

Supplementary material

Phylogenetic assessment of pollen characters in Myrtaceae

Andrew H. Thornhill^{A,B} and Michael D. Crisp^A

^ADivision of Evolution, Ecology and Genetics, Research School of Biology, The Australian National University, Canberra, ACT 0200, Australia.

^BCorresponding author. Email: andrew.thornhill@anu.edu.au



Fig. S1. RaxML of combined ITS, *matK* and *ndhF* Myrtaceae sequences with posterior support values at each node.

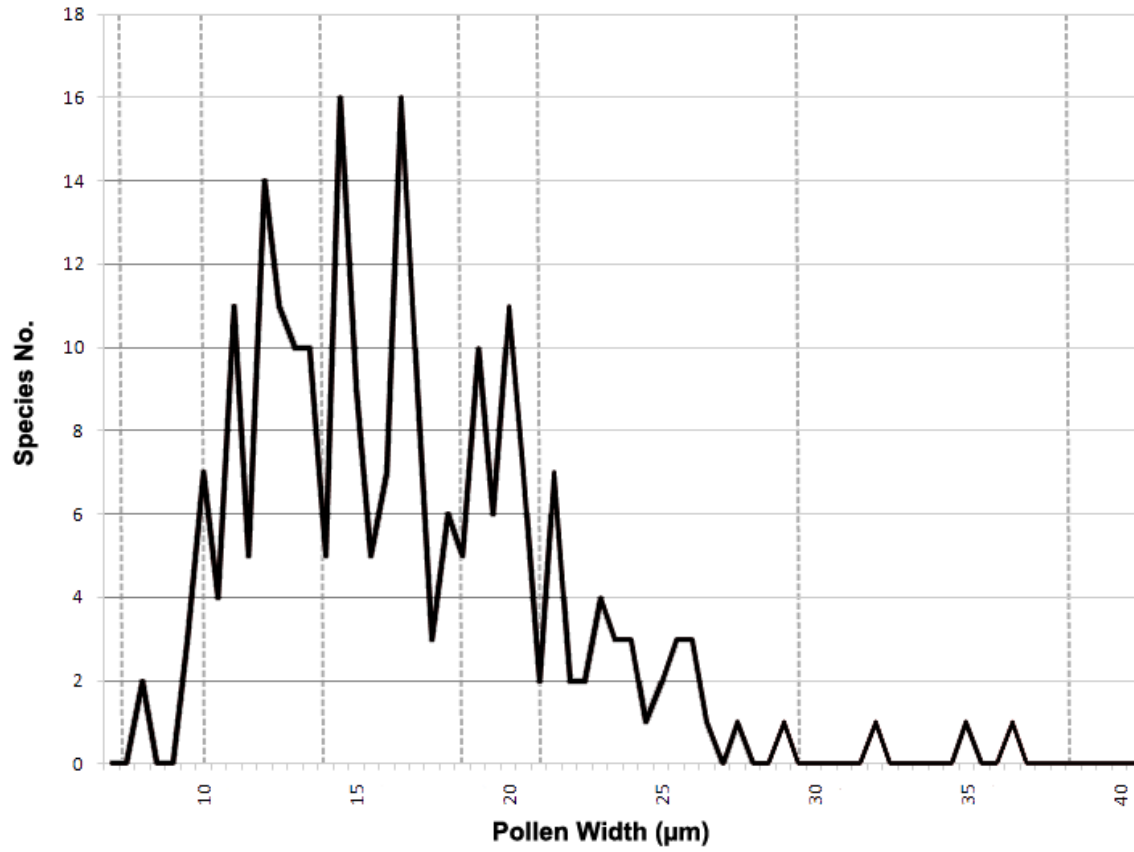


Fig. S2. Histogram representing the pollen width range of Myrtaceae. Broken lines indicate discrete measurement bins selected for tree optimisation.

