Additional file, A1

Genus	No. of species	Geographic distribution	No. of species collected
Boswellia	ca. 24	AF	13 (AF)
Canarium	ca. 150	IAA(116), M(33), AF(1)	50 (21 MA; 1AF 28 IAA)
Dacryodes	ca. 68	NE(15), AF(15), IAA(37)	13 (2 NE; 5 AF; 6 IAA)
Garuga	ca. 4	IAA	1 (IAA)
Haplolobus	ca. 17	IAA	-
Pseudodacryodes	ca. 1	AF	-
Rosselia	ca. 1	IAA	-
Santiria	ca. 23	IAA (15), AF(8)	11 (IAA)
Scutinanthe	ca. 2	IAA	-
Trattinnickia	ca. 15	NE	2 (NE)
Triomma	ca. 1	IAA	1 (IAA)

Table 1: Currently recognized genera of Canarieae with the number of species and their geographic distributions indicated. The number of species collected for use in phylogenetic inference and their geographic provenance are also shown. AF = Africa, IAA = Malesia/Asia/Australia, MA = Madagascar, NE = Neotropics.

Additional file, A2: voucher & GenBank information

			GenBank accession numbers			
Taxon	Collection number	Herbarium	ETS	rps16	trnLF	rbcL
Canarium ntidifolium	4304	MO	KT698385	KT698405	KT698456	--
Canarium longistipulatum	D12950	NY	KT698383	KT698398	KT698450	KT698493
Canarium boivinii	D12962	NY	KT698379	KT698389	KT698440	--
Canarium elegans	D12963	NY	KT698380	KT698391	KT698443	KT698537
Canarium globosum	D12967	NY	KT698381	KT698394	KT698446	KT698516
Canarium pilicarpum	D13052	NY	KT698386	KT698410	KT698461	KT698500
Canarium pulchrebracteatum	D13061	NY	KT698387	KT698413	KT698464	KT698505
Canarium lamianum	D13063	NY	KT698382	KT698396	KT698448	KT698492
Canarium betamponae	D13073	NY	KT698378	KT698388	KT698439	KT698513
Canarium madagascariense	D13091	NY	KT698384	KT698399	--	--
Canarium ferrugineum	D13094	NY	KT698337	KT698392	KT698444	KT698514
Canarium compressum	D13097	NY	KT698335	--	KT698441	KT698495
Canarium galokense	D13101	NY	KT698338	KT698393	KT698445	KT698515
Canarium egregium	D13103	NY	KT698336	KT698390	KT698442	KT698533
Canarium indicum	D13374	NY	--	KT698395	KT698447	KT698491
Canarium spnov	D13847	NY	KT698358	KT698421	KT698472	KT698511
Santiria griffithii	D14266	NY	KT698371	--	KT698484	KT698530
Canarium ovatum	D14268	NY	KT698347	KT698408	KT698459	KT698498
Santiria sf7	D14275	NY	KT698374	KT698435	KT698487	--
Santiria tomentosa	D14281	NY	KT698376	KT698437	KT698489	KT698517
Dacryodes laxa	D14282	NY	KT698363	--	KT698476	KT698524
Dacryodes rugosa	D14284	NY	KT698366	KT698428	KT698479	KT698522
Dacryodes rostrata	D14288	NY	KT698364	KT698426	KT698477	KT698521
Triomma malaccensis	D14290	NY	KT698377	KT698438	KT698490	KT698518
Santiria conferta	D14291	NY	KT698368	KT698430	KT698481	KT698526
Dacryodes rubiginosa	D14293	NY	KT698365	KT698427	KT698478	KT698523
Canarium patentinervium	D14294	NY	KT698348	KT698409	KT698460	KT698503
Santiria grandiflora	D14299	NY	KT698370	KT698432	KT698483	--
Dacryodes costata	D14303	NY	KT698361	KT698424	KT698474	KT698535
Santiria apiculata	D14306	NY	KT698367	KT698429	KT698480	KT698527
Canarium rufum	D14307	NY	KT698352	KT698415	KT698466	KT698508
Santiria conferta	D14308	NY	KT698369	KT698431	KT698482	KT698525
Canarium sf13	D14317	NY	KT698357	KT698420	KT698471	KT698512
Canarium sf10	D14321	NY	KT698356	KT698419	KT698470	KT698509
Canarium sf8	D14326	NY	KT698355	KT698418	KT698469	KT698510
Canarium sarawakanum	D14328	NY	KT698353	KT698416	KT698467	KT698532
Santiria oblongifolia	D14347	NY	KT698372	KT698433	KT698485	KT698529
Canarium pilosum	D14360	NY	KT698349	KT698411	KT698462	KT698502
Dacryodes kingii	D14401	NY	KT698362	KT698425	KT698475	KT698520
Santiria rubiginosa	D14409	NY	KT698373	KT698434	KT698486	KT698528
Canarium microcarpum	D14412	NY	KT698340	KT698400	KT698451	--
Canarium multiflorum	D14477	NY	KT698341	KT698401	KT698452	KT698494
Canarium multinervis	D14482	NY	KT698344	KT698404	KT698455	KT698496
Canarium multiflorum	D14485	NY	KT698342	KT698402	KT698453	KT698536
Canarium velutinifolium	D14504	NY	KT698360	KT698423	KT698473	KT698534
Canarium multiflorum	D14513	NY	KT698343	KT698403	KT698454	KT698497
Canarium pulchrebracteatum	D14528	NY	KT698351	KT698414	KT698465	KT698504
Canarium planifolium	SF153	NY	KT698350	KT698412	KT698463	KT698506
Canarium scholasticum	SF197	NY	KT698354	KT698417	KT698468	KT698507
Canarium spnov	SF211	NY	KT698359	KT698422	--	KT698519
Canarium obtusifolium	SF224	NY	KT698345	KT698406	KT698457	KT698501
Canarium odontophyllum	SFC1988	NY	KT698346	KT698407	KT698458	KT698499
Santiria sf9	SFC1991	NY	KT698375	KT698436	KT698488	KT698531
Canarium latistipulatum	SFC1995	NY	KT698339	KT698397	KT698449	KT698538

Table 1. List of taxa collected by the authors and examined in this study, collection numbers, herbaria where collections are deposited (NY: New York Botanical Garden; MO: Missouri Botanical Garden), and GenBank accession numbers.

Additional file, A3: GenBank information

Taxon	NCBI gi number ETS	rps16	trnLF	rbcL
Boswellia ameero	224459566	224459585	--	--
Boswellia elongata	224459567	224459586	--	--
Boswellia frereana	37677988	36939077	60116052	--
Boswellia nana	224459570	224459588	--	--
Boswellia neglecta	37677993	224459589	313756119	313755989
Boswellia ogadensis	224459572	224459590	--	--
Boswellia ovalifoliolata	224459573	224459591	--	--
Boswellia pirottae	224459574	224459592	--	--
Boswellia popoviana	224459575	224459593	--	--
Boswellia rivae	224459576	224459594	--	--
Boswellia sacra	37677996	17385396	313756120	313755991
Boswellia serrata	224459578	224459596	--	--
Boswellia socotrana	224459579	224459597	23664289	--
Canarium album	55613449	55613410	239949635	239949672
Canarium balansae	239949630	239949664	239949636	239949674
Canarium bengalense	55613450	55613411	239949637	239949676
Canarium decumanum	55613451	55613412	239949638	239949678
Canarium harveyi	55613452	55613413	239949639	239949682
Canarium littorale	37678020	36939086	239949641	239949686
Canarium muelleri	--	--	313756127	313756005
Canarium oleiferum	239949631	239949665	239949643	239949690
Canarium schweinfurthii	--	--	189231869	189231917
Canarium strictum	55613456	55613415	239949646	239949696
Canarium tramdenum	55613457	55613416	239949647	239949698
Canarium vulgare	37678027	36939088	239949648	239949700
Canarium whitei	239949632	239949666	239949649	239949702
Canarium zeylanicum	37678030	36939089	239949650	239949704
Dacryodes buettneri	37678044	36939103	313756132	313756013
Dacryodes cuspidata	--	--	313756133	313756015
Dacryodes edulis	--	36939104	313756134	313756017
Dacryodes excelsa	--	--	60116062	313756019
Dacryodes igaganga	--	--	189231876	189231931
Dacryodes klaineana	37678047	36939105	295042073	295042022
Dacryodes macrophylla	--	--	295042074	189231935
Garuga floribunda	224459580	17385391	313756137	313756025
Santiria apiculata	37678033	36939109	239949653	239949708
Trattinnickia demerarae			313756143	224382413
Trattinnickia glaziovii	224459581	239949669	239949656	239949712
Toxicodendron radicans	264665338	60116185	60116093	7261039
Toxicodendron verniciflu	264665372	60116186	264665535	4624857
Aucoumea klaineana	224459565	224459584	313756118	313755987
Commiphora edulis	61677155	36939091	313756128	326394081
Commiphora falcata	61677159	61677231	313756129	313756007
Commiphora schimperi	37677980	36939097	313756130	326394095
Beiselia mexicana	224459583	36939076	313756117	11967698
Bursera biflora	29421897	36939080	313756121	313755993
Bursera cuneata	29421915	36939082	313756122	313755995
Bursera hindsiana	37677953	36939083	313756123	313755997
Bursera lancifolia	35287960	35299318	313756124	313755999
Bursera microphylla	35287967	35299321	313756125	313756001
Bursera simaruba	299151256	35299325	313756126	384589510
Bursera tecomaca	29421928	35299312	239949634	239949670
Crepidospermum goudoti	37678004	364886106	364886146	313756011
Tetragastris altissima	37678054	36939111	313756142	224382411
Tetragastris panamensis	62287819	364886089	364886152	263042445
Protium apiculatum	364885928	364886092	364886150	387767761
Protium copal	37678008	36939106	313756138	313756027
Protium guianense	37678012	36939107	313756139	313756029
Protium madagascariens	37678014	364886107	364886147	239949706
Protium sagotianum	364885930	364886102	364886151	224382401
Protium subserratum	62287816	364886100	364886142	387768031

Table 1. List of taxa obtained from GenBank for use in the molecular phylogeny with NCBI gi numbers.

Additional file, A4: biogeographic models

Ancestral Area time slice justification:

These time slices broadly encompass major paleo-ecological and climatic regimes that most likely influenced the biogeographic history of *Canarium* in Madagascar.

Paleocene-Eocene (61.7-33.9 Ma):

During this geologic era, much of the earth was warm and moist, facilitating cosmopolitan distributions for many clades confined to the tropics today (Morely 2003). Marine currents favored dispersal from Africa to Madagascar, and much of SE Asia, including the Indo-Australian Archipelago (IAA) had not yet formed (von der Heydt & Dijkstra 2006; Ali & Huber 2010). Additionally, India had not yet collided with mainland Asia and remained relatively close to Madagascar, also facilitating dispersal (Buerki et al. 2013). Madagascar transitions from a moist temperate climate to an arid one (Wells 2003).

Oligocene- early Miocene (33.9-16 Ma):

During this geologic era, the boreotropics began contracting, and tropical clades either had to move towards warmer latitudes or adapt to temperate climates (Morely 2003). India drifted further from Madagascar, dispersal from Africa was still possible but becoming less likely via marine pathways, the IAA and associated westward moving warm surface currents began forming (von der Heydt & Dijkstra 2006; Ali & Huber 2010; Buerki et al. 2013). Additionally, this geologic era marks the advent of Madagascar's moist forest biome (Wells 2003).

Mid-Miocene-Present (16 Ma – Present):

During this geologic era, the eastern Tethys seaway closed drastically altering marine currents between Africa and Eurasia (Kennett 1985), the IAA and associated fast moving westward surface currents had formed (running almost directly between the IAA and Madagascar), monsoon pathways had formed (figure 3; Dewar & Richard 2007), India had collided with Eurasia, and marine currents between Africa and Madagascar were no longer conducive to dispersal from the mainland (Ali & Huber 2010; Buerki et al. 2013).

TERRESTRIAL MODEL

16-present

	MA	IAA	LA	IN	SP	AF	NE
MA	1	0	0	0.05	0	1	0
IAA	0	1	1	1	1	0	0
LA	0	1	1	1	0	1	1

IN	0.05	1	1	1	0	1	0
SP	0	1	0	0	1	0	0
AF	1	0	1	1	0	1	0
NE	0	0	1	0	0	0	1

33.9-16

	MA	**IAA**	**LA**	**IN**	**SP**	**AF**	**NE**
MA	1	0	0	1	0	1	0
IAA	0	1	1	1	1	0	0
LA	0	1	1	1	0	1	0
IN	1	1	1	1	0	1	0
SP	0	1	0	0	1	0	0
AF	1	0	1	1	0	1	0
NE	0	0	0	0	0	0	1

61.7-33.9

	MA	**IAA**	**LA**	**IN**	**SP**	**AF**	**NE**
MA	1	0	0	1	0	1	0
IAA	0	1	1	1	0	0	0
LA	0	1	1	1	0	1	0
IN	1	1	1	1	0	1	0
SP	0	0	0	0	1	0	0
AF	1	0	1	1	0	1	0
NE	0	0	0	0	0	0	1

Table 1: Terrestrial model for seven biogeographic areas: Neotropics (NE); Africa (AF); Sundaland and Indochina (IAA); India (IN); Laurasia (LA); Madagascar (MA); and South Pacific (including New Caledonia, Australia, and Papua New Guinea [SP]). The model is divided into three time slices – (1) 56-33.9 Ma; (2) 33.9-16 Ma; and (3) 16 Ma – present. Dispersal rates between biogeographic areas are represented by: 0 (no dispersal); 0.05 (low dispersal probability among areas); and 1 (high dispersal probability among areas).

