

**Supplementary material for:**

**Niche evolution of the Neotropical tree genus *Otoba* in the context of global biogeography of the nutmeg family, Myristicaceae**

*Running title:* Biogeography of *Otoba* and Myristicaceae

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**Appendix S1.** Voucher information for *Otoba* samples, in the following format:

Sample ID; Taxon (Accepted Name); Voucher (Herbarium); Provenance; [Latitude, Longitude].

Otoba\_acuminata\_MM2720; **Otoba acuminata** (Standl.) A.H. Gentry; Mary Merello, Allison Miller & Beatriz Wong 2720 (MO); Panama; [09°13'10"N, 079°21'38"W].  
Otoba\_cyclobasis\_MT281; **Otoba cyclobasis** T.S.Jaram. & Balslev; Milton Tirado, E. Albuja & M. Chapiro 281 (MO); Ecuador; [00°43'N, 078°53'W]. Otoba\_glycycarpa\_LV25198; **Otoba glycycarpa** (Ducke) W.A.Rodrigues & T.S.Jaram.; Luis Valenzuela G., Jaime Flores, Gerry Shareva M., et al. 25198 (MO); Peru; [11°21'39"S 074°02'31"W]. Otoba\_gordoniiifolia\_RZ196; **Otoba gordoniiifolia** (A. DC.) A.H. Gentry; R.A. Zahawi 196 (MO); Ecuador; [00°05'N, 079°40'W]. Otoba\_gracilipes\_DC884; **Otoba gracilipes** (A.C. Sm.) A.H. Gentry; D. Cárdenas L. 884 (MO); Colombia; [7°26'20.0"N, 77°07'15.8"W]. Otoba\_latialata\_RC4751; **Otoba latialata** (Pittier) A.H. Gentry; R. Callejas et al. 4751 (MO); Colombia; [7°0'59.36"N, 76°18'31.52"W]. Otoba\_novogranatensis\_AG476; **Otoba novogranatensis** Moldenke; A. Grijalva, C. Aulestia & J. Taicúz 476 (MO); Ecuador; [01°02'N, 078°15'W]. Otoba\_novogranatensis\_CK681; **Otoba novogranatensis** Moldenke; C. Kernan & P. Phillips 681 (MO); Costa Rica; [08°27'N, 083°33'W]. Otoba\_novogranatensis\_EB500; **Otoba novogranatensis** Moldenke; E. Bello C. 500 (MO); Costa Rica; [10°18'36"N, 084°42'00"W]. Otoba\_novogranatensis\_GP2325; **Otoba novogranatensis** Moldenke; G. A. Tipaz, P. Méndez, H. Vargas & M. Chapiro 2325 (MO); Ecuador; [00°45'N, 078°47'W]. Otoba\_novogranatensis\_LG20482; **Otoba novogranatensis** Moldenke; L. D. Gómez P., R. L. Liesner & E. J. Judziewicz 20482 (MO); Costa Rica; [09°38'24"N, 082°48'30"W]. Otoba\_novogranatensis\_WP16081; **Otoba novogranatensis** Moldenke; W. A. Palacios & M. Tirado 16081 (MO); Ecuador; [00°45'N, 078°56'W]. Otoba\_novogranatensis\_WS36336; **Otoba novogranatensis** Moldenke; W. D. Stevens & O. M. Montiel J. 36336 (MO); Nicaragua; [12°17'36"N, 085°05'58"W]. Otoba\_parvifolia\_DN9151; **Otoba parvifolia** (Markgr.) A.H.Gentry; D. A. Neill, F. Hurtado & A. A. Alvarado 9151 (MO); Ecuador, Napo; [00°36'S, 077°23'W]. Otoba\_parvifolia\_MN37243; **Otoba parvifolia** (Markgr.) A.H.Gentry; M. H. Nee 37243 (MO); Bolivia; [17°39'S, 063°43'W] Otoba\_parvifolia\_MS1182; **Otoba parvifolia** (Markgr.) A.H.Gentry; M.S. Silveira 1182 (MO); Brazil, Acre; [08°17'48"S, 071°08'36"W]. Otoba\_parvifolia\_RV19070; **Otoba parvifolia** (Markgr.) A.H.Gentry; R. Vásquez & R. Apanú 19070 (MO); 08 September 1994; Peru, Amazonas, Condorcanqui; 320 m; [04°51'S, 078°18'W]. Otoba\_sp\_nov\_JP16902; **n/a**; J. J. Pipoly, III, Á. Cogollo P. et al. 16902 (MO); Colombia; [06°29'N, 076°14'W]. Otoba\_sp\_nov\_RC5752; **n/a**; R. Callejas, R. Fonnegra G., F. J. Roldán & A. L. Arbeláez 5752 (MO); Colombia; [07°20'N, 076°30'W]. Otoba\_vespertilio\_GM12543; **Otoba vespertilio** D. Santam. & J.E. Jiménez; Gordon McPherson 12543 (MO); Panama; [08°47'03"N, 082°10'52"W].

