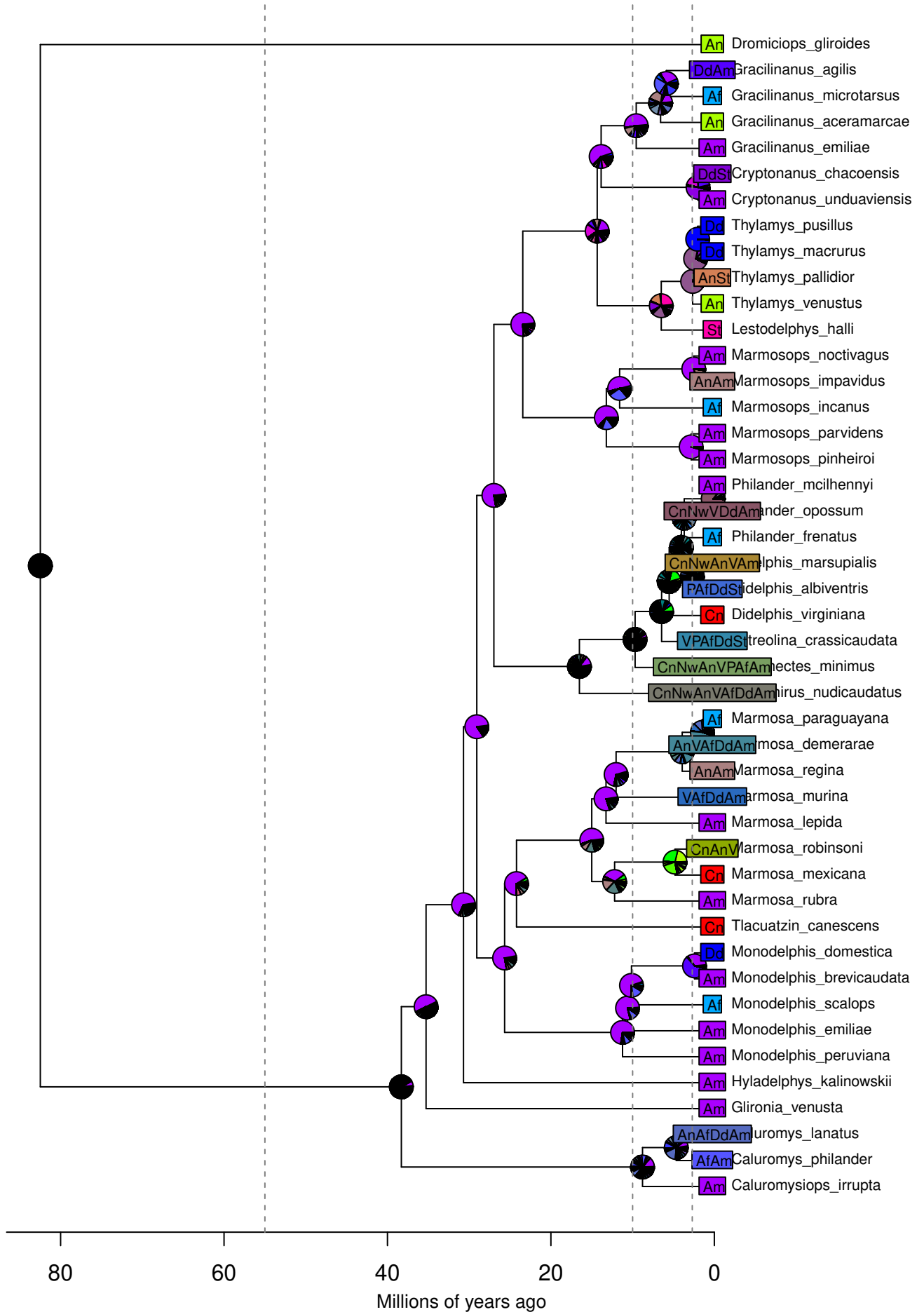
DEC M5 (not so relaxed) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0253; e=0.0374; w=1; LnL=-220.27