MARINE+TERRESTRIAL MODEL

16-present

	MA	**IAA**	**LA**	**IN**	**SP**	**AF**	**NE**
MA	1	0.05	0	0.05	0.05	1	0
IAA	1	1	1	1	1	1	0.05
LA	0	1	1	1	0	1	1
IN	1	1	1	1	0.05	1	0
SP	1	1	0	1	1	1	0.05
AF	1	0.05	1	1	0.05	1	1
NE	0	0.05	1	0	0.05	1	1

33.9-16

	MA	IAA	LA	IN	SP	AF	NE
MA	1	1	0	1	1	1	0
IAA	1	1	1	1	1	1	0.05
LA	0	1	1	1	0	1	0
IN	1	1	1	1	0	1	0
SP	1	1	0	0	1	0	0.05
AF	1	1	1	1	0	1	0.05
NE	0	0.05	0	0	0.05	0.05	1

61.7-33.9

	MA	IAA	LA	IN	SP	AF	NE
MA	1	0	1	1	0	1	0
IAA	0	1	1	1	0	0	0.05
LA	1	1	1	1	0	1	0
IN	1	1	1	1	0	1	0
SP	0	0	0	0	1	0	0.05
AF	1	0	1	1	0	1	0.05
NE	0	0.05	0	0	0.05	0.05	1

Table 2: Marine + terrestrial model for seven biogeographic areas: Neotropics (NE); Africa (AF); Sundaland and Indochina (IAA); India (IN); Laurasia (LA); Madagascar (MA); and South Pacific (including New Caledonia, Australia, and Papua New Guinea [SP]). The model is divided into three time slices – (1) 56-33.9 Ma; (2) 33.9-16 Ma; and (3) 16 Ma – present. Dispersal rates between biogeographic areas are represented by: 0 (no dispersal); 0.05 (low dispersal probability among areas); and 1 (high dispersal probability among areas)

Additional file, A5 (A) Fossil node dated phylogeny, with Canarieae Fossil

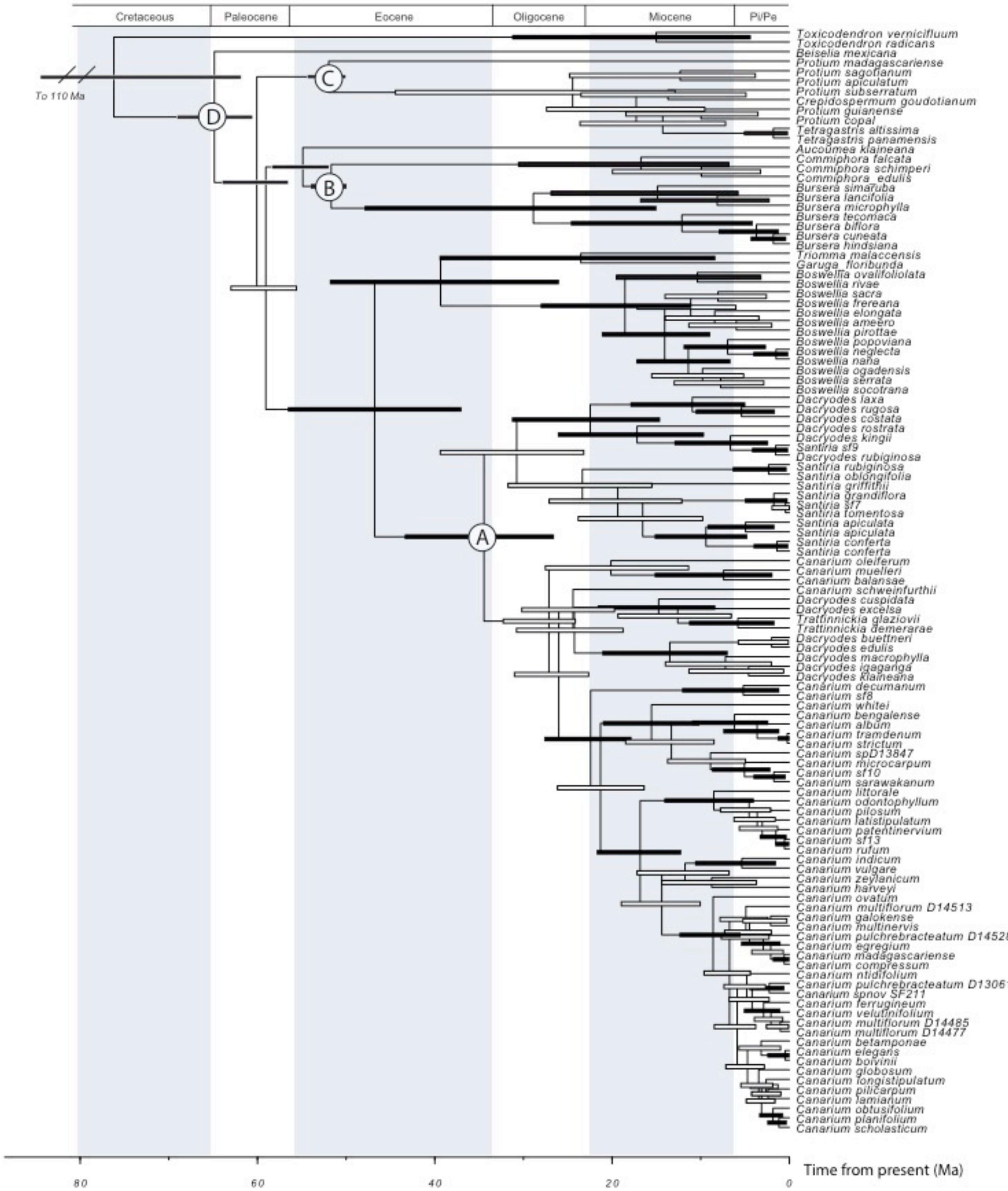


Figure 1. Molecular phylogeny of the Canarieae. Maximum clade credibility tree summarizing the results of Bayesian dating analysis in BEAST (fossil calibration nodes marked with letters A-D), with a normal probability prior on node A and lognormal probability priors on nodes B-D, following Fine *et al.* (2014). Bars represent both highest posterior density intervals of the dating analysis as well as Bayesian posterior probabilities (BPP), where black bars represent a BPP of .95 and higher while uncolored bars have a BPP of .94 and below.

A5 (B) Fossil node dated phylogeny, without Canarieae Fossil

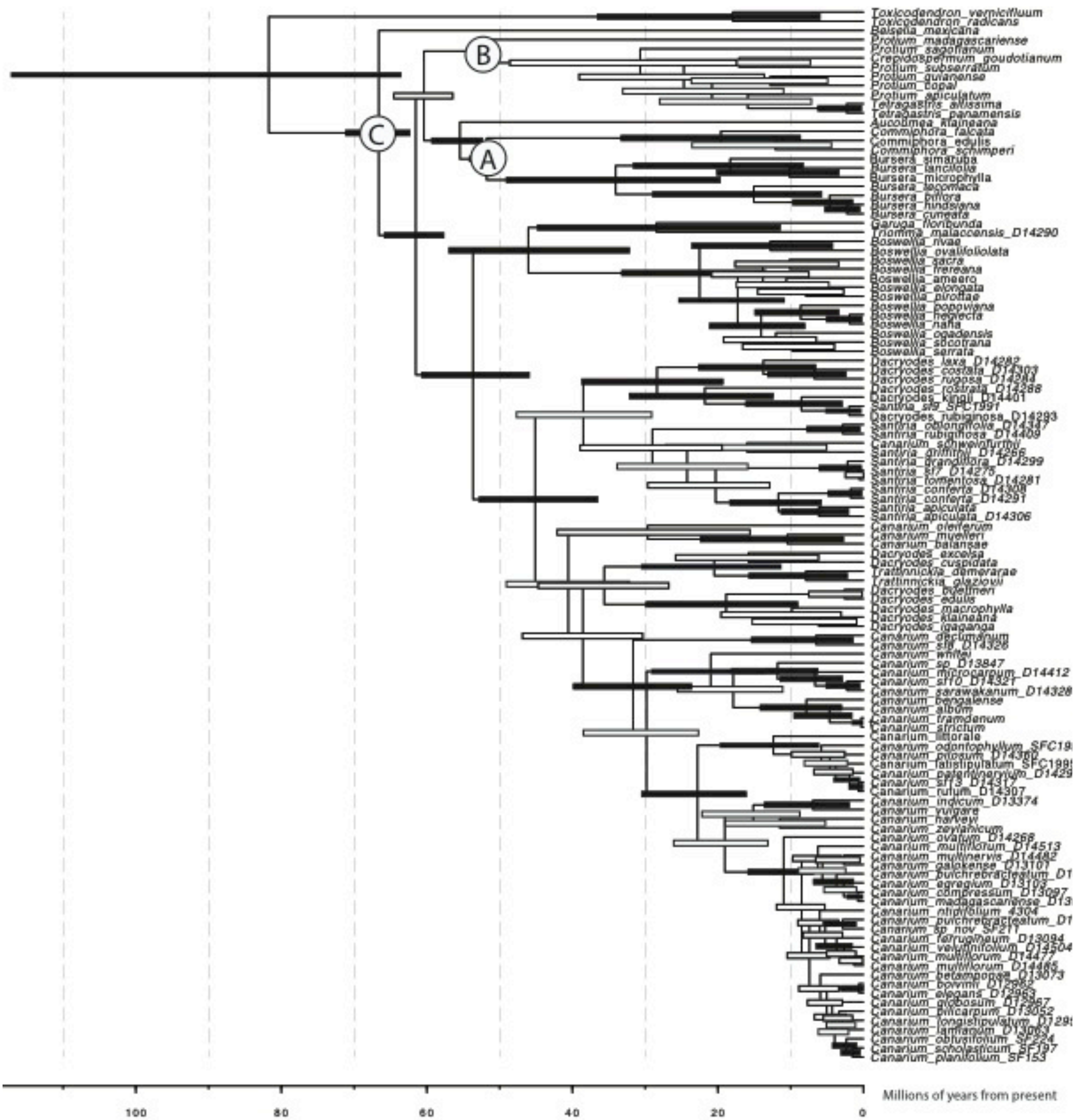


Figure 1. Molecular phylogeny of the Canarieae. Maximum clade credibility tree summarizing the results of Bayesian dating analysis in BEAST (fossil calibration nodes

marked with letters A-C), with a normal probability prior on node A and lognormal probability priors on nodes B-C, following Fine *et al.* (2014). Bars represent both highest posterior density intervals of the dating analysis as well as Bayesian posterior probabilities (BPP), where black bars represent a BPP of .95 and higher while uncolored bars have a BPP of .94 and below.

Additional file, A6: RaxML phylogeny

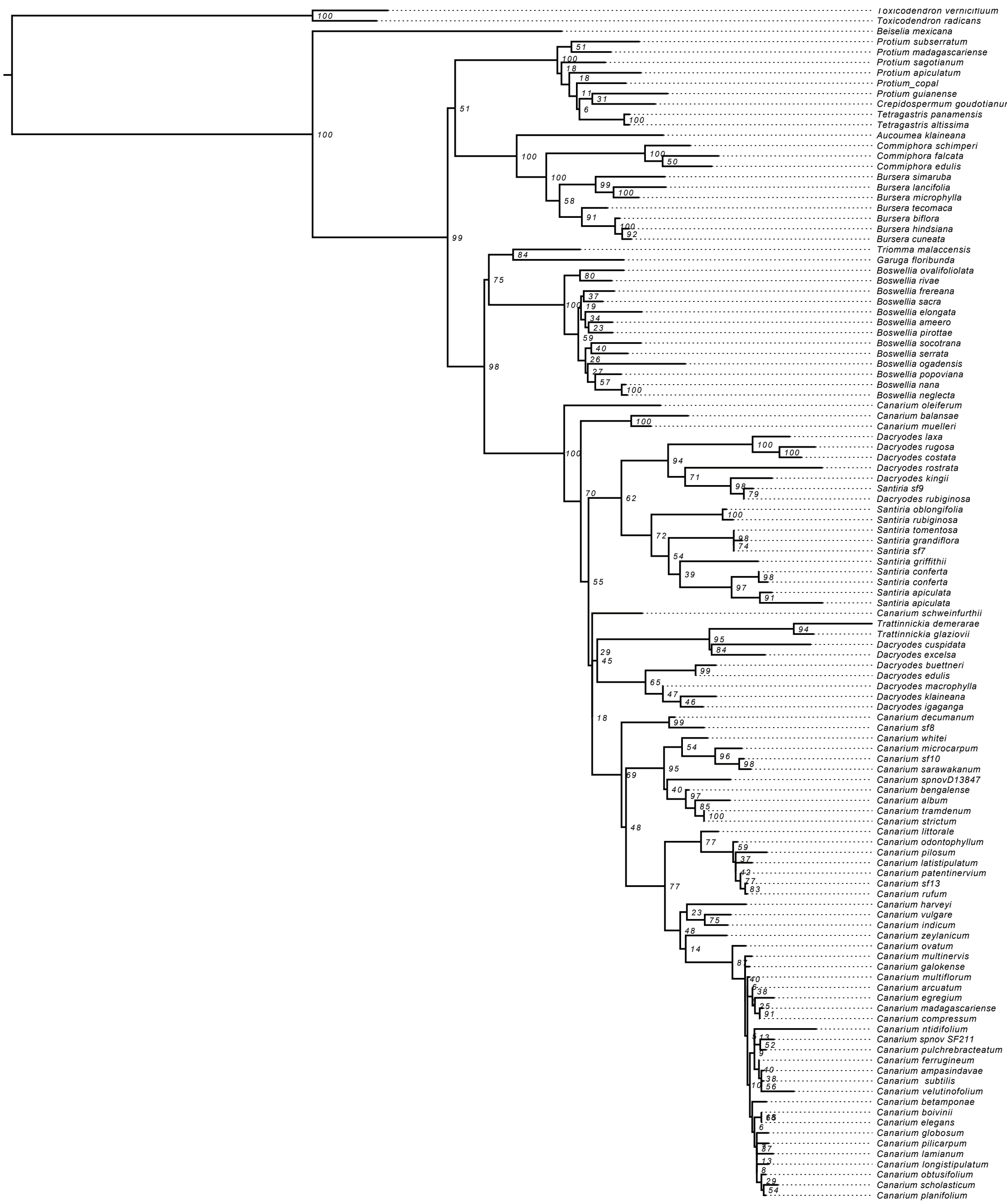


Figure 1. Maximum likelihood Canarieae phylogeny constructed in RaxML with 1000 bootstraps. Bootstrap support values are detailed at each node

Additional file, A7: Statistical Dispersal Vicariance Extinction (DEC)