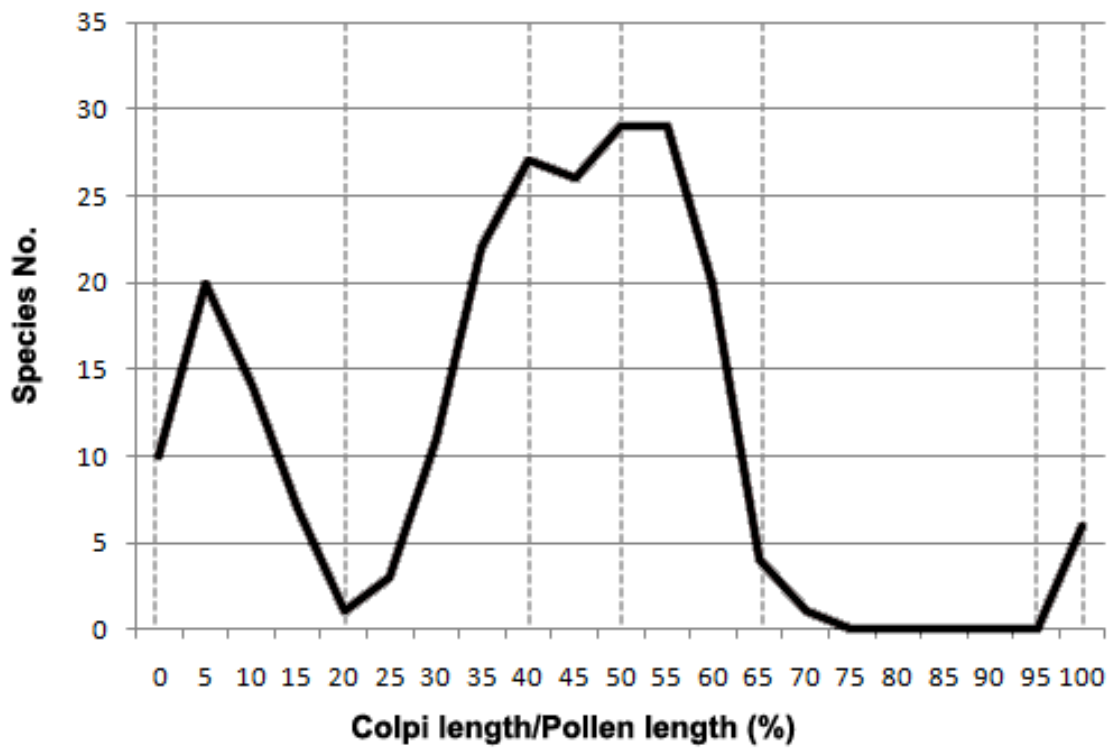


Fig. S3. Histogram representing the colpus/length ratio range of Myrtaceae species. Broken lines indicate discrete measurement bins selected for tree optimisation.