## Appendix S2. Myristicaceae GenBank accession numbers

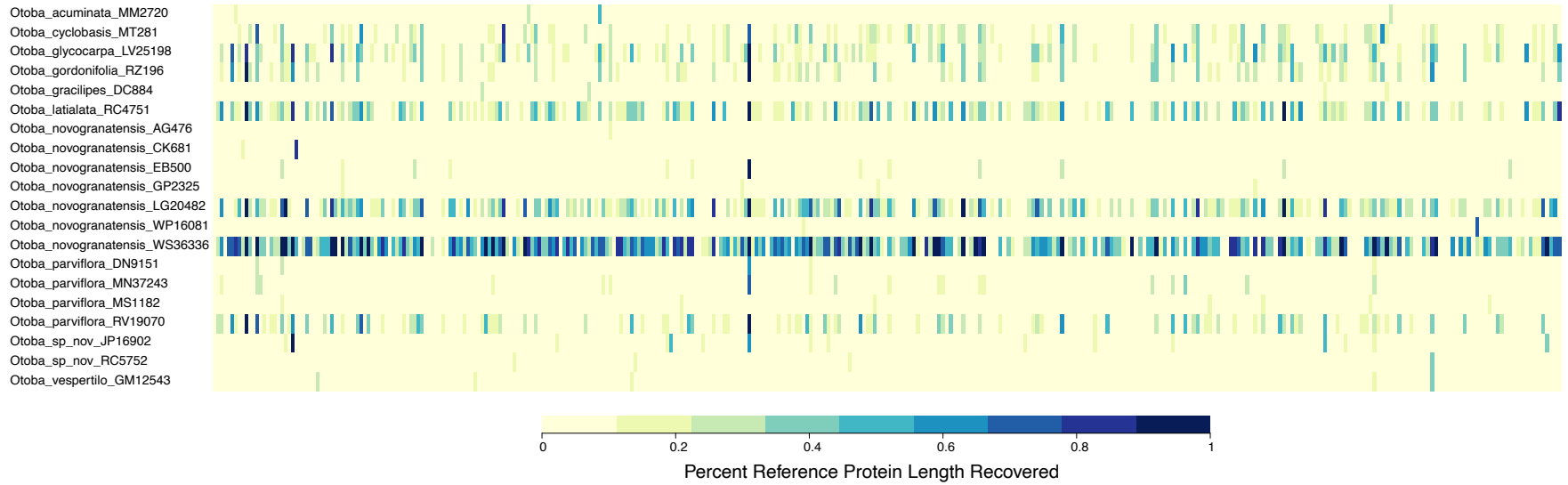
Species	matK	rbcl	ndhF
<i>Ambavia gerrardii</i>	AY220435	-	AY218168
<i>Anaxagorea acuminata</i>	AY220436	-	AY218169
<i>Annickia kummeriae</i>	AY238961	-	-
<i>Annona muricata</i>	-	-	AY218170
<i>Artabotrys hexapetalus</i>	AY238962	-	-
<i>Asimina triloba</i>	AY220437	-	AY218171
<i>Brochoneura acuminata</i>	AY220442	-	AY218179
<i>Cananga odorata</i>	AY220438	-	AY218172
<i>Cassytha filiformis</i>	-	-	-
<i>Cephalosphaera usambarensis</i>	AY220443	-	AY218180
<i>Coelocaryon oxycarpum</i>	AY220444	-	AY218181
<i>Compsonera atopa</i>	EU090469	EU090508	-
<i>Compsonera capitellata</i>	EU090473	EU090509	-
<i>Compsonera debilis</i>	EU090475	EU090514	-
<i>Compsonera excelsa</i>	EU090482	EU090518	-
<i>Compsonera mutisii</i>	EU090496	EU090532	-
<i>Compsonera sprucei</i>	AY220445	EU090539	AY218182
<i>Compsonera ulei</i>	EU090505	EU090541	-
<i>Degeneria roseiflora</i>	AY220440	-	AY218174
<i>Gymnacranthera contracta</i>	MH332593	-	-
<i>Gymnacranthera forbesii</i>	MH332622	-	-
<i>Horsfieldia amygdalina</i>	KR530941	KR529438	-
<i>Horsfieldia amygdalina</i>	MF547527	-	-
<i>Horsfieldia grandis</i>	MH332620	-	-
<i>Horsfieldia kingii</i>	KR530945	KR529441	-
<i>Horsfieldia pandurifolia</i>	NC042225	NC042225	NC042225
<i>Horsfieldia polyspherula</i>	KJ708961	MG817045	-
<i>Horsfieldia prainii</i>	KR530951	KR529444	-
<i>Horsfieldia pulcherrima</i>	MG816907	MG817055	-
<i>Horsfieldia punctatifolia</i>	AY220448	-	AY218184
<i>Horsfieldia subglobosa</i>	MH332591	-	-
<i>Iryanthera hostmanni</i>	AY220449	JQ625774	AY218185
<i>Iryanthera sagotiana</i>	FJ514645	JQ625975	-
<i>Isolona campanulata</i>	AY238963	-	-
<i>Knema cinerea</i>	KJ708967	KJ594758	-
<i>Knema elegans</i>	KR530962	KR529456	-
<i>Knema furfuracea</i>	KR530963	KR529457	-
<i>Knema globularia</i>	AB924868	KR529464	-
<i>Knema hookeriana</i>	KJ708968	KJ594760	-
<i>Knema laurina</i>	AY220450	KJ594761	AY218186
<i>Knema lenta</i>	KR530973	KR529465	-