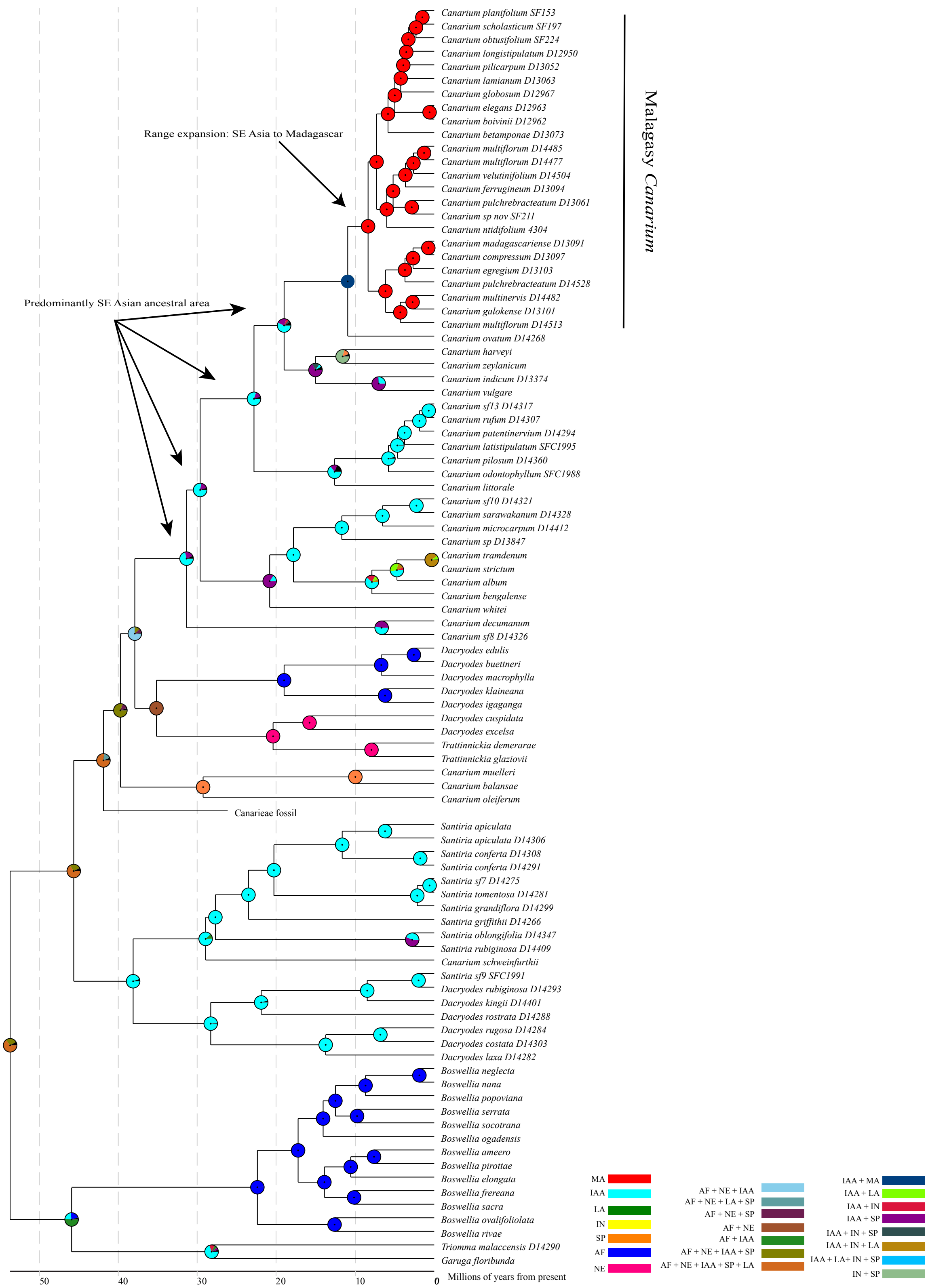


Figure 1. Statistical dispersal extinction cladogenesis (S-DEC) ancestral area reconstructions

using 1000 trees from the posterior distribution of the fossil-tip dated phylogeny. Ancestral areas are color-coded with the legend in the lower right of the figure. Areas are coded as: Neotropics (NE); Africa (AF); Sundaland and Indochina (IAA); India (IN); Laurasia (LA); Madagascar (MA); and South Pacific (including New Caledonia, Australia, and Papua New Guinea [SP]).

Additional file, A8: Biogeobears biogeographic reconstructions

Model*	LnL[1]	P[2]	d[3]	e[4]	j[5]	AIC[6]	dAIC[7]	W[8]
SD (BAY)	-134.699	2.000	0.005	0.039	0.000	273.399	55.515	8.81E-13
SD + j (BAY)	-133.080	3.000	0.005	0.035	0.005	272.159	54.276	1.64E-12
LDD (BAY)	-127.897	2.000	0.004	0.028	0.000	259.794	41.910	7.93E-10
LDD + j (BAY)	-121.394	3.000	0.003	0.017	0.009	248.787	30.904	1.95E-07
LDD + j (DEC)	-116.717	3.000	0.007	0.003	0.000	239.434	21.550	2.09E-05
SD + j (DEC)	-114.831	3.000	0.011	0.004	0.000	235.661	17.778	1.38E-04
SD (DEC)	-114.830	2.000	0.011	0.004	0.000	233.659	15.775	3.75E-04
LDD (DEC)	**-106.942**	**2.000**	**0.006**	**0.002**	**0.000**	**217.884**	**0.000**	**0.999**

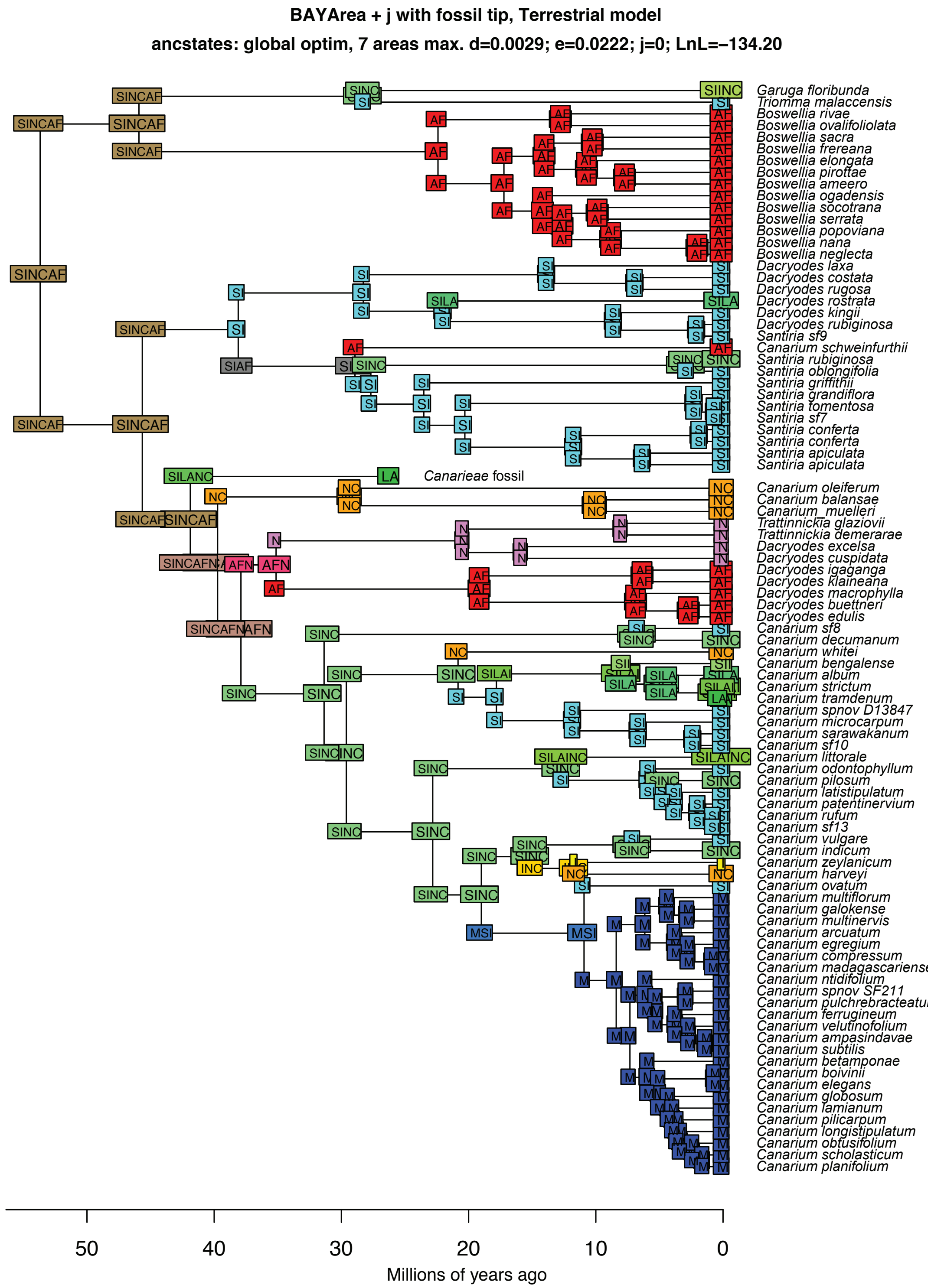
Table 1. Biogeographic model fits for the fossil-node calibrated tree

* SD refers to models incorporating terrestrial and short distance marine pathways of dispersal, while LDD also incorporates long distance marine dispersal pathways; the addition of a + j, indicates that colonization pathways were inferred with the founder event parameter. BAY refers to models estimated using a likelihood version of BayArea while DEC refers to models estimated using dispersal extinction cladogenesis.
[1] Log likelihood
[2] Number of parameters in the model
[3] Estimated dispersal rate
[4] Estimated extinction rate
[5] Estimated founder event speciation rate
[6] AIC score
[7] difference in AIC between the best fit and other candidate models
[8] AIC weight, or the relative likelihood of the model

Results of colonization pathway estimations for SD and LDD models with inferences using DEC versus DEC + j, and BayArea vesus BayArea + j. The bolded line corresponds to best fitting model, which represent LDD events estimated under DEC, and account for .999 of the Akaike weights. Results of colonization pathway estimations for the fossil-tip dated phylogeny can be found in Table 1 of the main text.

Additional file A8 (A-H): reconstructions using the fossil-tip phylogeny (ordered according to AIC scores, as in Table 1 of the main text)

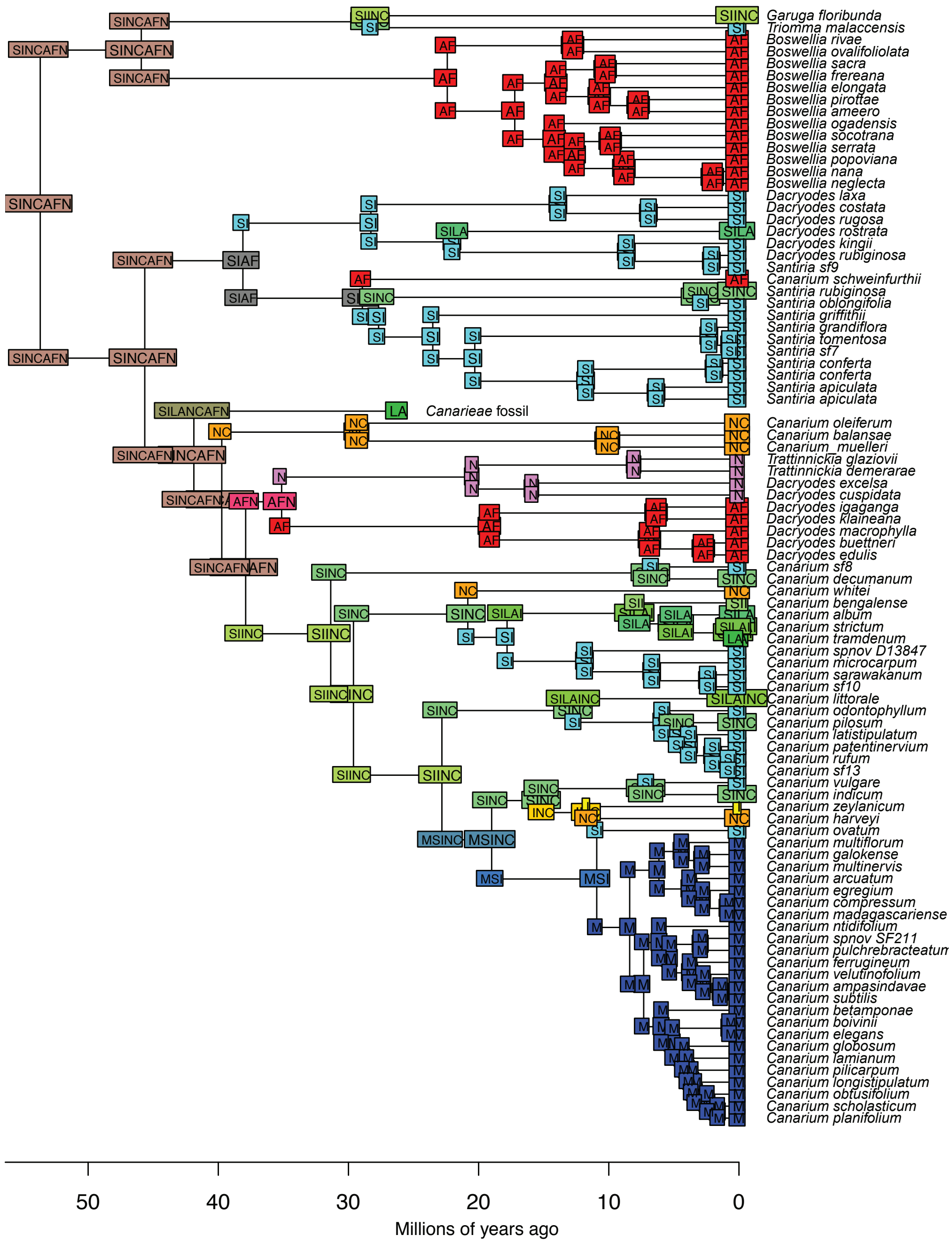
A8, (A)