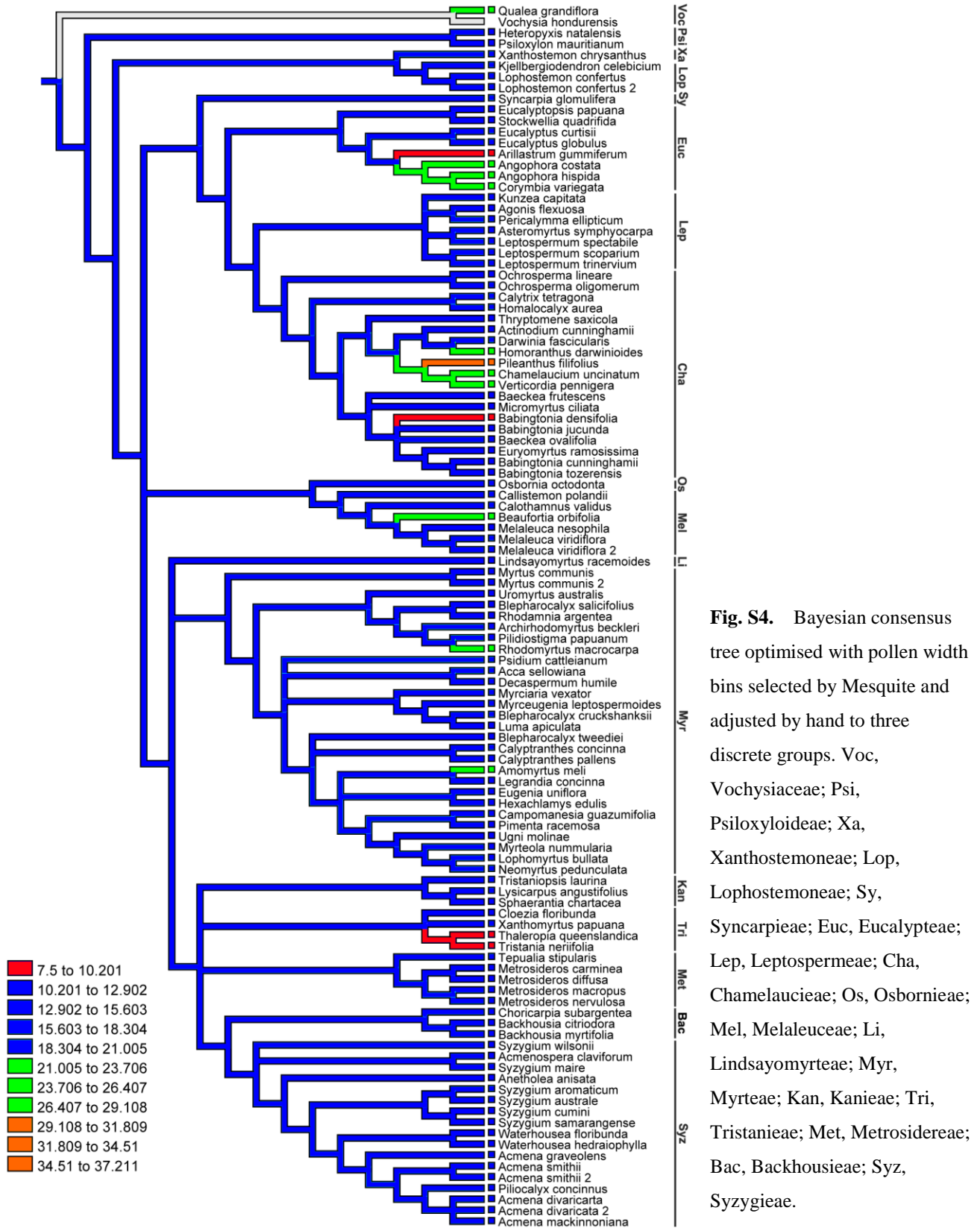


Fig. S4. Bayesian consensus tree optimised with pollen width bins selected by Mesquite and adjusted by hand to three discrete groups. Voc, Vochysiaceae; Psi, Psiloxylloideae; Xa, Xanthostemoneae; Lop, Lophostemoneae; Sy, Syncarpieae; Euc, Eucalyptae; Lep, Leptospermeae; Cha, Chamelaucieae; Os, Osbornieae; Mel, Melaleuceae; Li, Lindsayomyrteae; Myr, Myrteae; Kan, Kanieae; Tri, Tristanieae; Met, Metrosidereae; Bac, Backhouseiae; Syz, Syzygieae.