<i>Knema linifolia</i>	KR530976	KR529470	-
<i>Knema patentinervia</i>	KJ708971	KJ594762	-
<i>Knema tenuinervia</i>	KR530977	KR529476	-
<i>Malmea dielsiana</i>	AY238964	AY238955	-
<i>Mauloutchia chapelieri</i>	AY220451	AF197594	AY218187
<i>Michelia audiaei</i>	MN990580	MN990580	MN990580
<i>Myristica andamanica</i>	MF547528	MF158638	-
<i>Myristica beddomei</i>	MF547537	MF186600	-
<i>Myristica cinnamomea</i>	KJ709010	KJ594811	-
<i>Myristica fragrans</i>	KT445278	AF206798	AY218188
<i>Myristica gigantea</i>	MG816899	MG817047	-
<i>Myristica malabarica</i>	MF547530	KY945260	-
<i>Osteophloeum platyspermum</i>	JQ626371	JQ625884	-
<i>Polyalthia suberosa</i>	AY220439	-	-
<i>Pycnanthus angolensis</i>	AY220453	-	AY218189
<i>Staudtia gabonensis</i>	KC627785	KC628454	-
<i>Staudtia kamerunensis</i>	KC627748	KC628429	-
<i>Uvaria afzelii</i>	AY238966	-	-
<i>Virola koschnyi</i>	EU669473	JQ592895	-
<i>Virola kwatae</i>	FJ514688	JQ626043	-
<i>Virola multiflora</i>	GQ982125	GQ981913	-
<i>Virola nobilis</i>	GQ982126	GQ981914	-
<i>Xylopia peruviana</i>	AY238967	-	-