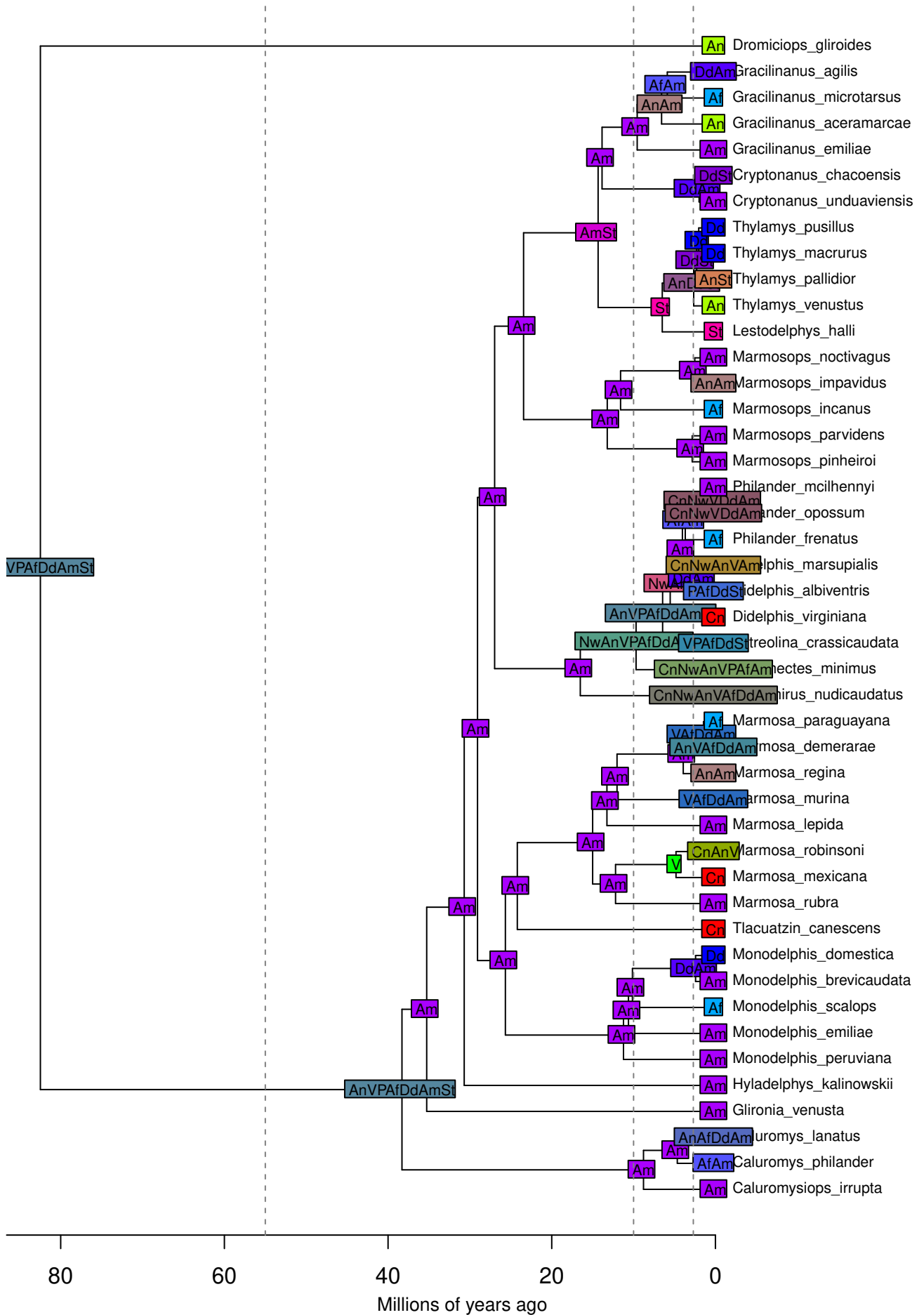
DEC M5 (not so relaxed) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0253; e=0.0374; w=1; LnL=-220.27