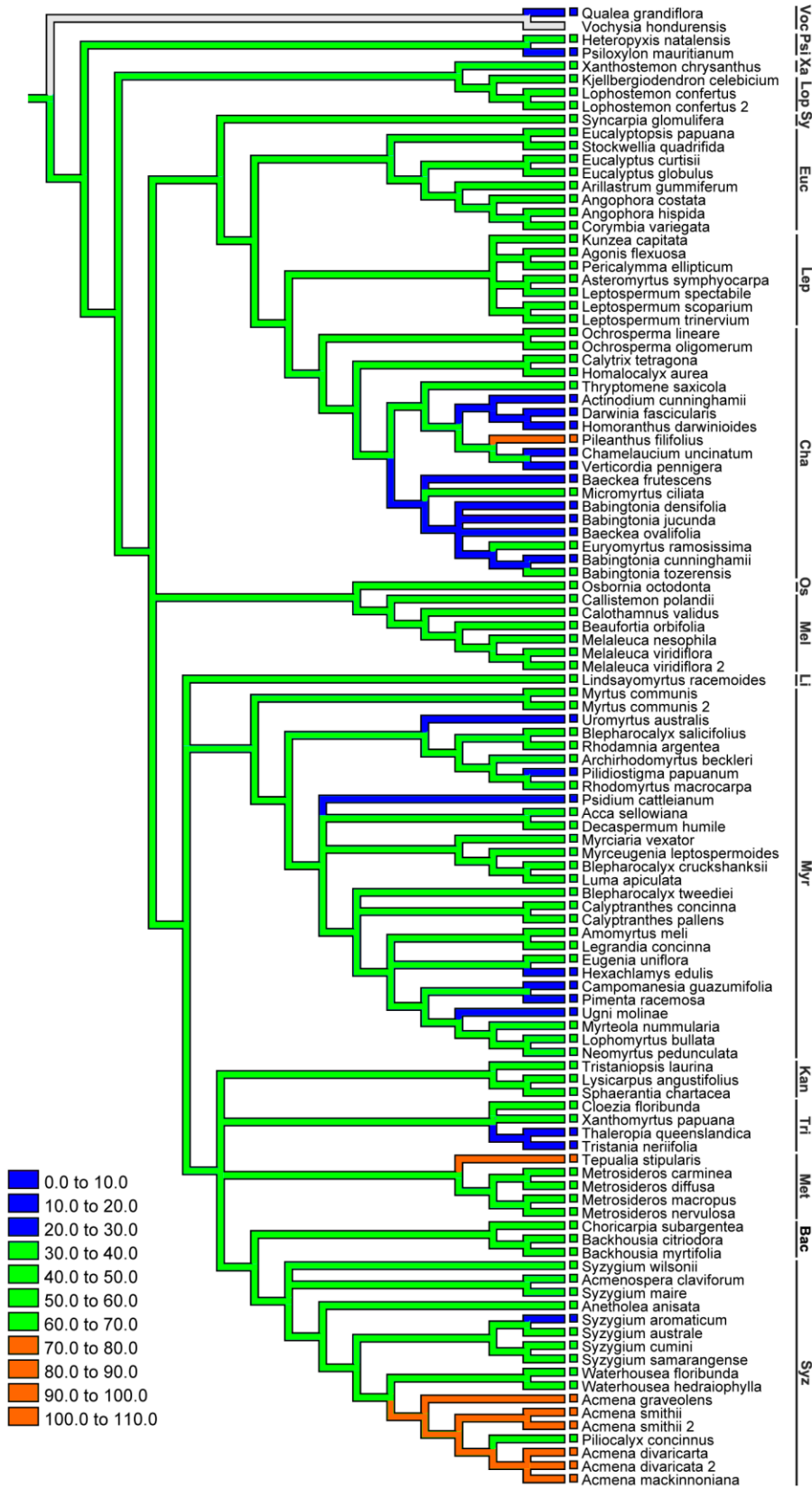


Fig. S5. Bayesian consensus tree optimised with colpus/pollen ratio bins selected by Mesquite and adjusted by hand to three discrete groups.