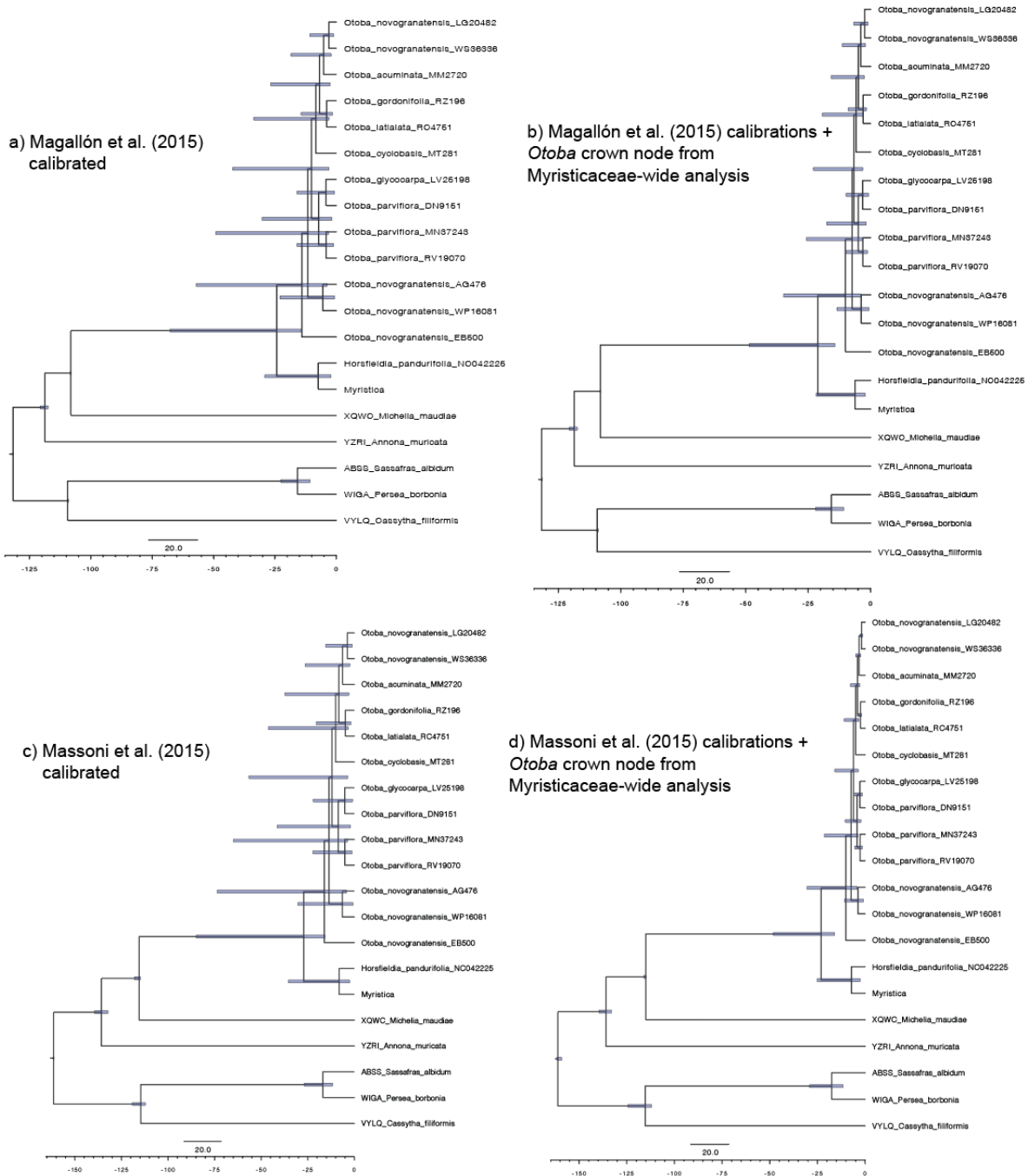
**Appendix S3.** Summary of sequence data recovered for each sample for targeted and off-target (cpDNA) loci. Asterisks at sample names indicate samples that were not included in any phylogenetic analysis. Samples for which there was insufficient cpDNA data to include in phylogenetic analyses are marked with “n/a”.