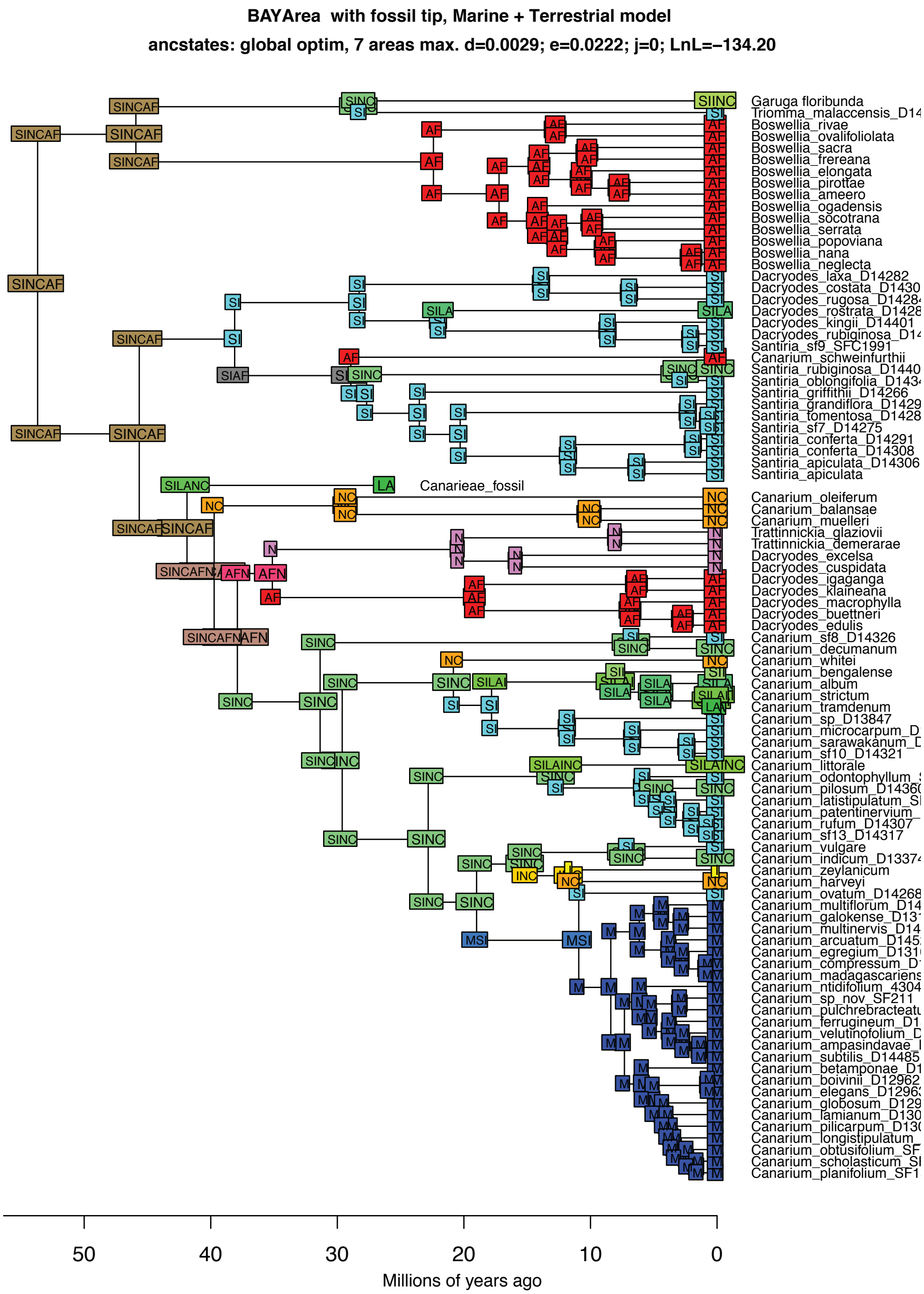
A8, (B)

BAYArea with fossil tip, Terrestrial model

ancstates: global optim, 7 areas max. d=0.0038; e=0.0292; j=0; LnL=−137.13



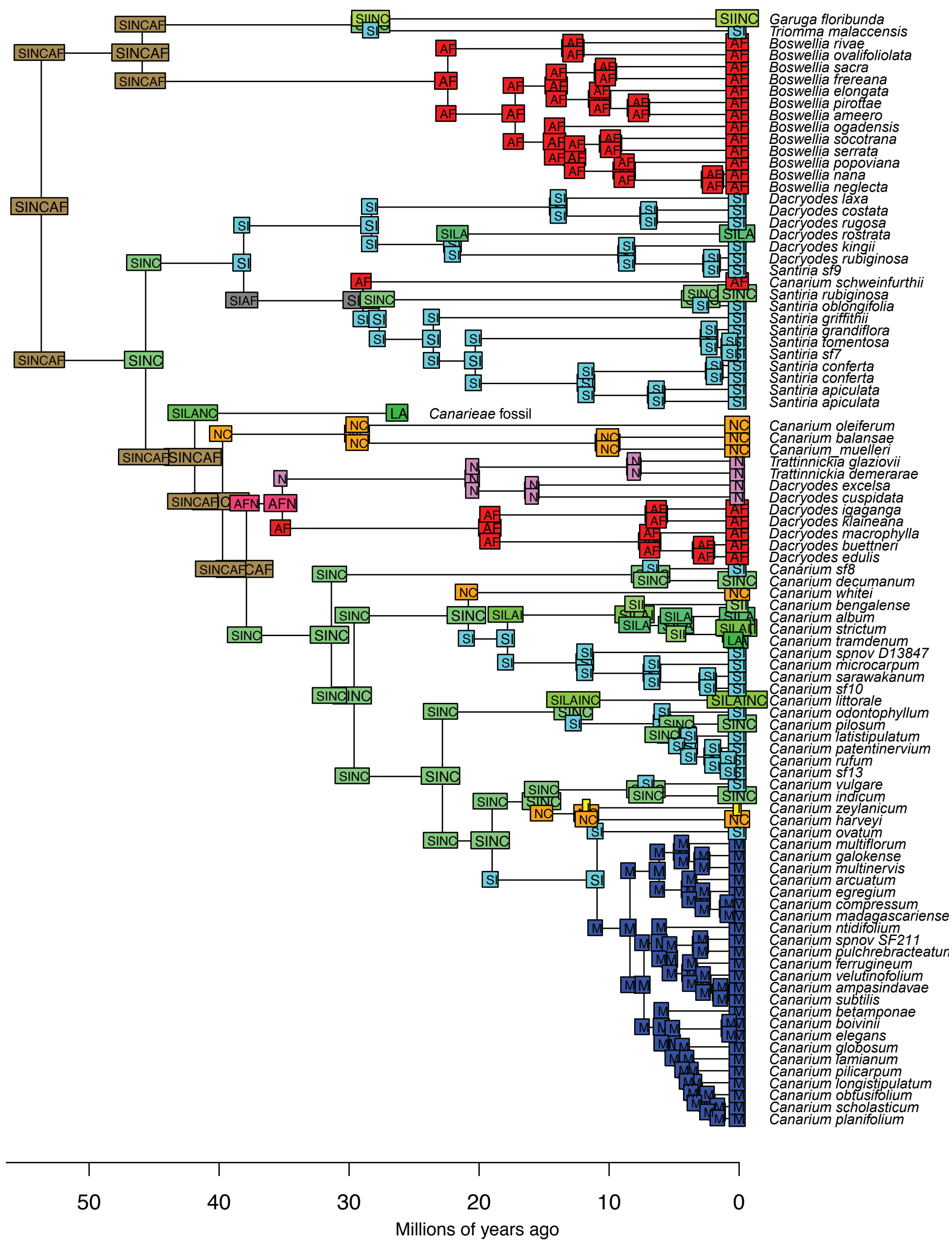
A8, (C)


BAYArea with fossil tip, Marine + Terrestrial model
ancstates: global optim, 7 areas max. d=0.0029; e=0.0222; j=0; LnL=−134.20
Garuga floribunda
Triomma_malaccensis_D14
Boswellia_rivae
Boswellia_ovalifoliolata
Boswellia_sacra
Boswellia_frereana
Boswellia_elongata
Boswellia_pirottae
Boswellia_ameero
Boswellia_ogadensis
Boswellia_socotrana
Boswellia_serrata
Boswellia_popoviana
Boswellia_nana
Boswellia_neglecta
Dacryodes_laxa_D14282
Dacryodes_costata_D1430
Dacryodes_rugosa_D1428
Dacryodes_rostrata_D1428
Dacryodes_kingii_D14401
Dacryodes_rubiginosa_D14
Santiria_sf9_SFC1991
Canarium_schweinfurthii
Santiria_rubiginosa_D1440
Santiria_oblongifolia_D143
Santiria_griffithii_D14266
Santiria_grandiflora_D1429
Santiria_tomentosa_D1428
Santiria_sf7_D14275
Santiria_conferta_D14291
Santiria_conferta_D14308
Santiria_apiculata_D14306
Santiria_apiculata
Canarieae_fossil
Canarium_oleiferum
Canarium_balansae
Canarium_muelleri
Trattinnickia_glaziovii
Trattinnickia_demerarae
Dacryodes_excelsa
Dacryodes_cuspidata
Dacryodes_igaganga
Dacryodes_klaineana
Dacryodes_macrophylla
Dacryodes_buettneri
Dacryodes_edulis
Canarium_sf8_D14326
Canarium_decumanum
Canarium_whitei
Canarium_bengalense
Canarium_album
Canarium_strictum
Canarium_tramdenum
Canarium_sp_D13847
Canarium_microcarpum_D
Canarium_sarawakanum_D
Canarium_sf10_D14321
Canarium_littorale
Canarium_odontophyllum_
Canarium_pilosum_D1436
Canarium_latistipulatum_S
Canarium_patentinervium_
Canarium_rufum_D14307
Canarium_sf13_D14317
Canarium_vulgare
Canarium_indicum_D1337
Canarium_zeylanicum
Canarium_harveyi
Canarium_ovatum_D14268
Canarium_multiflorum_D14
Canarium_galokense_D13
Canarium_multinervis_D14
Canarium_arcuatum_D145
Canarium_egregium_D131
Canarium_compressum_D
Canarium_madagascariens
Canarium_ntidifolium_4304
Canarium_sp_nov_SF211
Canarium_pulchrebracteat
Canarium_ferrugineum_D1
Canarium_velutinofolium_D
Canarium_ampasindavae_
Canarium_subtilis_D14485
Canarium_betamponae_D1
Canarium_boivinii_D12962
Canarium_elegans_D1296
Canarium_globosum_D129
Canarium_lamianum_D130
Canarium_pilicarpum_D13
Canarium_longistipulatum_
Canarium_obtusifolium_SF
Canarium_scholasticum_S
Canarium_planifolium_SF1
50
40
30
20
10
0
Millions of years ago

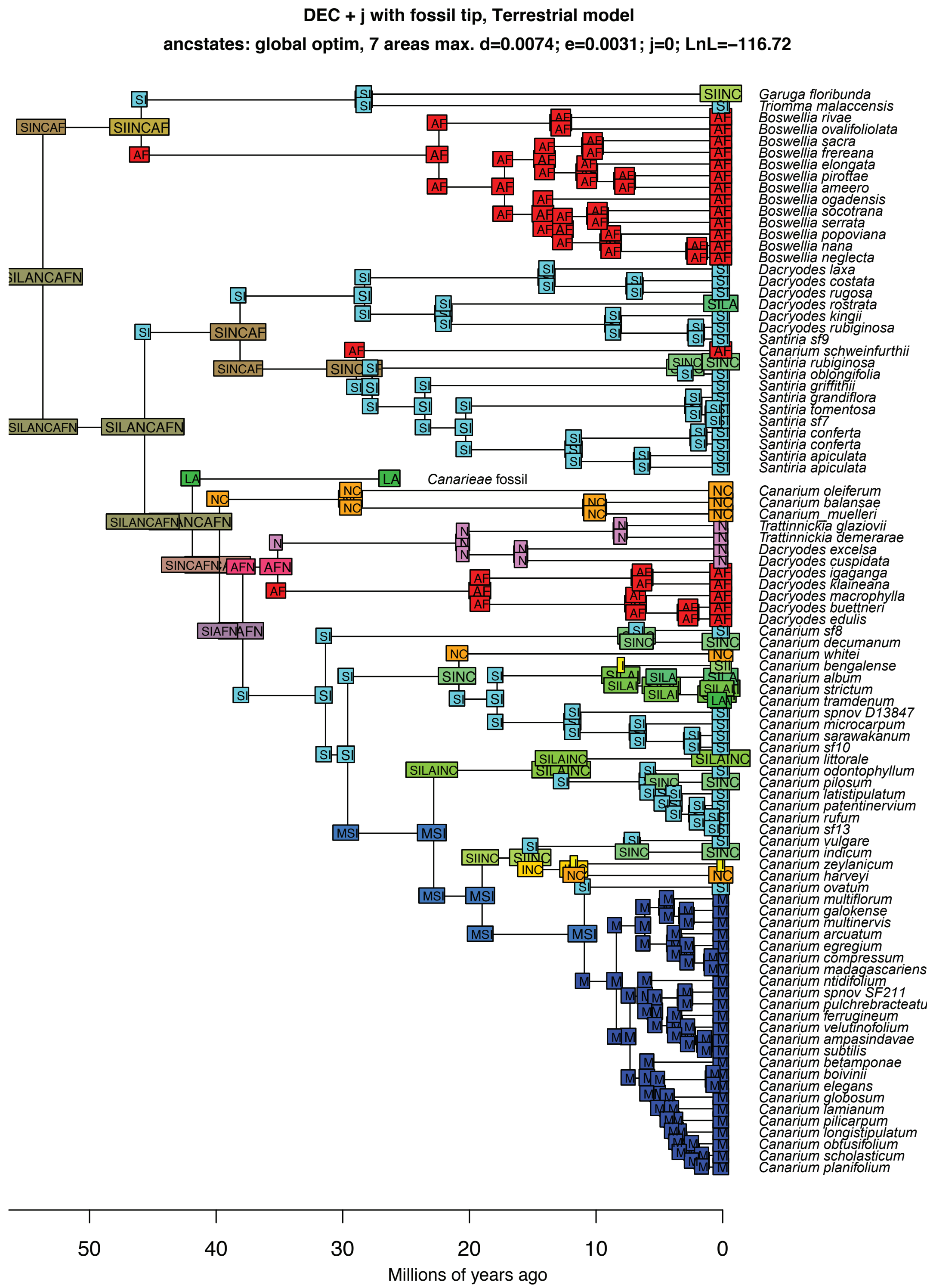
A8, (D)