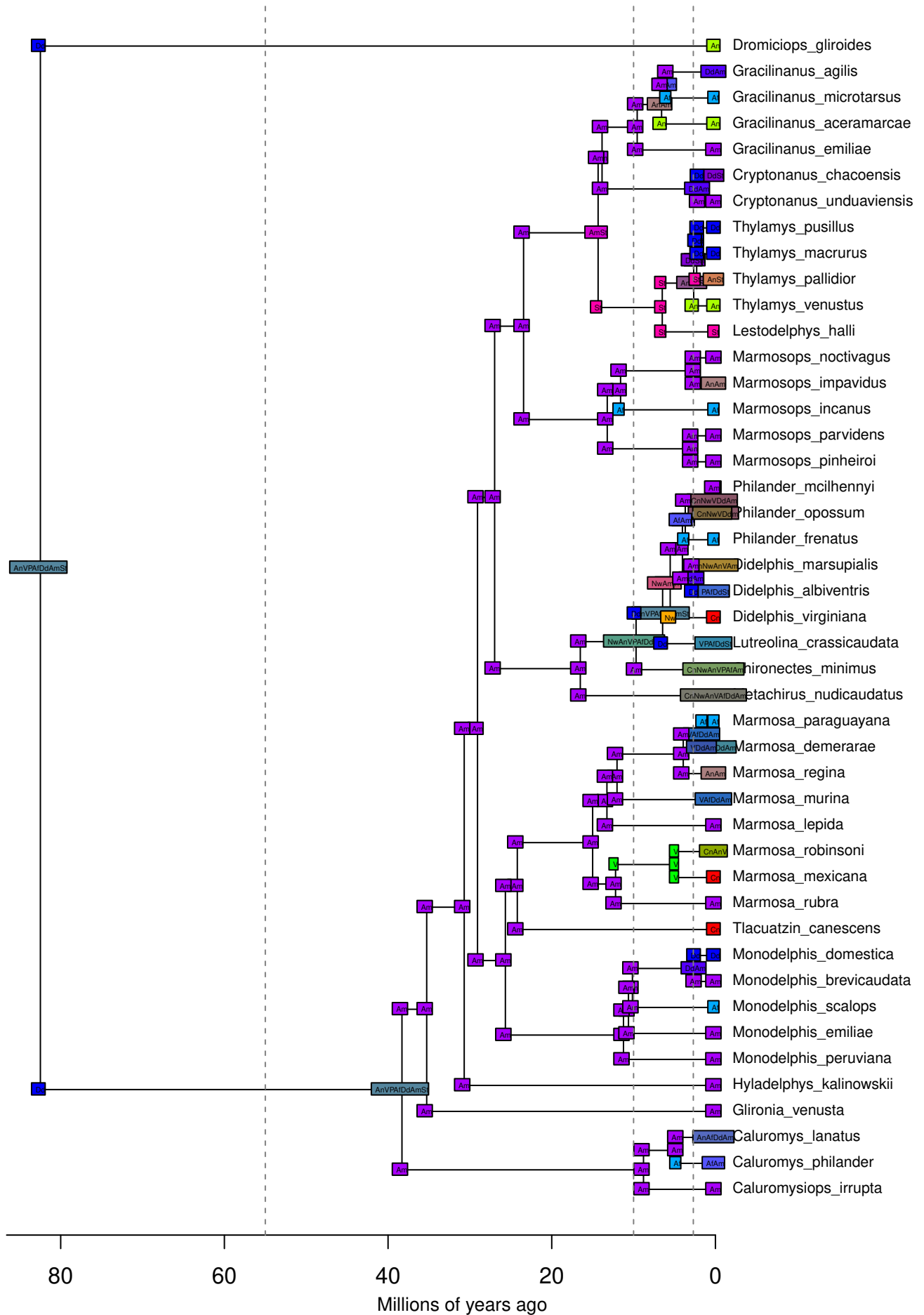
DEC M5 (not so relaxed) Didelphidae
 ancstates: global optim, 7 areas max. d=0.0253; e=0.0374; w=1; LnL=-220.27