Sample	Mean sequence length (bp)	# of loci	Length of ungapped cpDNA (bp)	Collection year	Annual precipitation (mm)
<i>Otoba acuminata</i> _MM2720	209.25	4	39,553	2001	3,021
<i>Otoba cyclobasis</i> _MT281	183.9	73	3,399	1993	2,265
<i>Otoba glycyarpa</i> _LV25198	227.88	96	32,401	2013	1,842
<i>Otoba gordoniiifolia</i> _RZ196	206.51	61	20,318	1996	1,933
<i>Otoba gracilipes</i> _DC884*	192	2	n/a	1987	3,065
<i>Otoba latialata</i> _RC4751	244.39	142	42,374	1987	2,610
<i>Otoba novogranatensis</i> _AG476	102	1	3,533	1993	3,048
<i>Otoba novogranatensis</i> _CK681	174	2	13,653	1988	3,499
<i>Otoba novogranatensis</i> _EB500*	208.91	11	n/a	1988	3,524
<i>Otoba novogranatensis</i> _GP2325	186.75	4	41,378	1992	2,057
<i>Otoba novogranatensis</i> _LG20482	299.92	157	111,863	1983	3,244
<i>Otoba novogranatensis</i> _WP16081	90	1	47,902	1993	2,326
<i>Otoba novogranatensis</i> _WS36336	457.56	217	n/a	2015	1,864
<i>Otoba parvifolia</i> _DN9151*	183	4	n/a	1989	3,870
<i>Otoba parvifolia</i> _MN37243	173.47	17	28,315	1988	1,449
<i>Otoba parvifolia</i> _MS1182	139.5	6	72,683	1995	2,109
<i>Otoba parvifolia</i> _RV19070	215.62	86	n/a	1994	2,095
<i>Otoba sp. nov.</i> _JP16902*	145.41	17	n/a	1992	2,438
<i>Otoba sp. nov.</i> _RC5752*	126	5	n/a	1987	3,732
<i>Otoba vespertilio</i> _GM12543	131	3	1,532	1988	3,561