Table S1. Taxa and sequences used in phylogenetic analyses

Taxon	GenBank accession		
	ITS	<i>matK</i>	<i>ndhF</i>
<i>Acca sellowiana</i> (O. Berg) Burret	AM234067.1	AY525128.1	AY498783.1
<i>Acmena divaricata</i> Merr. & L.M.Perry	AY187161.2	DQ088538.1	DQ088463.1
<i>Acmena divaricata</i> 2 Merr. & L.M.Perry	AY187160.2	DQ088538.1	DQ088463.1
<i>Acmena graveolens</i> (F.M. Bailey) L. S. Sm.	AY187163.2	AF368194.1	AY498759.1
<i>Acmena mackinnoniana</i> B.Hyland	AY187165.2	DQ088543.1	DQ088467.1
<i>Acmena smithii</i> (Poir.) Merr. & L.M.Perry	AM234137.1	AM489974.1	AY498760.1
<i>Acmena smithii</i> (Poir.) Merr. & L.M.Perry	AY187168.2	–	DQ088469.1
<i>Acmenosperma claviflorum</i> (Roxb.) Kausel	AY187169.2	DQ088546.1	DQ088470.1
<i>Actinodium cunninghamii</i> Schauer	–	AF489394.2	AY498761.1
<i>Agonis flexuosa</i> (Willd.) Sweet	DQ499115.1	AF184711.2	AY498762.1
<i>Amomyrtus meli</i> (Phil.) D.Legrand & Kausel	AM234069.1	AM489976.1	–
<i>Anetholea anisata</i> (Vickery) Peter G. Wilson	AM234138.1	AF368195.2	DQ088471
<i>Angophora costata</i> Britten	AF058455.1	–	AM235418.1
<i>Angophora hispida</i> (Sm.) Blaxell	–	AF368196.2	AY498763.1
<i>Archirhodomomyrtus beckleri</i> (F.Muell.) A.J. Scott	–	AF368197.1	AY498764.1
<i>Arillastrum gummiferum</i> (Brongn. & Gris) Pancher ex Baill.	AF058454	AF368198.2	AY498765.1
<i>Asteromyrtus symphyocarpa</i> (F.Muell.) Craven	EF041509.1	AF184719.1	–
<i>Babingtonia cunninghamii</i> (Schauer) A.R.Bean	–	AF489356.2	EF581215.1
<i>Babingtonia densifolia</i> (Sm.) F.Muell.	–	AF489357.2	EF581216.1
<i>Babingtonia jucunda</i> (S.T.Blake) A.R.Bean	–	EF581198.1	EF581218.1
<i>Babingtonia tozerensis</i> A.R. Bean	–	AF368199.3	AY498767.1
<i>Backhousia citriodora</i> F. Muell.	–	AY525129.1	AY498768.1
<i>Backhousia myrtifolia</i> Hook.	EF026609.1	AF368200.2	AY498769.1
<i>Baeckea frutescens</i> L.	–	AF489365.1	AY498770.1
<i>Baeckea ovalifolia</i> (F.Muell.) F.Muell.	–	EF581206.1	EF581225.1