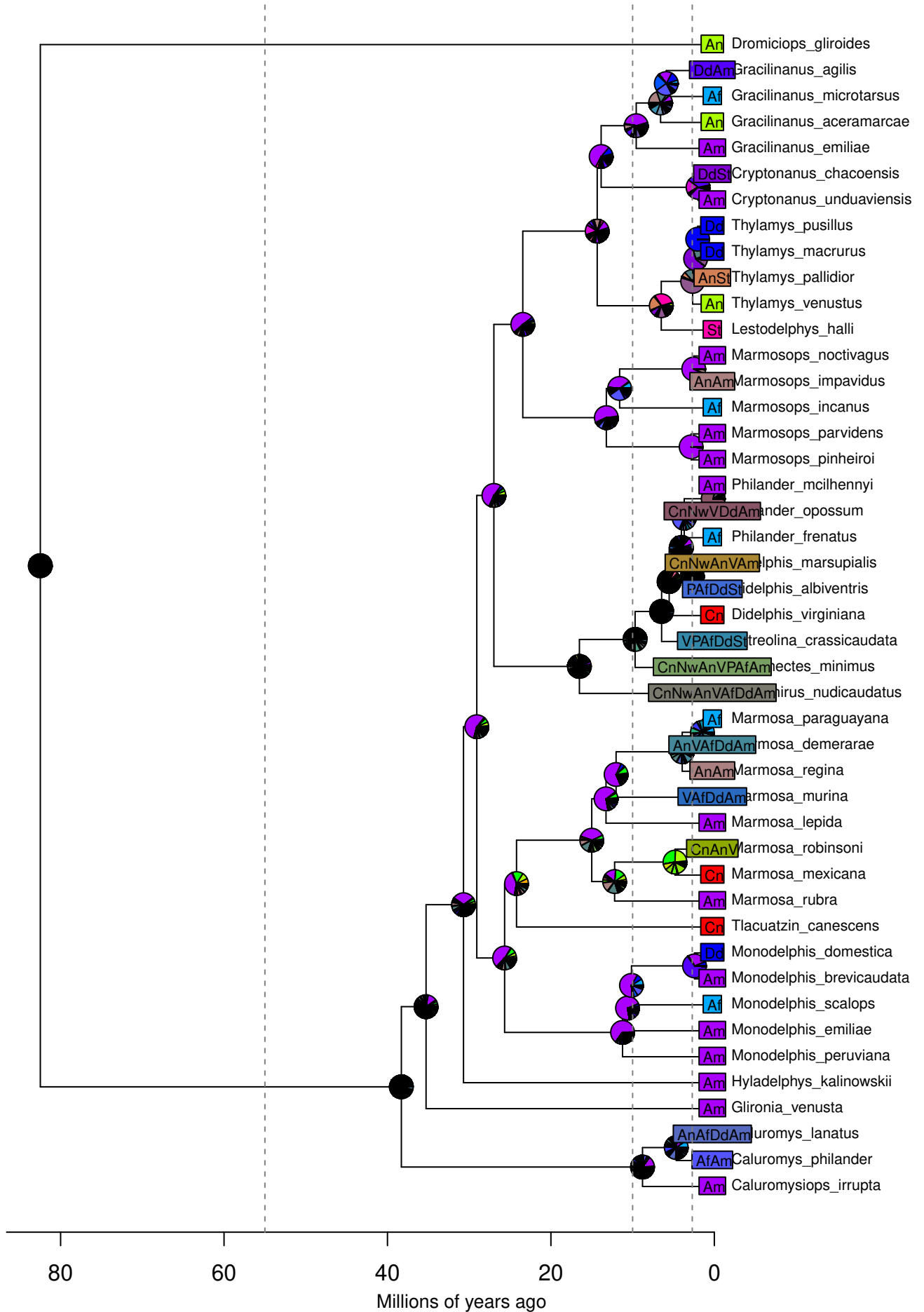
DIVALIKE M0 (w=1) Didelphidae
ancstates: global optim, 7 areas max. d=0.0421; e=0.0484; w=1; LnL=-227.54