BAYArea + j with fossil tip, Marine + Terrestrial model

ancstates: global optim, 7 areas max. d=0.0021; e=0.0157; j=0.0077; LnL=−130.53



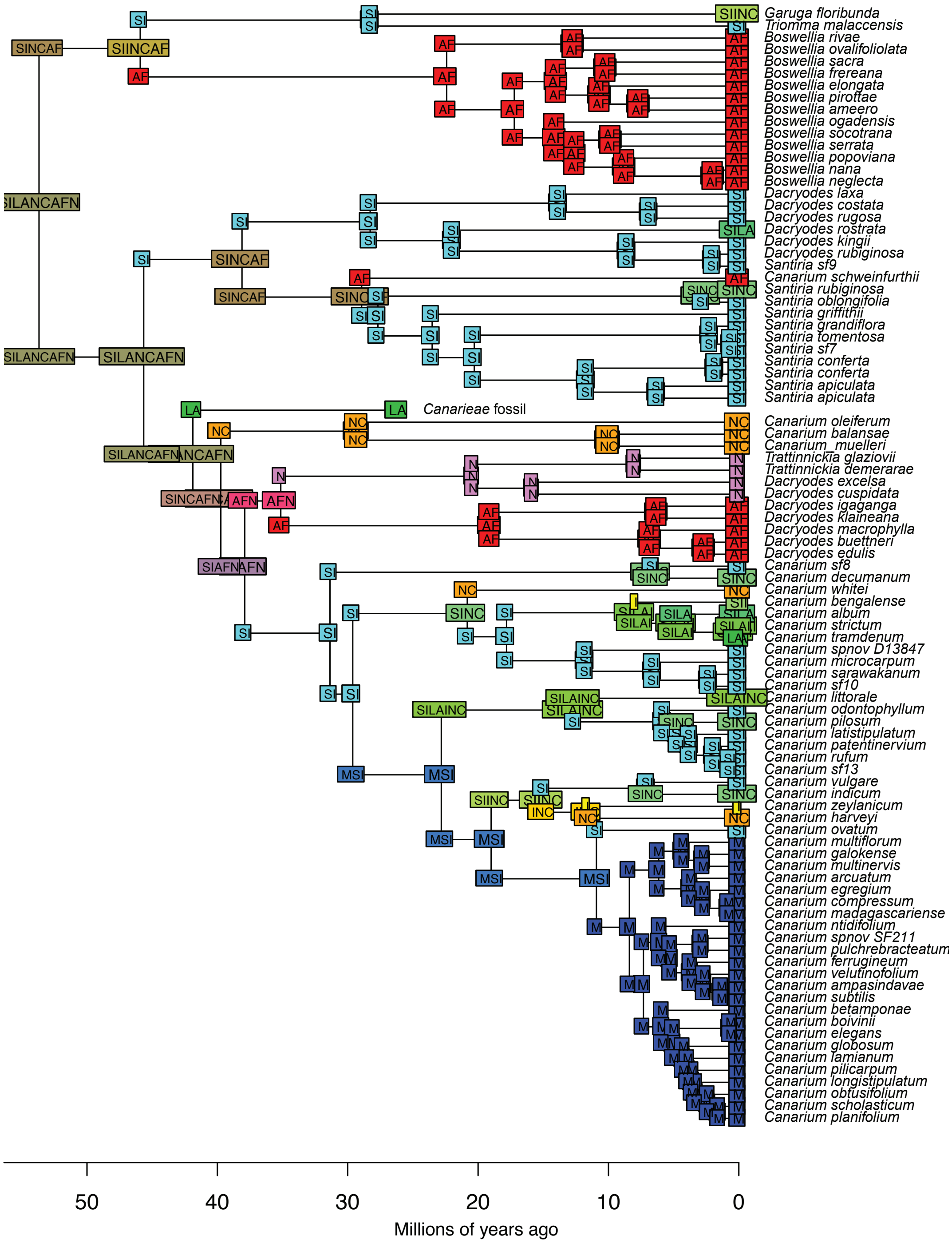
A7, (E)


DEC + j with fossil tip, Terrestrial model
ancstates: global optim, 7 areas max. d=0.0074; e=0.0031; j=0; LnL=−116.72
Garuga floribunda
Triomma malaccensis
Boswellia rivae
Boswellia ovalifoliolata
Boswellia sacra
Boswellia frereana
Boswellia elongata
Boswellia pirottae
Boswellia ameero
Boswellia ogadensis
Boswellia socotrana
Boswellia serrata
Boswellia popoviana
Boswellia nana
Boswellia neglecta
Dacryodes laxa
Dacryodes costata
Dacryodes rugosa
Dacryodes rostrata
Dacryodes kingii
Dacryodes rubiginosa
Santiria sf9
Canarium schweinfurthii
Santiria rubiginosa
Santiria oblongifolia
Santiria griffithii
Santiria grandiflora
Santiria tomentosa
Santiria sf7
Santiria conferta
Santiria conferta
Santiria apiculata
Santiria apiculata
Canarieae fossil
Canarium oleiferum
Canarium balansae
Canarium_muelleri
Trattinnickia glaziovii
Trattinnickia demerarae
Dacryodes excelsa
Dacryodes cuspidata
Dacryodes igaganga
Dacryodes klaineana
Dacryodes macrophylla
Dacryodes buettneri
Dacryodes edulis
Canarium sf8
Canarium decumanum
Canarium whitei
Canarium bengalense
Canarium album
Canarium strictum
Canarium tramdenum
Canarium spnov D13847
Canarium microcarpum
Canarium sarawakanum
Canarium sf10
Canarium littorale
Canarium odontophyllum
Canarium pilosum
Canarium latistipulatum
Canarium patentinervium
Canarium rufum
Canarium sf13
Canarium vulgare
Canarium indicum
Canarium zeylanicum
Canarium harveyi
Canarium ovatum
Canarium multiflorum
Canarium galokense
Canarium multinervis
Canarium arcuatum
Canarium egregium
Canarium compressum
Canarium madagascariens
Canarium ntidifolium
Canarium spnov SF211
Canarium pulchrebracteatu
Canarium ferrugineum
Canarium velutinofolium
Canarium ampasindavae
Canarium subtilis
Canarium betamponae
Canarium boivinii
Canarium elegans
Canarium globosum
Canarium lamianum
Canarium pilicarpum
Canarium longistipulatum
Canarium obtusifolium
Canarium scholasticum
Canarium planifolium
50
40
30
20
10
0
Millions of years ago

A7, (F)

DEC with fossil tip, Terrestrial model

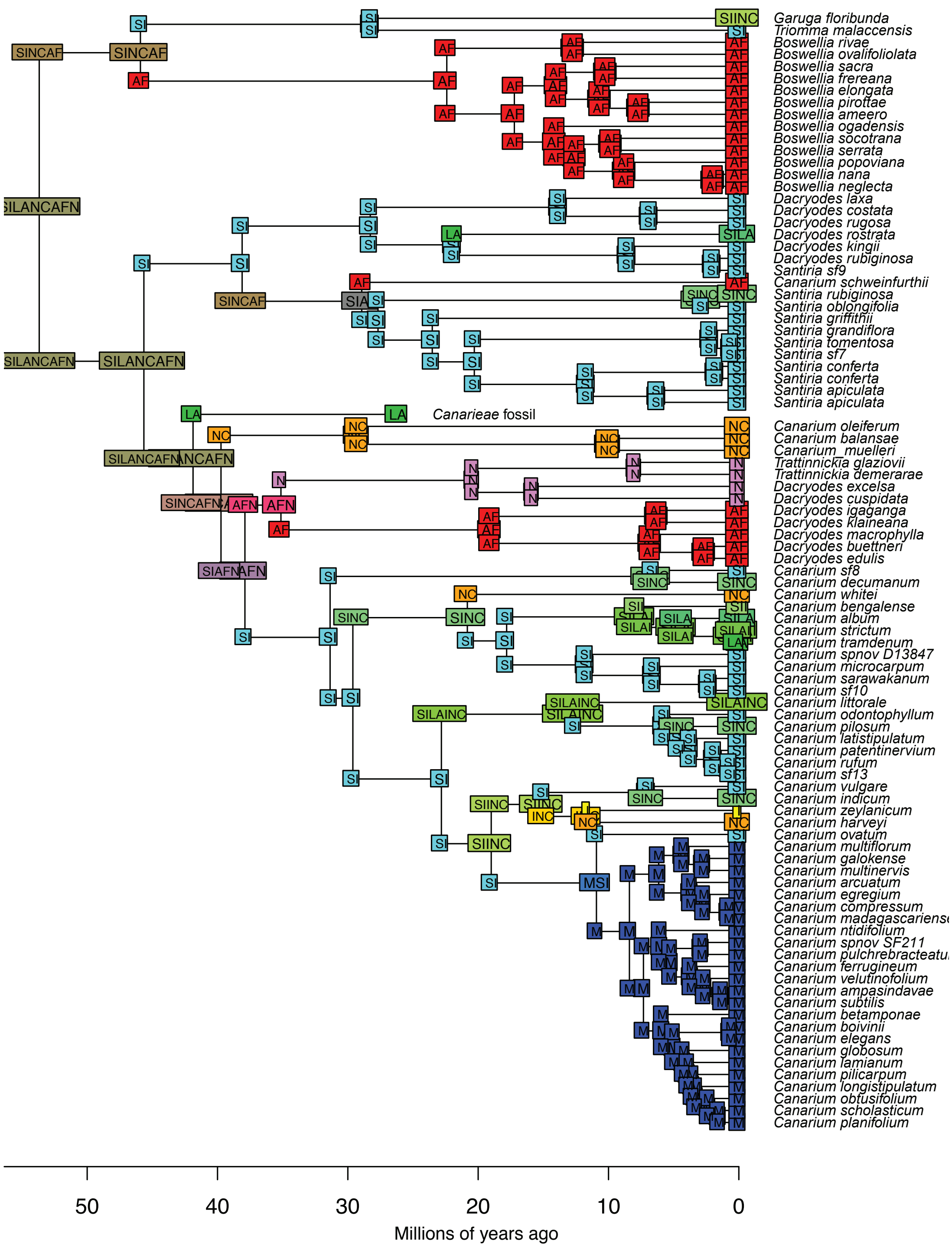
ancstates: global optim, 7 areas max. d=0.0074; e=0.0031; j=0; LnL=−116.72



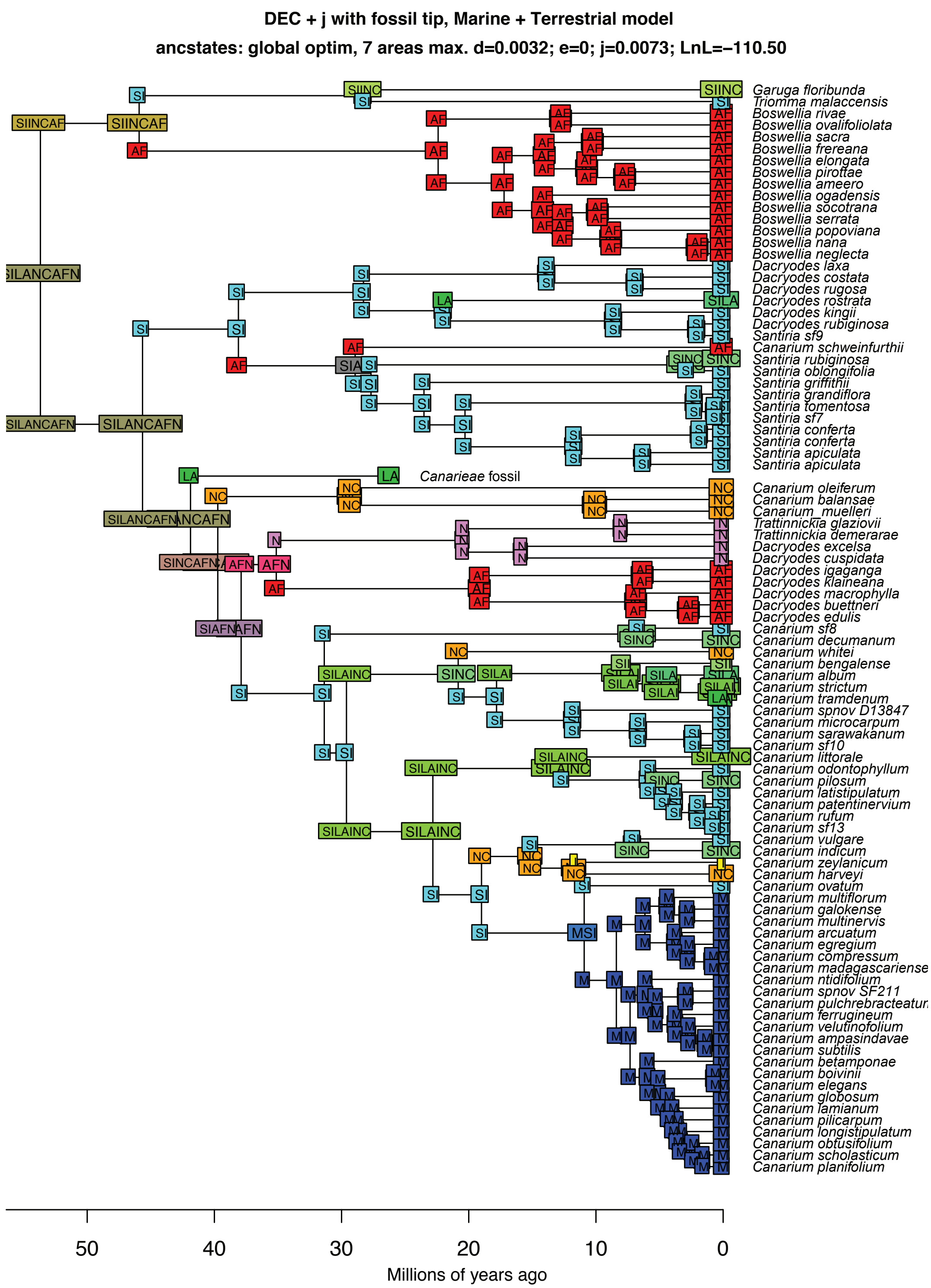
A8, (G)