**Appendix S4.** Heatmap showing the percent reference protein length recovered for all samples across all 353 loci.



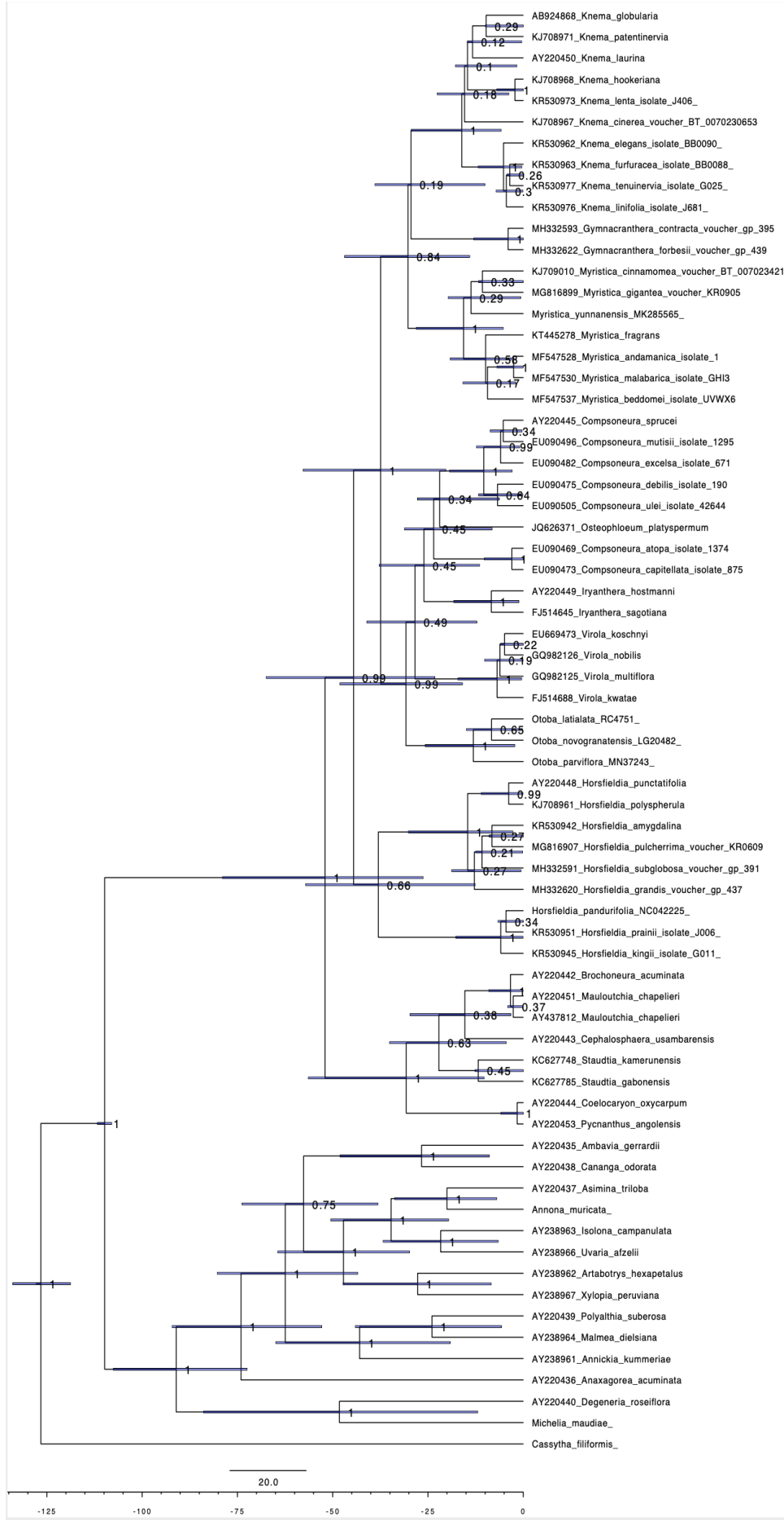
**Appendix S5.** Divergence date estimations of *Otoba* using difference calibration schema (denoted to left of phylogeny).