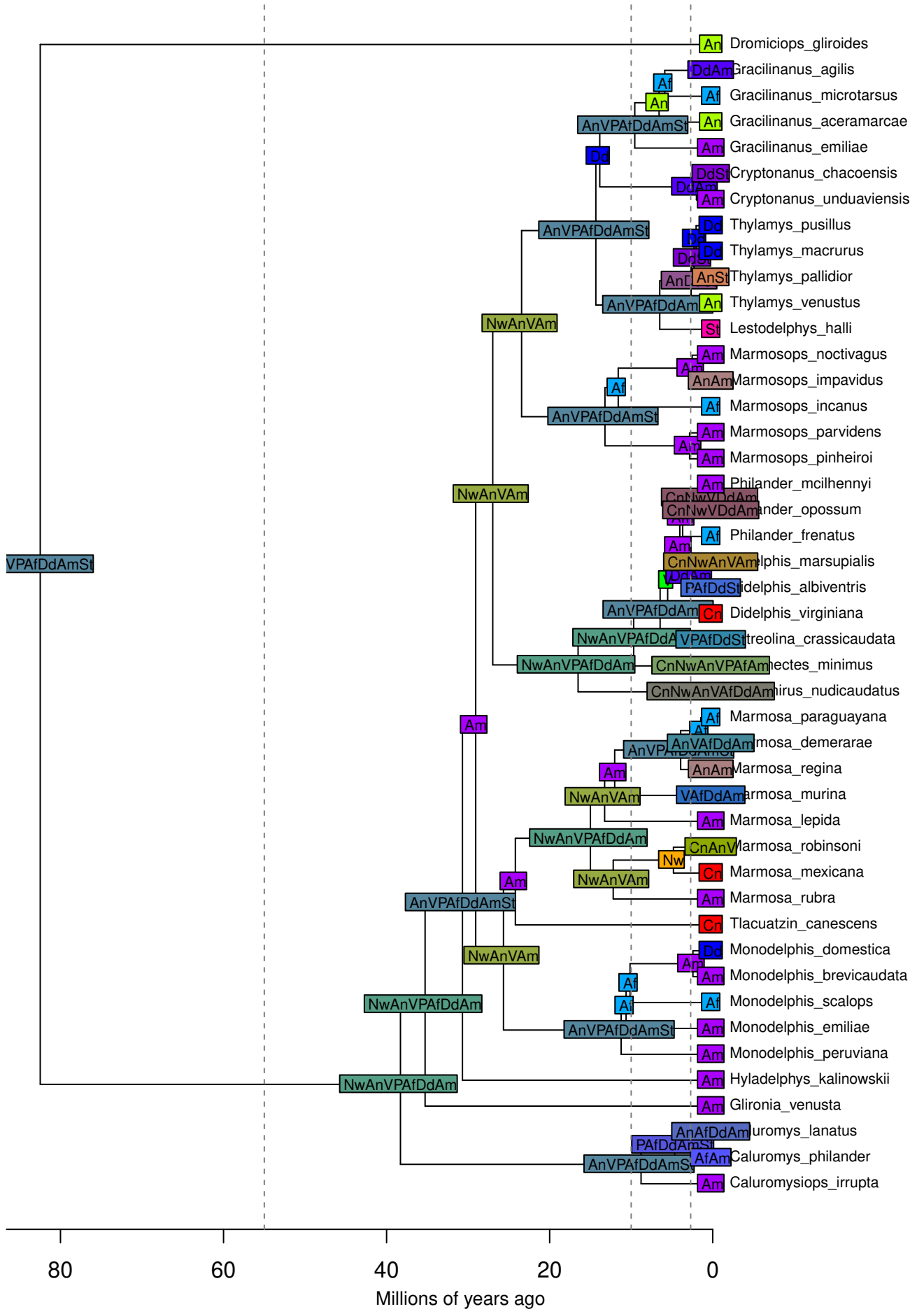
DIVALIKE M0 (w=1) Didelphidae
ancstates: global optim, 7 areas max. d=0.0421; e=0.0484; w=1; LnL=-227.54