DEC with fossil tip, Marine + Terrestrial model

ancstates: global optim, 7 areas max. d=0.0039; e=0.0012; j=0; LnL=−112.01

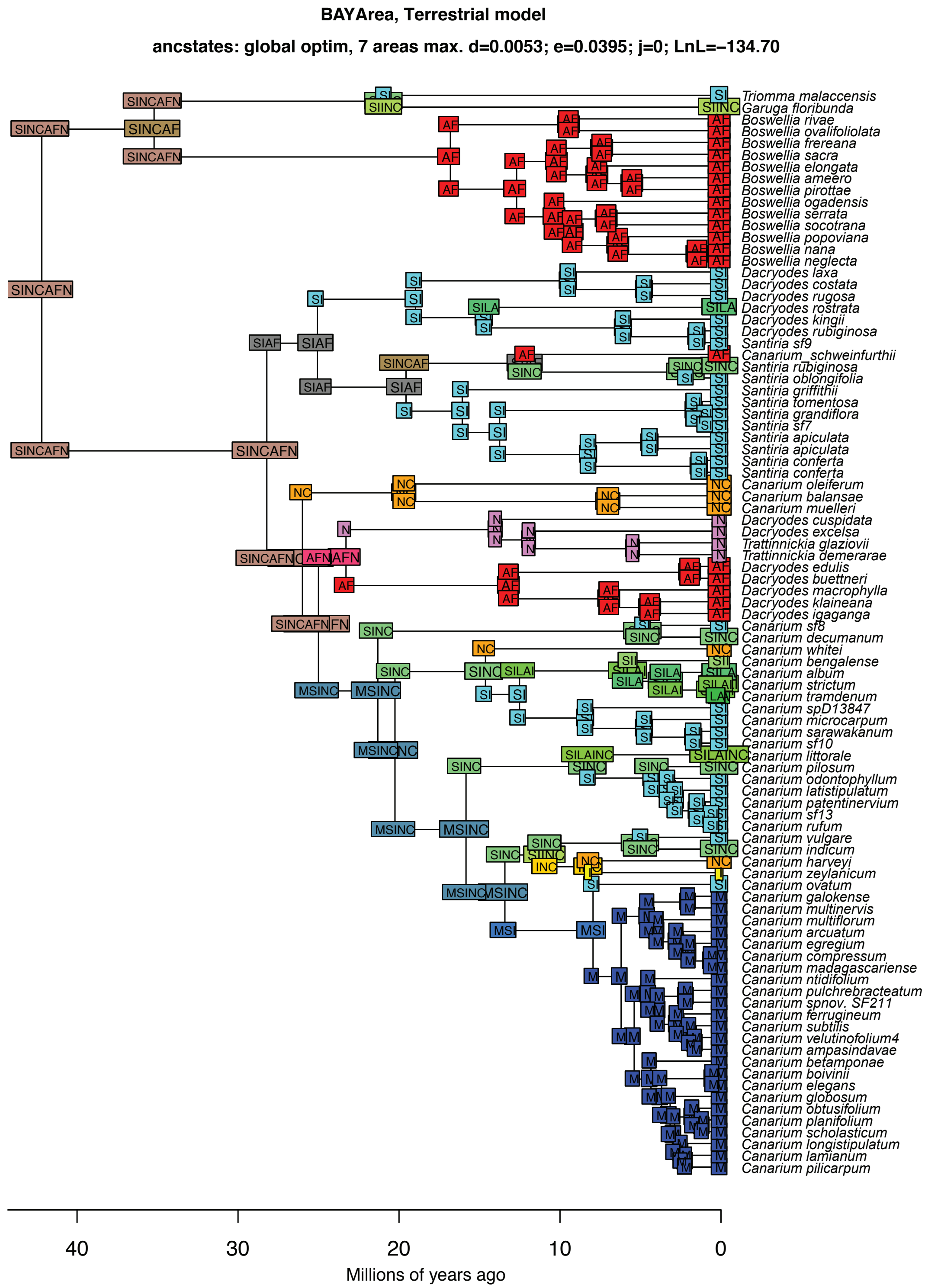


A8, (H)

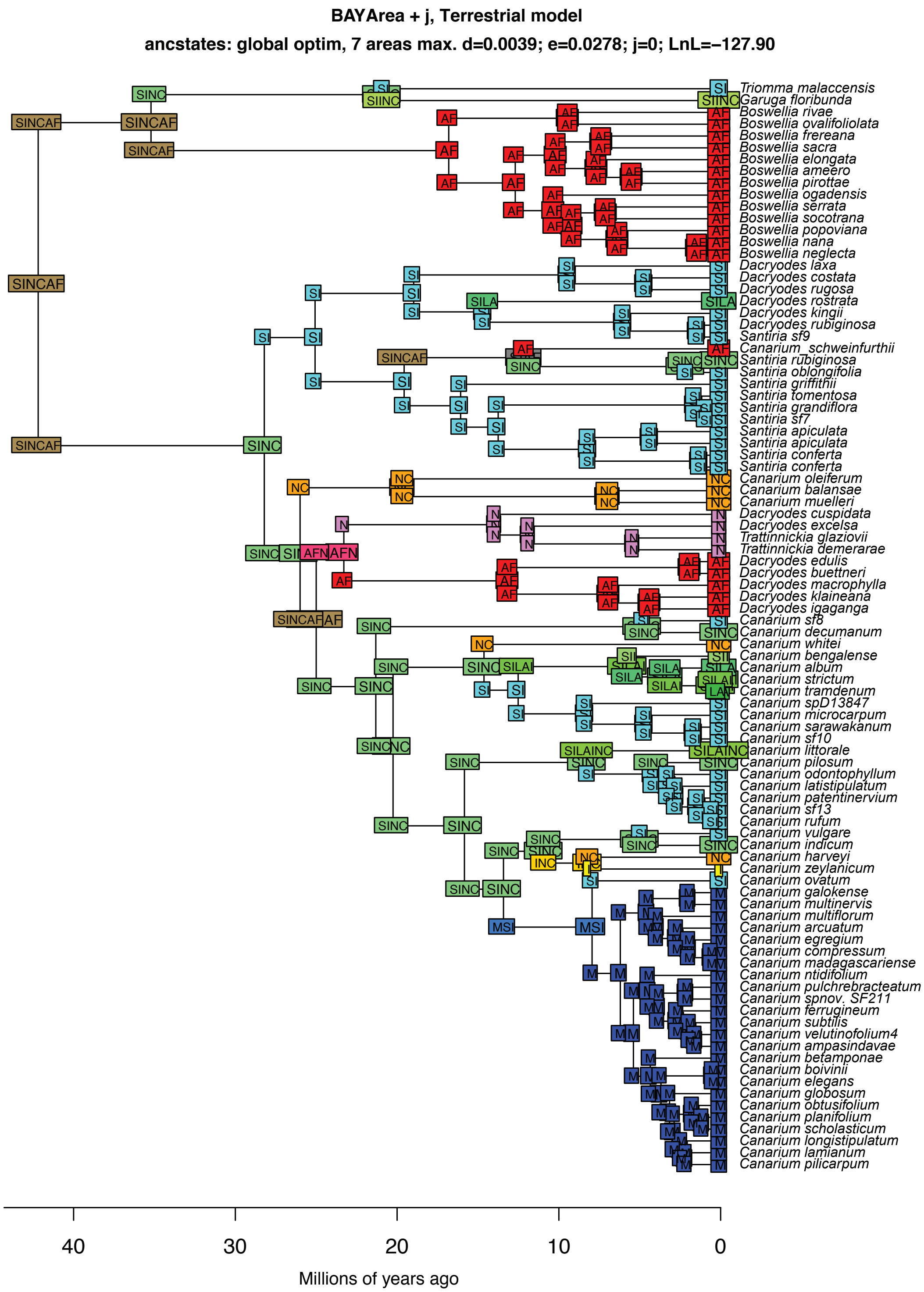

DEC + j with fossil tip, Marine + Terrestrial model
ancstates: global optim, 7 areas max. d=0.0032; e=0; j=0.0073; LnL=−110.50
Garuga floribunda
Triomma malaccensis
Boswellia rivae
Boswellia ovalifoliolata
Boswellia sacra
Boswellia frereana
Boswellia elongata
Boswellia pirottae
Boswellia ameero
Boswellia ogadensis
Boswellia socotrana
Boswellia serrata
Boswellia popoviana
Boswellia nana
Boswellia neglecta
Dacryodes laxa
Dacryodes costata
Dacryodes rugosa
Dacryodes rostrata
Dacryodes kingii
Dacryodes rubiginosa
Santiria sf9
Canarium schweinfurthii
Santiria rubiginosa
Santiria oblongifolia
Santiria griffithii
Santiria grandiflora
Santiria tomentosa
Santiria sf7
Santiria conferta
Santiria conferta
Santiria apiculata
Santiria apiculata
Canarieae fossil
Canarium oleiferum
Canarium balansae
Canarium_muelleri
Trattinnickia glaziovii
Trattinnickia demerarae
Dacryodes excelsa
Dacryodes cuspidata
Dacryodes igaganga
Dacryodes klaineana
Dacryodes macrophylla
Dacryodes buettneri
Dacryodes edulis
Canarium sf8
Canarium decumanum
Canarium whitei
Canarium bengalense
Canarium album
Canarium strictum
Canarium tramdenum
Canarium spnov D13847
Canarium microcarpum
Canarium sarawakanum
Canarium sf10
Canarium littorale
Canarium odontophyllum
Canarium pilosum
Canarium latistipulatum
Canarium patentinervium
Canarium rufum
Canarium sf13
Canarium vulgare
Canarium indicum
Canarium zeylanicum
Canarium harveyi
Canarium ovatum
Canarium multiflorum
Canarium galokense
Canarium multinervis
Canarium arcuatum
Canarium egregium
Canarium compressum
Canarium madagascariense
Canarium ntidifolium
Canarium spnov SF211
Canarium pulchrebracteatum
Canarium ferrugineum
Canarium velutinofolium
Canarium ampasindavae
Canarium subtilis
Canarium betamponae
Canarium boivinii
Canarium elegans
Canarium globosum
Canarium lamianum
Canarium pilicarpum
Canarium longistipulatum
Canarium obtusifolium
Canarium scholasticum
Canarium planifolium
50
40
30
20
10
0
Millions of years ago

Additional file A8 (I-P): reconstructions using the fossil-node phylogeny (ordered according to AIC scores, as in Table 1 of Additional file A8)

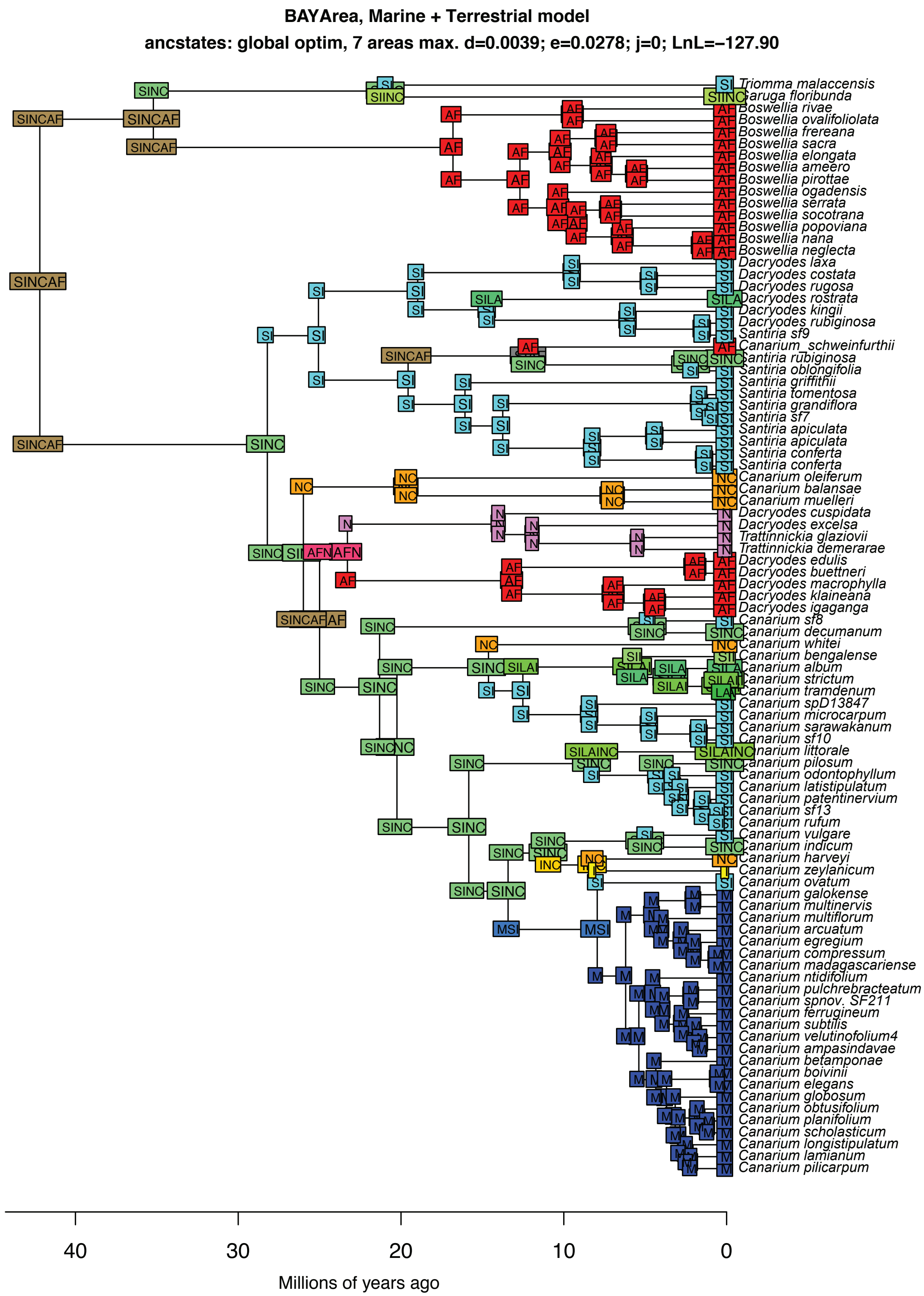
A8, (I)