<i>Beaufortia orbifolia</i> F. Muell.	AF048888.1	AY521530.1	AY498766
<i>Blepharocalyx cruckshanksii</i> (Hook. & Arn.) Nied	AM234070.1	AM489978.1	–
<i>Blepharocalyx salicifolius</i> (Kunth) O.Berg	AM234084.1	AM489979.1	–
<i>Blepharocalyx tweediei</i> (Hook. et Arn.) O. Berg	–	AY521531.1	AY498772.1
<i>Callistemon polandii</i> F.M. Bailey	AF048856.1	AF184705.3	AY498773.
<i>Calothamnus validus</i> S. Moore	–	AF184704.2	AY498774.1
<i>Calyptranthes concinna</i> DC.	AM234103.1	AM489980.1	AY498775.1
<i>Calyptranthes pallens</i> Griseb.	–	AF368201	AY498776.1
<i>Calytrix tetragona</i> Labill.	HM160102/03	AF489396.1	AY498777.1
<i>Campomanesia guazumifolia</i>	AM234076.1	AM489982.1	DQ088473.1
<i>Chamelaucium uncinatum</i> Schauer	EF026605.1	AY259816.1	–
<i>Choricarpia subargentea</i> (C.T. White) L.A.S.Johnson	EF026610.1	AF368202.2	AY498778.1
<i>Cloezia floribunda</i> Brongn. & Gris	AF172767.1	AY521533.1	–
<i>Corymbia variegata</i> (F. Muell.) K.D.Hill & L.A.S.Johnson	AF390462.1	AF368203.2	–
<i>Darwinia fascicularis</i> Rudge	–	AF368204.2	AY498780.1
<i>Decaspermum humile</i> (G. Don) A.J. Scott	AM234128.1	AY521534.1	AY498781.1
<i>Eucalyptopsis papuana</i> C.T.White	AF190354.1	AF368205.2	–
<i>Eucalyptus curtisii</i> Blakely & C.T.White	AF390524.1	AF368206.2	AY498781
<i>Eucalyptus globulus</i> Labill.	AY615678.1	AY521535.1	AY780259
<i>Eugenia uniflora</i> L.	AM234088.1	AF368207.2	DQ088457.1
<i>Euryomyrtus ramosissima</i> (A.Cunn.) Trudgen	–	AF489376.1	AY498824.1
<i>Heteropyxis natalensis</i> Harv.	HM160104/05	AF368208.2	AY498784.1
<i>Hexachlamys edulis</i> (O. Berg) Klaus et Legr.	–	AY525131.1	AY498785.1
<i>Homalocalyx aureus</i> (C.A.Gardner) Craven	HM160106/07	–	AY498785
<i>Homoranthus darwinioides</i> (Maiden & Betche) Cheel	HM160108	–	AY498786.1
<i>Kjellbergiodendron celebicum</i> (Koord.) Merrill	HM160109/10	AF368209.1	AY498788
<i>Kunzea capitata</i> (Sm.) Heynh.	–	AF184721.1	AY498790