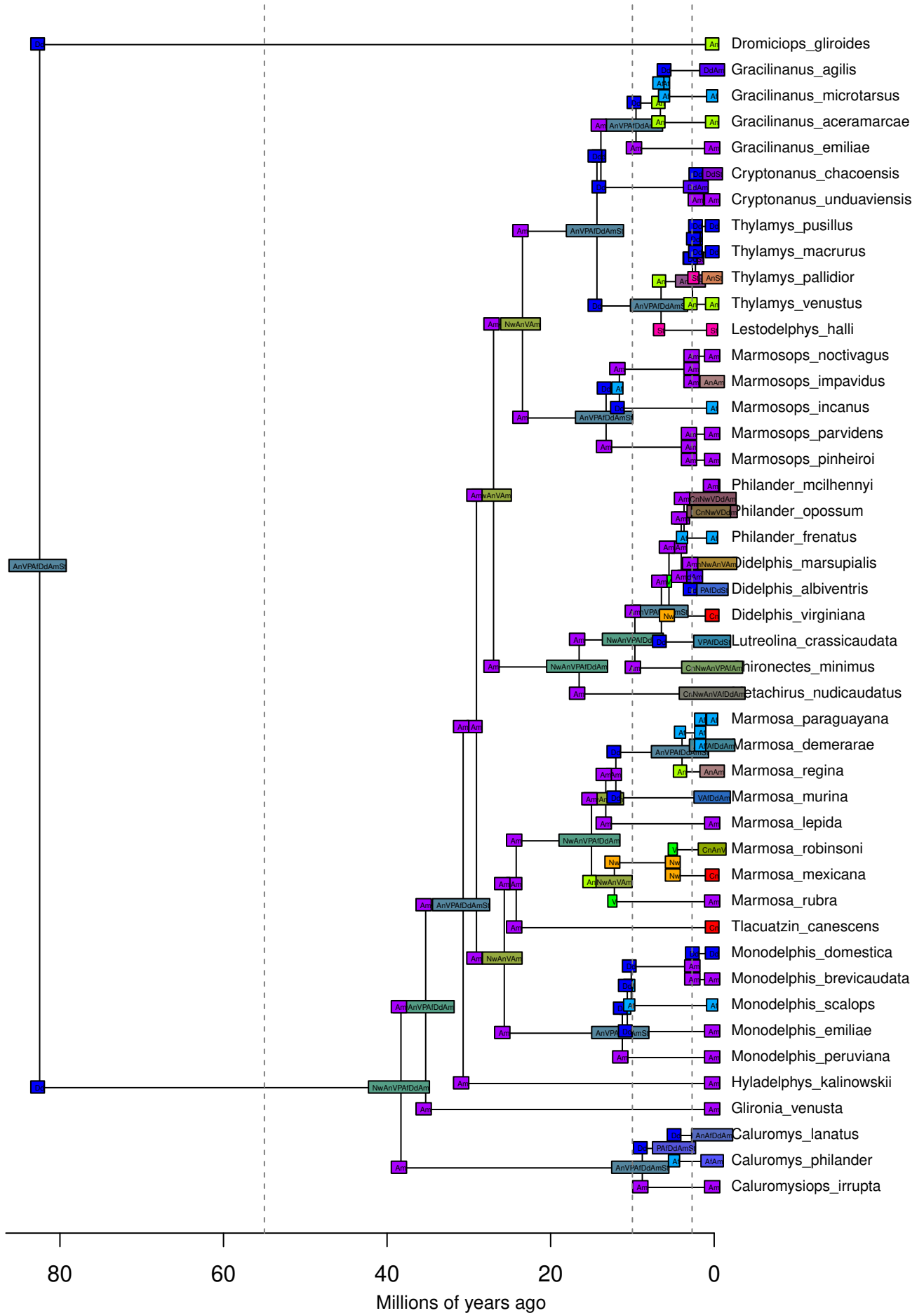
DIVALIKE M0 (w=1) Didelphidae
ancstates: global optim, 7 areas max. d=0.0421; e=0.0484; w=1; LnL=-227.54