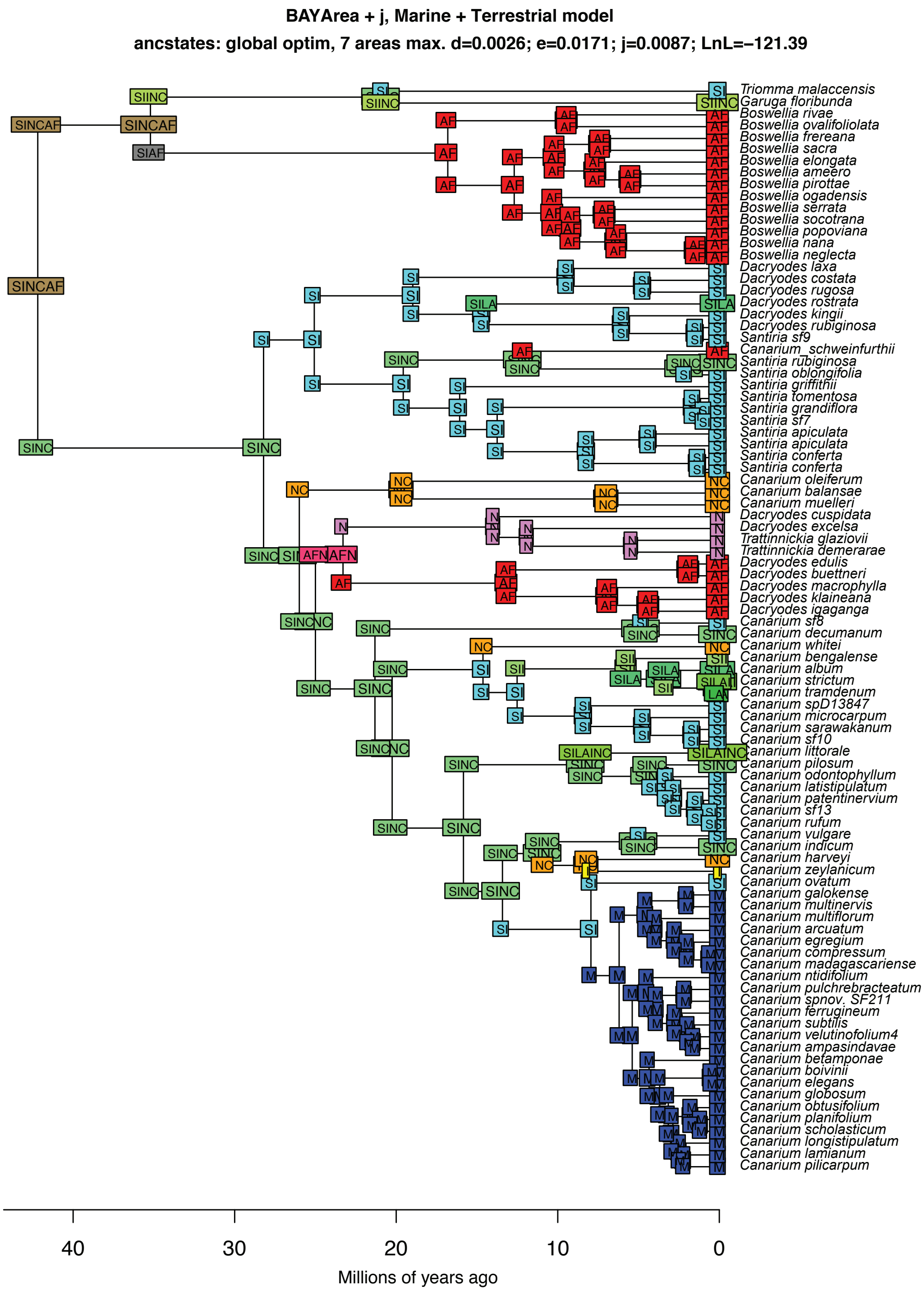
A8, (J)


BAYArea + j, Terrestrial model
ancstates: global optim, 7 areas max. d=0.0039; e=0.0278; j=0; LnL=-127.90
Triomma malaccensis
Garuga floribunda
Boswellia rivae
Boswellia ovalifoliolata
Boswellia frereana
Boswellia sacra
Boswellia elongata
Boswellia ameero
Boswellia pirottae
Boswellia ogadensis
Boswellia serrata
Boswellia socotrana
Boswellia popoviana
Boswellia nana
Boswellia neglecta
Dacryodes laxa
Dacryodes costata
Dacryodes rugosa
Dacryodes rostrata
Dacryodes kingii
Dacryodes rubiginosa
Santiria sf9
Canarium_schweinfurthii
Santiria rubiginosa
Santiria oblongifolia
Santiria griffithii
Santiria tomentosa
Santiria grandiflora
Santiria sf7
Santiria apiculata
Santiria apiculata
Santiria conferta
Santiria conferta
Canarium oleiferum
Canarium balansae
Canarium muelleri
Dacryodes cuspidata
Dacryodes excelsa
Trattinnickia glaziovii
Trattinnickia demerarae
Dacryodes edulis
Dacryodes buettneri
Dacryodes macrophylla
Dacryodes klaineana
Dacryodes igaganga
Canarium sf8
Canarium decumanum
Canarium whitei
Canarium bengalense
Canarium album
Canarium strictum
Canarium tramdenum
Canarium spD13847
Canarium microcarpum
Canarium sarawakanum
Canarium sf10
Canarium littorale
Canarium pilosum
Canarium odontophyllum
Canarium latistipulatum
Canarium patentinervium
Canarium sf13
Canarium rufum
Canarium vulgare
Canarium indicum
Canarium harveyi
Canarium zeylanicum
Canarium ovatum
Canarium galokense
Canarium multinervis
Canarium multiflorum
Canarium arcuatum
Canarium egregium
Canarium compressum
Canarium madagascariense
Canarium ntidifolium
Canarium pulchrebracteatum
Canarium spnov. SF211
Canarium ferrugineum
Canarium subtilis
Canarium velutinofolium4
Canarium ampasindavae
Canarium betamponae
Canarium boivinii
Canarium elegans
Canarium globosum
Canarium obtusifolium
Canarium planifolium
Canarium scholasticum
Canarium longistipulatum
Canarium lamianum
Canarium pilicarpum
40
30
20
10
0
Millions of years ago

A8, (K)


BAYArea, Marine + Terrestrial model
ancstates: global optim, 7 areas max. d=0.0039; e=0.0278; j=0; LnL=−127.90
Triomma malaccensis
Garuga floribunda
Boswellia rivae
Boswellia ovalifoliolata
Boswellia frereana
Boswellia sacra
Boswellia elongata
Boswellia ameero
Boswellia pirottae
Boswellia ogadensis
Boswellia serrata
Boswellia socotrana
Boswellia popoviana
Boswellia nana
Boswellia neglecta
Dacryodes laxa
Dacryodes costata
Dacryodes rugosa
Dacryodes rostrata
Dacryodes kingii
Dacryodes rubiginosa
Santiria sf9
Canarium_schweinfurthii
Santiria rubiginosa
Santiria oblongifolia
Santiria griffithii
Santiria tomentosa
Santiria grandiflora
Santiria sf7
Santiria apiculata
Santiria apiculata
Santiria conferta
Santiria conferta
Canarium oleiferum
Canarium balansae
Canarium muelleri
Dacryodes cuspidata
Dacryodes excelsa
Trattinnickia glaziovii
Trattinnickia demerarae
Dacryodes edulis
Dacryodes buettneri
Dacryodes macrophylla
Dacryodes klaineana
Dacryodes igaganga
Canarium sf8
Canarium decumanum
Canarium whitei
Canarium bengalense
Canarium album
Canarium strictum
Canarium tramdenum
Canarium spD13847
Canarium microcarpum
Canarium sarawakanum
Canarium sf10
Canarium littorale
Canarium pilosum
Canarium odontophyllum
Canarium latistipulatum
Canarium patentinervium
Canarium sf13
Canarium rufum
Canarium vulgare
Canarium indicum
Canarium harveyi
Canarium zeylanicum
Canarium ovatum
Canarium galokense
Canarium multinervis
Canarium multiflorum
Canarium arcuatum
Canarium egregium
Canarium compressum
Canarium madagascariense
Canarium ntidifolium
Canarium pulchrebracteatum
Canarium spnov. SF211
Canarium ferrugineum
Canarium subtilis
Canarium velutinofolium4
Canarium ampasindavae
Canarium betamponae
Canarium boivinii
Canarium elegans
Canarium globosum
Canarium obtusifolium
Canarium planifolium
Canarium scholasticum
Canarium longistipulatum
Canarium lamianum
Canarium pilicarpum
40
30
20
10
0
Millions of years ago

A8, (L)


BAYArea + j, Marine + Terrestrial model
ancstates: global optim, 7 areas max. d=0.0026; e=0.0171; j=0.0087; LnL=−121.39
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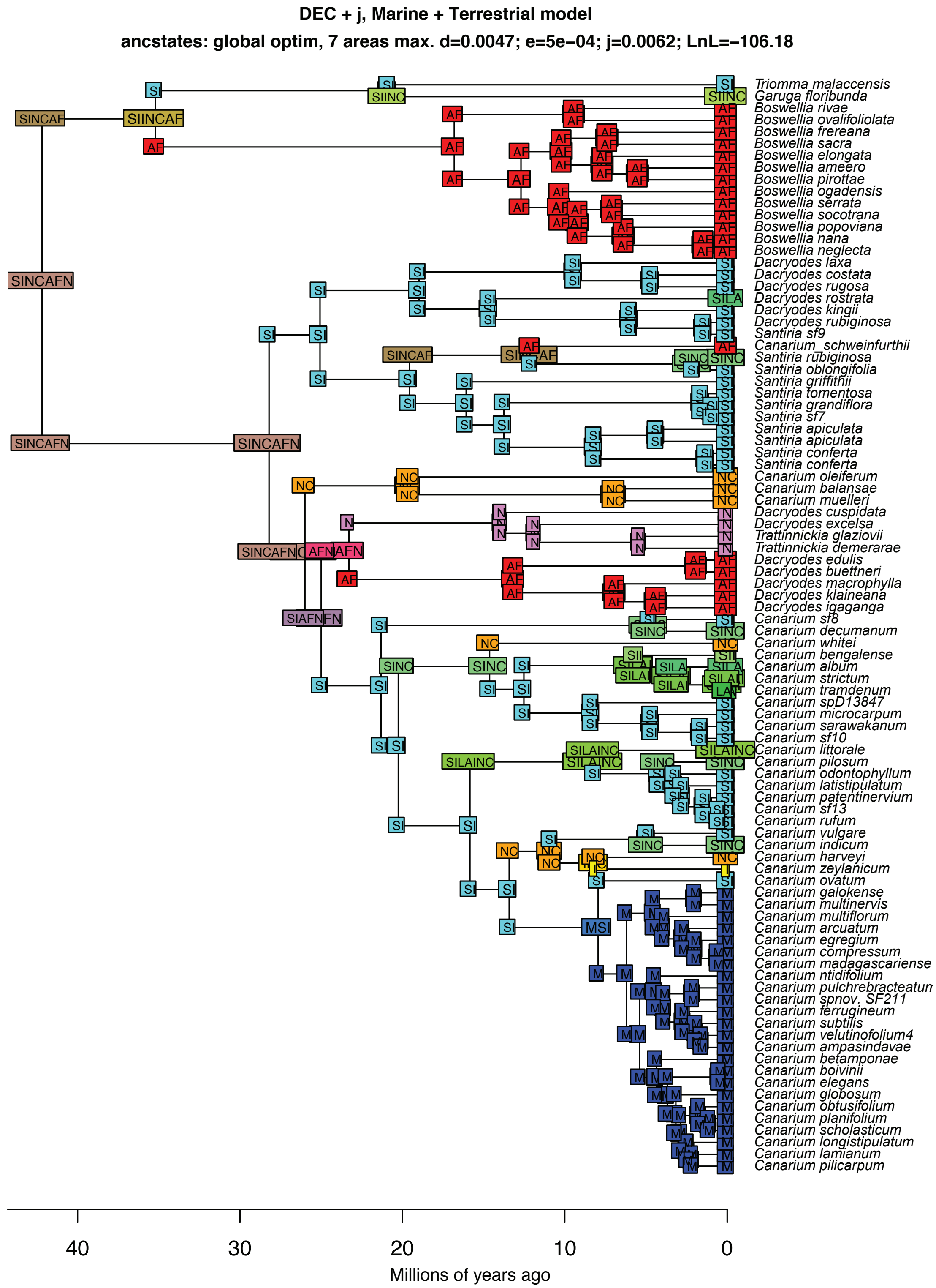
Garuga floribunda
Boswellia rivae
Boswellia ovalifoliolata
Boswellia frereana
Boswellia sacra
Boswellia elongata
Boswellia ameero
Boswellia pirottae
Boswellia ogadensis
Boswellia serrata
Boswellia socotrana
Boswellia popoviana
Boswellia nana
Boswellia neglecta
Dacryodes laxa
Dacryodes costata
Dacryodes rugosa
Dacryodes rostrata
Dacryodes kingii
Dacryodes rubiginosa
Santiria sf9
Canarium_schweinfurthii
Santiria rubiginosa
Santiria oblongifolia
Santiria griffithii
Santiria tomentosa
Santiria grandiflora
Santiria sf7
Santiria apiculata
Santiria apiculata
Santiria conferta
Santiria conferta
Canarium oleiferum
Canarium balansae
Canarium muelleri
Dacryodes cuspidata
Dacryodes excelsa
Trattinnickia glaziovii
Trattinnickia demerarae
Dacryodes edulis
Dacryodes buettneri
Dacryodes macrophylla
Dacryodes klaineana
Dacryodes igaganga
Canarium sf8
Canarium decumanum
Canarium whitei
Canarium bengalense
Canarium album
Canarium strictum
Canarium tramdenum
Canarium spD13847
Canarium microcarpum
Canarium sarawakanum
Canarium sf10
Canarium littorale
Canarium pilosum
Canarium odontophyllum
Canarium latistipulatum
Canarium patentinervium
Canarium sf13
Canarium rufum
Canarium vulgare
Canarium indicum
Canarium harveyi
Canarium zeylanicum
Canarium ovatum
Canarium galokense
Canarium multinervis
Canarium multiflorum
Canarium arcuatum
Canarium egregium
Canarium compressum
Canarium madagascariense
Canarium nitidifolium
Canarium pulchrebracteatum
Canarium spnov. SF211
Canarium ferrugineum
Canarium subtilis
Canarium velutinofolium4
Canarium ampasindavae
Canarium betamponae
Canarium boivinii
Canarium elegans
Canarium globosum
Canarium obtusifolium
Canarium planifolium
Canarium scholasticum
Canarium longistipulatum
Canarium lamianum
Canarium pilicarpum
40
30
20
10
0
Millions of years ago