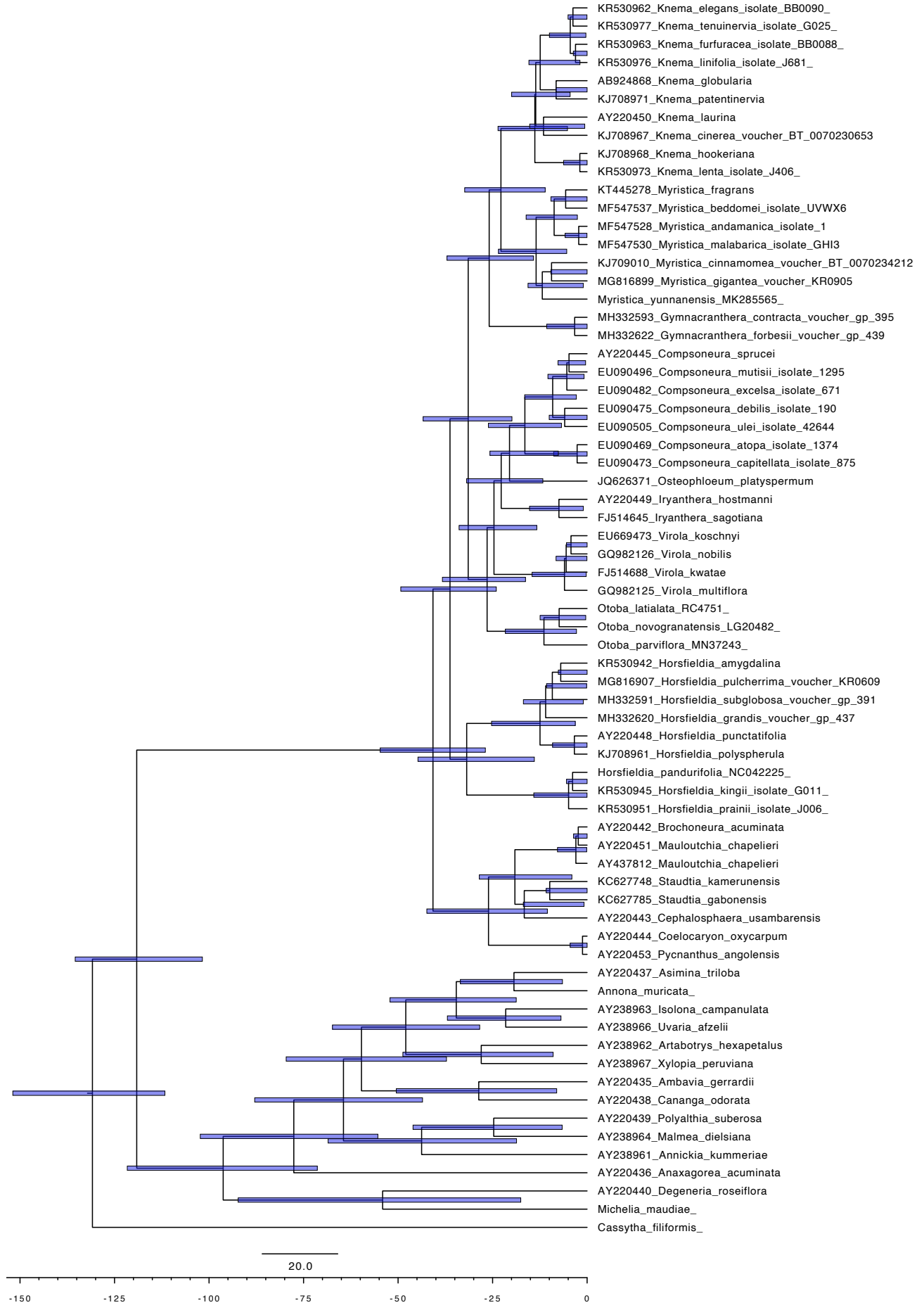
**Figure S5.** treePL divergence date estimations with different calibration schemes. a) and b) include secondary calibrations derived from Magallón et al. (2015) at the nodes corresponding to Laurales + Magnoliales, Laurales, Magnoliales, and Myristicaceae; b) additionally includes a calibration for the crown node of *Otoba* derived from our densely sampled, family-wide BEAST2 analysis of Myristicaceae calibrated with dates from Magallón et al (2015). c) and d) include secondary calibrations derived from Massoni et al. (2015) at the nodes corresponding to Laurales + Magnoliales, Laurales, Magnoliales, and Myristicaceae; d) additionally includes a calibration for the crown node of *Otoba* derived from our densely sampled, family-wide BEAST2 analysis of Myristicaceae calibrated with dates from Massoni et al (2015). Bars at nodes represent 95% confidence intervals as inferred across 100 RAxML bootstrap replicates.

**Appendix S6.** Divergence date estimation from BEAST2 analysis of Myristiaceae using the Magallón et al. (2015) calibration scheme. Values at nodes correspond to the posterior probability, while bars at nodes represented the 95% HPD on the estimated age of the node, with time scale below phylogeny in millions of years before present. (Figure on next page)





**Appendix S7.** Divergence date estimation from BEAST2 analysis of Myristicaceae using the Massoni et al. (2015) calibration scheme. Values at nodes correspond to the posterior probability, while bars at nodes represented the 95% HPD on the estimated age of the node with time scale below phylogeny in millions of years before present. (Figure on next page)



**Appendix S8.** Average values for each BIOCLIM variable and elevation in *Otoba*. A description of each bioclimatic variable can be found on the WorldClim website (<https://www.worldclim.org/data/bioclim.html>).