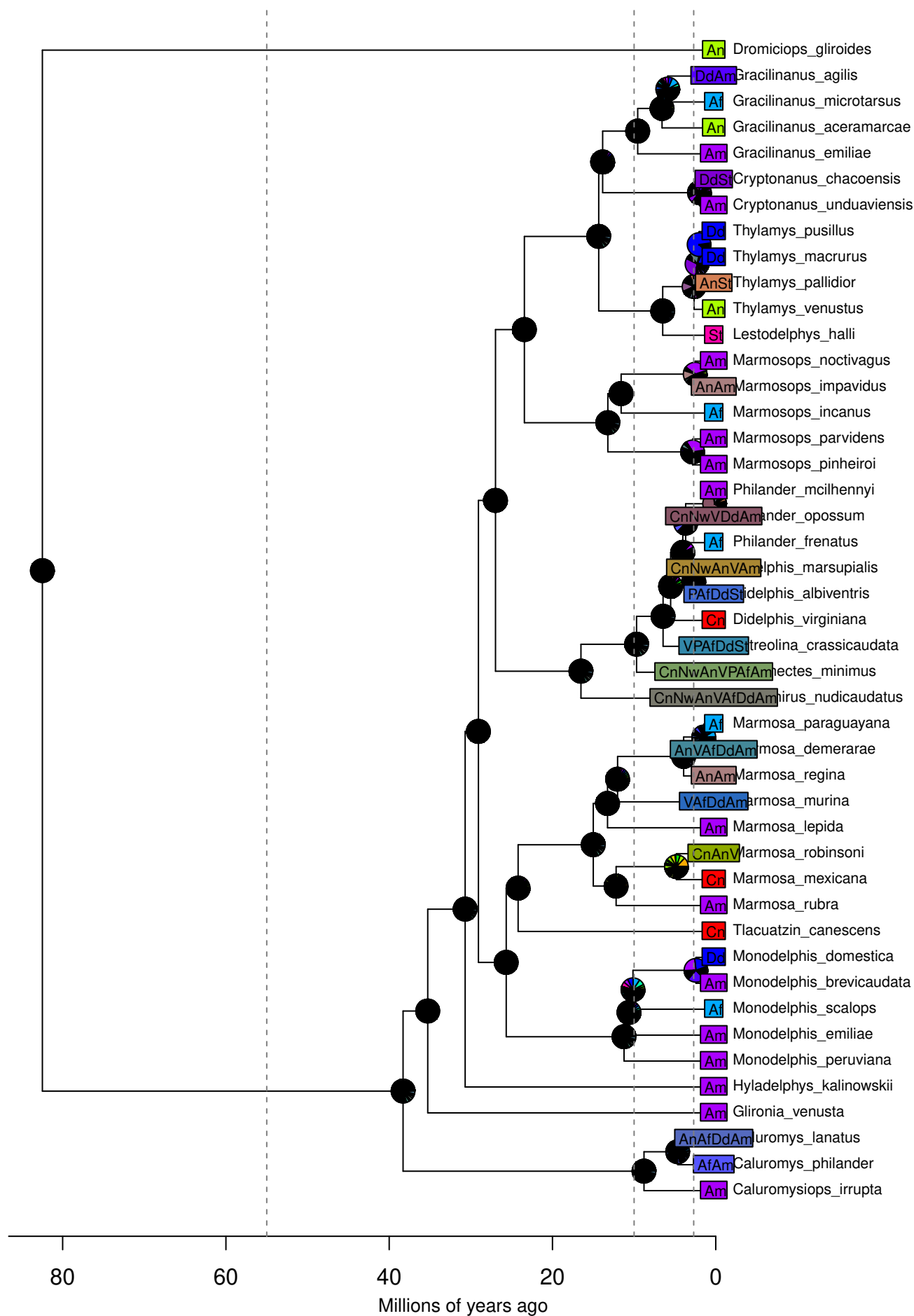
DIVALIKE M1 (w=free) Didelphidae
ancstates: global optim, 7 areas max. d=0.1986; e=0.2208; w=1.2208; LnL=-245.71



DIVALIKE M1 (w=free) Didelphidae
ancstates: global optim, 7 areas max. d=0.1986; e=0.2208; w=1.2208; LnL=-245.71



DIVALIKE M1 (w=free) Didelphidae
ancstates: global optim, 7 areas max. d=0.1986; e=0.2208; w=1.2208; LnL=-245.71



12. Credits of the photographs presented in Fig. 1

Gracilinanus agilis - author: Naturalselections; date: 29.08.2017

Didelphis albiventris - author: Alex Popovkin; date: 18.04.2009

Marmosa paraguayana - author: Renato Augusto Martins; date: 11.06.2015

Caluromys derbianus - author: Charles J. Sharp; date: 06.05.2019