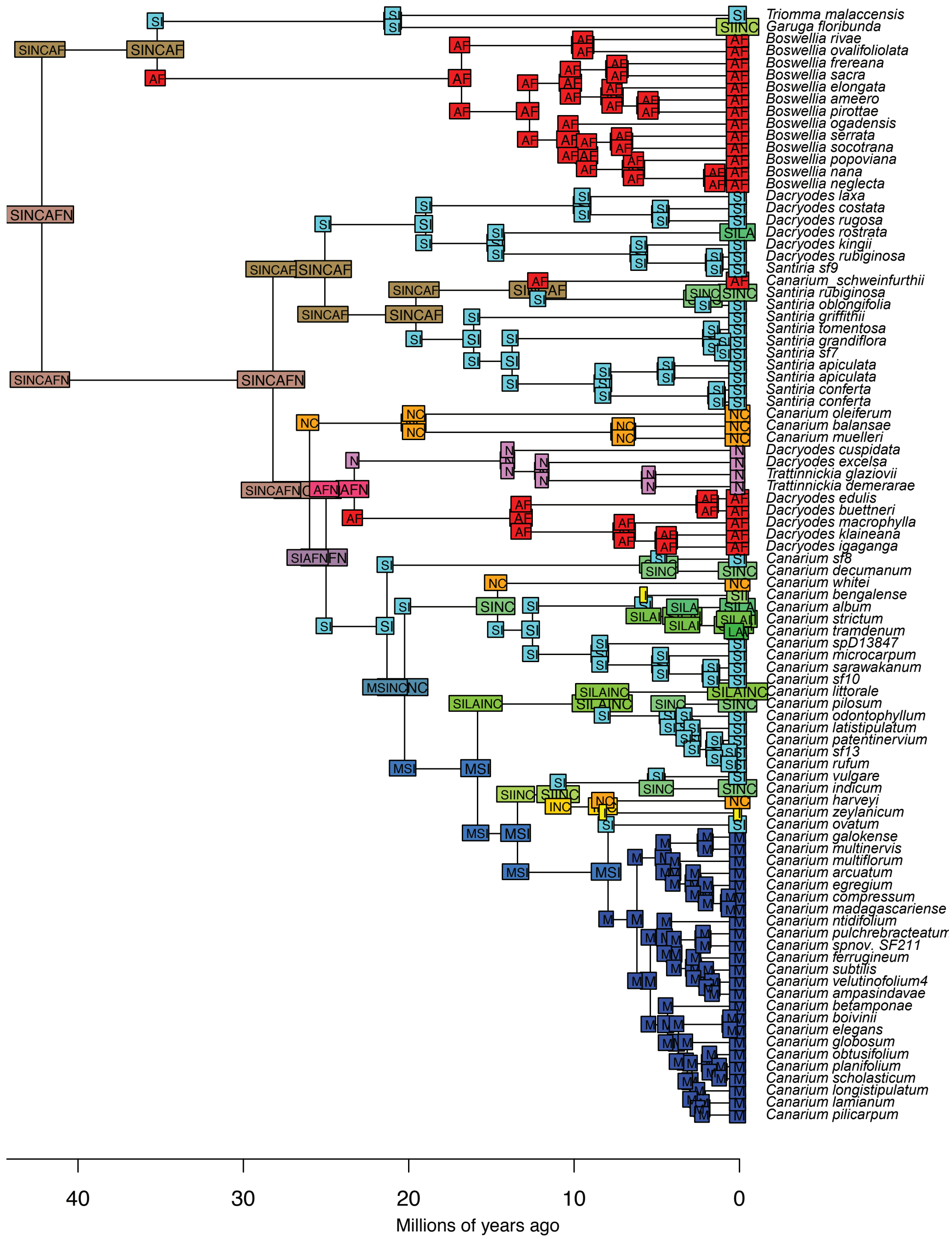
A8, (M)


DEC + j, Marine + Terrestrial model
ancstates: global optim, 7 areas max. d=0.0047; e=5e−04; j=0.0062; LnL=−106.18
Millions of years ago
40
30
20
10
0

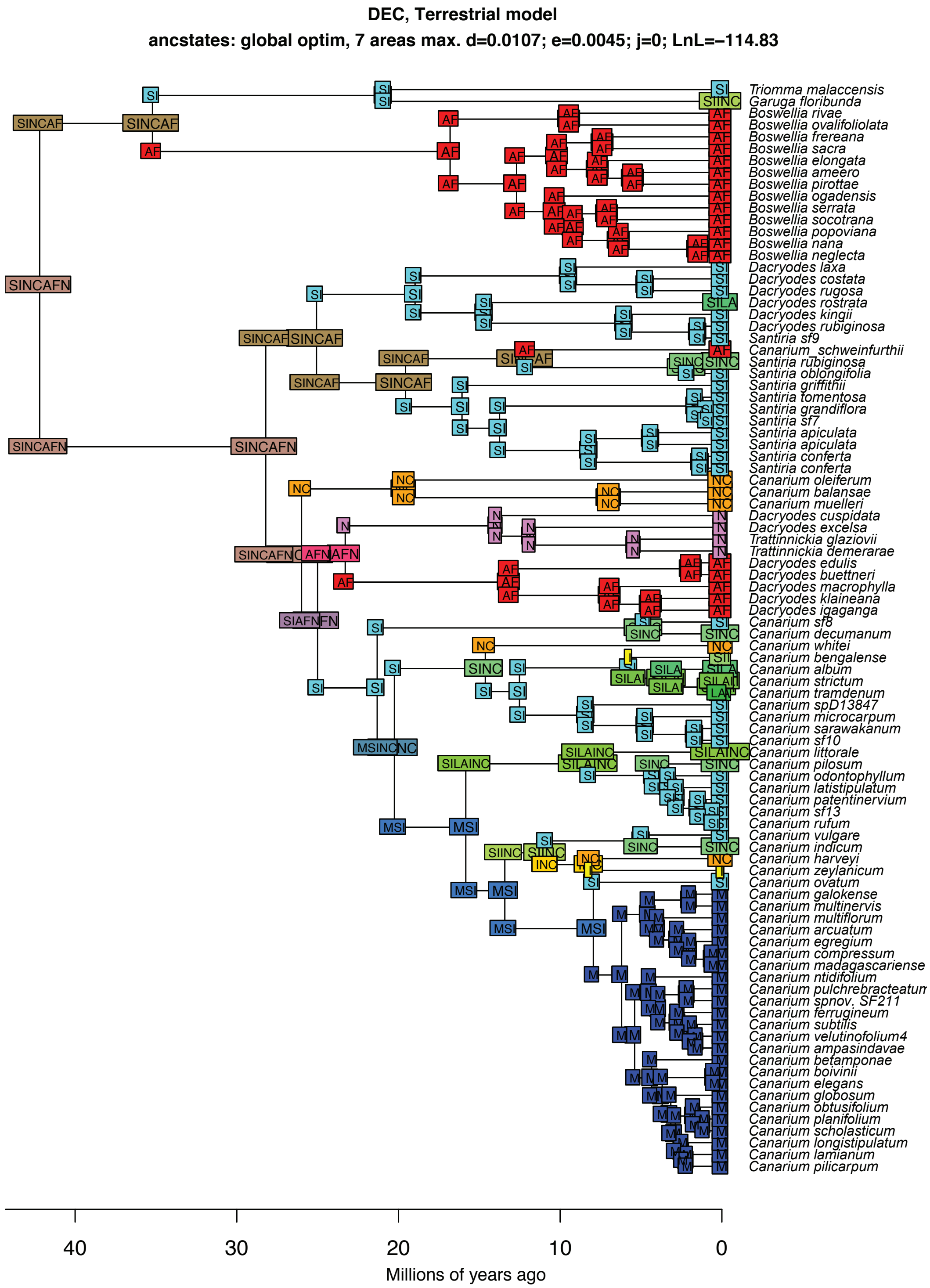
A8, (N)

DEC + j, Terrestrial model

ancstates: global optim, 7 areas max. d=0.0107; e=0.0045; j=0; LnL=−114.83



A8, (O)


DEC, Terrestrial model
ancstates: global optim, 7 areas max. d=0.0107; e=0.0045; j=0; LnL=-114.83
Triomma malaccensis
Garuga floribunda
Boswellia rivae
Boswellia ovalifoliolata
Boswellia frereana
Boswellia sacra
Boswellia elongata
Boswellia ameero
Boswellia pirottae
Boswellia ogadensis
Boswellia serrata
Boswellia socotrana
Boswellia popoviana
Boswellia nana
Boswellia neglecta
Dacryodes laxa
Dacryodes costata
Dacryodes rugosa
Dacryodes rostrata
Dacryodes kingii
Dacryodes rubiginosa
Santiria sf9
Canarium_schweinfurthii
Santiria rubiginosa
Santiria oblongifolia
Santiria griffithii
Santiria tomentosa
Santiria grandiflora
Santiria sf7
Santiria apiculata
Santiria apiculata
Santiria conferta
Santiria conferta
Canarium oleiferum
Canarium balansae
Canarium muelleri
Dacryodes cuspidata
Dacryodes excelsa
Trattinnickia glaziovii
Trattinnickia demerarae
Dacryodes edulis
Dacryodes buettneri
Dacryodes macrophylla
Dacryodes klaineana
Dacryodes igaganga
Canarium sf8
Canarium decumanum
Canarium whitei
Canarium bengalense
Canarium album
Canarium strictum
Canarium tramdenum
Canarium spD13847
Canarium microcarpum
Canarium sarawakanum
Canarium sf10
Canarium littorale
Canarium pilosum
Canarium odontophyllum
Canarium latistipulatum
Canarium patentinervium
Canarium sf13
Canarium rufum
Canarium vulgare
Canarium indicum
Canarium harveyi
Canarium zeylanicum
Canarium ovatum
Canarium galokense
Canarium multinervis
Canarium multiflorum
Canarium arcuatum
Canarium egregium
Canarium compressum
Canarium madagascariense
Canarium ntidifolium
Canarium pulchrebracteatum
Canarium spnov. SF211
Canarium ferrugineum
Canarium subtilis
Canarium velutinofolium4
Canarium ampasindavae
Canarium betamponae
Canarium boivinii
Canarium elegans
Canarium globosum
Canarium obtusifolium
Canarium planifolium
Canarium scholasticum
Canarium longistipulatum
Canarium lamianum
Canarium pilicarpum
40
30
20
10
0
Millions of years ago

A8, (P)

DEC, Marine + Terrestrial model
ancstates: global optim, 7 areas max. d=0.0055; e=0.0016; j=0; LnL=−106.94

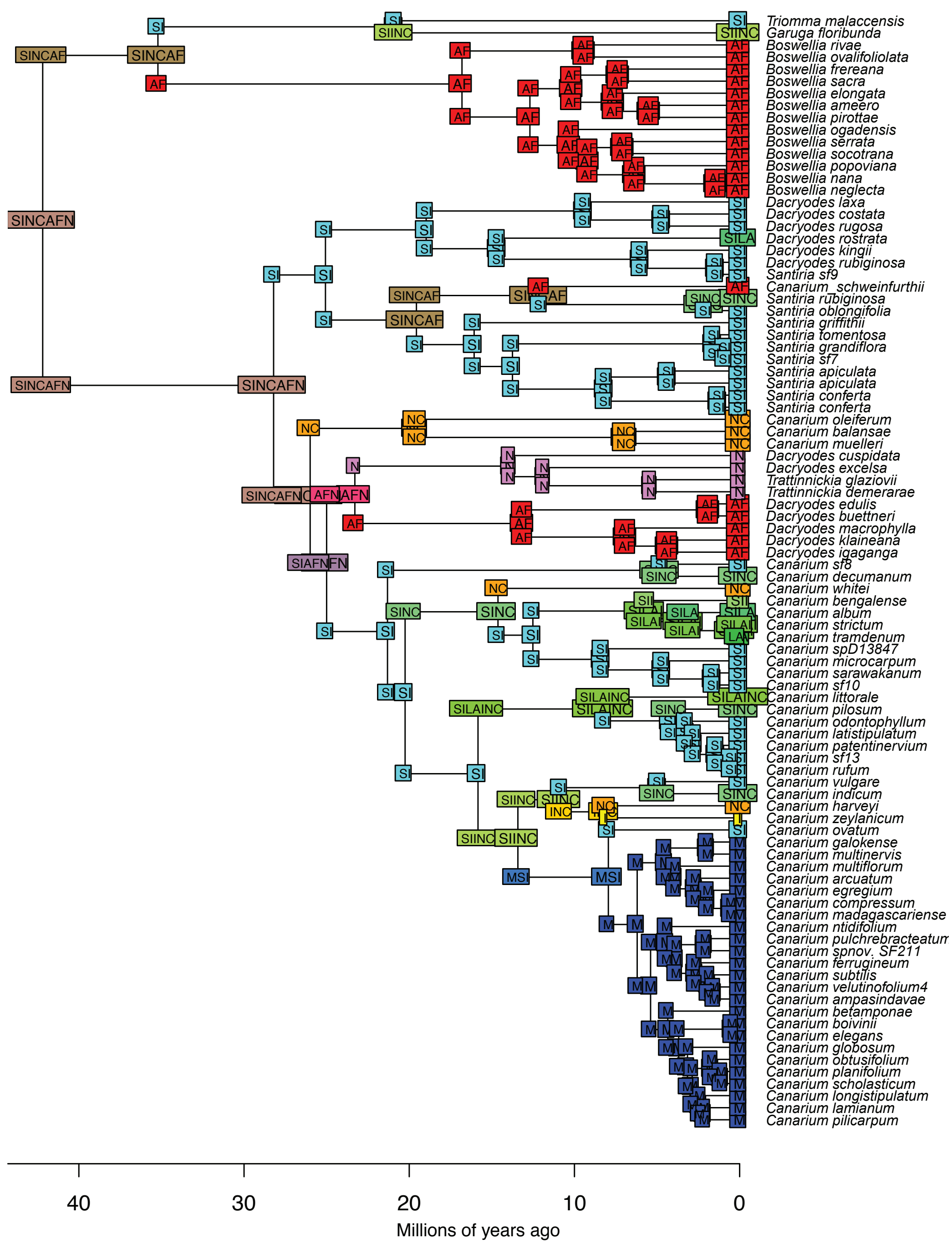


Figure 1. Ancestral area reconstructions in biogeobears (Matzke 2014) using both the fossil tip dated phylogeny (A8, (A-H)) and the fossil-node dated phylogeny (A8, (I-P)). All ancestral areas are ordered according to their AIC weights as listed in Table 1 of the main text and Table 1 of Additional File, A8. Ancestral areas were inferred on each tree using a variety of inference methodologies such as dispersal extinction cladogenesis (DEC) (Ree et al. 2005; Ree & Smith 2008), DEC + founder event speciation (j) (Matzke 2014), BayArea (Landis 2013) and BayArea + j (Matzke 2014). Each inference method is noted at the top of each reconstruction (A-P). Additionally, inferences with each reconstruction methodology were done twice: once for the Marine + Terrestrial model (in the text, this is referred to as the LDD + terrestrial model) and once for the Terrestrial model (in the text, this is referred to as the SD + terrestrial model), the model used is also noted at the top of each phylogeny, along with the maximum number of areas (7), Log Likelihood of the model (LnL), and rates dispersal (d), extinction (e), and j (when applicable) (A-P). The seven biogeographic areas are colored and coded at each phylogeny's tips and in combinations at nodes as follows: **(1)** Africa (AF) colored in red; **(2)** Sundaland and Indochina (SI) colored in teal; **(3)** Neotropics (N) colored in pink; **(4)** India (I) colored in yellow; **(5)** Laurasia (LA) colored in green; **(6)** Madagascar (M) colored in blue; **(7)** South Pacific (including New Caledonia, Australia, and Papua New Guinea [NC]) colored in orange.

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