species	BIO1	BIO2	BIO3	BIO4	BIO5	BIO6	BIO7	BIO8	BIO9	BIO10	BIO11	BIO12	BIO13	BIO14	BIO15	BIO16	BIO17	BIO18	BIO19	Elevation
<i>acuminata</i>	24.64	8.05	81.37	59.04	29.81	19.92	9.89	24.43	24.92	25.45	23.99	2917.25	413.34	66.94	48.61	1066.25	275.81	522.28	852.25	404.84
<i>cyclobasis</i>	23.72	8.52	87.41	33.67	28.73	18.97	9.76	24.08	23.48	24.17	23.38	2224.57	283.14	100.43	35.38	794.71	356.86	741.43	429.71	405.86
<i>glycyarpa</i>	24.04	9.53	82.77	50.71	29.60	18.08	11.51	23.93	23.97	24.54	23.32	2927.28	337.47	162.28	26.65	952.24	515.58	682.83	714.08	543.70
<i>gordonifolia</i>	19.46	8.93	88.10	36.04	24.58	14.42	10.15	19.52	19.40	19.89	19.04	2067.50	296.54	64.08	49.44	814.19	245.00	676.53	473.68	1380.33
<i>latialata</i>	24.55	8.17	86.77	38.33	29.37	19.96	9.40	24.23	24.73	25.04	24.09	4127.77	522.05	168.54	37.46	1392.22	628.37	868.07	1248.70	448.46
<i>novogranatensisCA</i>	24.20	8.67	80.03	69.02	29.78	18.96	10.82	23.92	24.42	25.15	23.42	3031.06	473.82	46.26	56.74	1213.22	209.37	537.39	885.85	432.73
<i>novogranatensisSA</i>	22.52	8.67	87.29	39.20	27.55	17.60	9.95	22.62	22.43	23.00	22.05	2752.89	367.19	101.41	44.34	1003.30	371.61	774.67	692.98	799.55
<i>parvifolia</i>	24.18	9.79	82.33	60.19	29.90	17.97	11.93	24.25	23.85	24.77	23.33	2710.19	325.99	135.41	32.68	918.32	438.74	677.39	593.91	511.48

**Appendix S9.** Loadings of phylogenetic PCA of BIOCLIM variables in *Otoba*. A description of each bioclimatic variable can be found on the WorldClim website (<https://www.worldclim.org/data/bioclim.html>).

	PC1	PC2	PC3	PC4
BIO1	0.9590468	0.14849091	-0.12600397	0.20116525
BIO2	-0.4602410	0.20067826	-0.77533178	-0.36089120
BIO3	-0.4027127	-0.89055722	0.13301025	0.08391671
BIO4	0.2890433	0.92875105	-0.08879483	-0.19983694
BIO5	0.9271045	0.26345593	-0.20576943	0.15920598
BIO6	0.9564835	0.03836619	0.07135413	0.27848748
BIO7	-0.2007299	0.56990207	-0.71722923	-0.34127397
BIO8	0.9319273	0.12154685	-0.17278971	0.28132250
BIO9	0.9685474	0.17064102	-0.05535913	0.17190043
BIO10	0.9502414	0.22187517	-0.09810446	0.18980573
BIO11	0.9617379	0.08309425	-0.09836778	0.23662162
BIO12	0.9104890	-0.15241647	0.15008476	-0.35080041
BIO13	0.8240385	0.09699091	0.38962441	-0.39547895
BIO14	0.6495930	-0.58925208	-0.42578738	-0.18673285
BIO15	-0.3713011	0.56788707	0.69624654	-0.16370803
BIO16	0.8466405	0.01969772	0.32392806	-0.41709562
BIO17	0.7224432	-0.59367026	-0.27452234	-0.20035213
BIO18	0.3329619	-0.88486442	-0.09434808	-0.17350519
BIO19	0.8706295	-0.06163663	0.29534788	-0.37339337

**Appendix S10.** Ancestral state reconstruction of individual phylogenetic principal components of BIOCLIM variables in *Otoba* (See Appendix S9). Analysis conducted with contMap in phytools.