Taxon	GenBank accession		
	ITS	<i>matK</i>	<i>ndhF</i>
<i>Legrandia concinna</i> (Phil.) Kausel	AM234072.1	AF184724.1	–
<i>Leptospermum scoparium</i> J.R.Forst. & G.Forst.	AM234142.1	AY521538.1	–
<i>Leptospermum spectabile</i> Joy Thomps.	–	AY521539.1	AY498791
<i>Leptospermum trinervium</i> (Sm.) Joy Thomps.	–	AF184735.2	AY498792
<i>Lindsayomyrtus racemoides</i> (Greves) Craven	HM160111/12	AF184706.2	AY498793
<i>Lophomyrtus bullata</i> Burret	AM234145.1	AM489992.1	–
<i>Lophostemon confertus</i> (R.Br.) Peter G.Wilson & J.T.Waterh.	AF048897.1	AF184707.2	AY498794
<i>Lophostemon confertus</i> (R.Br.) Peter G.Wilson & J.T.Waterh.	AF390444.1	AM489994.1	–
<i>Luma apiculata</i> (DC) Burret	AM234101.1	AM489995.1	AY498795
<i>Lysicarpus angustifolius</i> (Hook.) Druce	–	AF368210.2	AY498796.1
<i>Melaleuca nesophila</i> F.Muell.	AF294591.1	AY525135.1	AY498797
<i>Melaleuca viridiflora</i> Gaertn.	AF294603.1	AF184708.1	AY498798.1
<i>Melaleuca viridiflora</i> Gaertn.	AF294609.1	–	EU410173.1
<i>Metrosideros carminea</i> W.R.B.Oliver	AF211498.1	AY521541.1	AY498799
<i>Metrosideros diffusa</i> (G. Forst.) Sm.	AF211500.1	AY521542.1	AY498800
<i>Metrosideros macropus</i> Hook. & Arn.	AF172745.1	AF368212.2	AY498801
<i>Metrosideros nervulosa</i> C.Moore & F.Muell.	AF172747.1	DQ088535.1	DQ088458.1
<i>Micromyrtus ciliata</i> (Sm.) Druce	HM160113/14	AF489400.1	–
<i>Myrceugenia leptospermoides</i>	AM234075.1	AM489999.1	–
<i>Myrciaria vexator</i> McVaugh	–	AY521544.1	AY498804.1
<i>Myrteola nummularia</i> (Lam.) O.Berg	AM234068.1	AM490008.1	–
<i>Myrtus communis</i> L.	AM234149.1	AM490009.1	AF215593.1
<i>Myrtus communis</i> L.	–	AY525136.1	EU002244.1
<i>Neomyrtus pedunculata</i> (Hook.f.) Allan	AM234144.1	AM490010.1	–
<i>Ochrosperma lineare</i> (C.T.White) Trudgen	–	AF489384.2	EF581229.1
<i>Ochrosperma oligomerum</i> (Radlk.) A.R.Bean	–	AF489385.2	EF581230.1
<i>Osbornia octodonta</i> F.Muell.	EF041844.1	AF368213.2	DQ088459.1
<i>Pericalymma ellipticum</i> var. <i>ellipticum</i>	EF026604.1	AF184740.1	AY498806.1
<i>Pileanthus filifolius</i> Labill.	–	EF581210.1	EF581231
<i>Pilidiostigma papuanum</i> (Lauterb.) A.J. Scott	–	AF368214.1	AY498807.1
<i>Ptilocalyx concinnus</i> A.C.Sm.	EF026615.1	DQ088550.1	DQ088476.1
<i>Pimenta racemosa</i> (Mill.) J.W. Moore	AM234082.1	AY521545.	AY498808
<i>Psidium cattleianum</i> Sabine	AM234080	AB354959.1	HM160101
<i>Psiloxylon mauritianum</i> (Hook. f.) Baill.	EF026606.1	AF368215.2	AY498825
<i>Qualea grandiflora</i> Mart. (Vochysiaceae)	–	AF368216.1	AY498829
<i>Rhodamnia argentea</i> Benth.	AM234129.1	AF368217.1	AY498810
<i>Rhodomyrtus macrocarpa</i> Benth.	–	AY525137.1	AY498811
<i>Sphaerantia chartacea</i> Peter G. Wilson & B. Hyland	HM160115/16	AY521547.1	–
<i>Stockwellia quadrifida</i> D.J. Carr, S.G.M.Carr & B.Hyland	AF058452.1	AY525138.1	AY498812
<i>Syncarpia glomulifera</i> (Sm.) Nied.	HM160117/18	AF368220.2	AY498813
<i>Syzygium aromaticum</i> (L.) Merr. & Perry	EF026622.1	–	DQ088485.1
<i>Syzygium australe</i> (Link) B. Hyland	AY187177.2	AF368221.1	–
<i>Syzygium cumini</i> Skeels	FM887016.1	AY525140.1	AY498814.1
<i>Syzygium maire</i> (A.Cunn.) Sykes & Garn.-Jones	AM234136.1	DQ088589.1	DQ088508.1
<i>Syzygium samarangense</i> (Blume) Merr. & L.M. Perry	–	AY525141.1	AY498815.
<i>Syzygium wilsonii</i> (F.Muell.) B.Hyland	AY187218.2	DQ088618	DQ088530.1
<i>Tepualia stipularis</i> (Hook. & Arn.) Griseb.	AM234071.1	AF368222.2	–
<i>Thaleroxia queenslandica</i> (L.S. Sm.) Peter G. Wilson	AY264945.1	AF368223	DQ088460.1
<i>Thryptomene saxicola</i> (Hook.) Schauer	–	AF184709	AY498816
<i>Tristania neriifolia</i> (Sieber ex Sims) R.Br.	EF026608.1	AF368224.2	AY498817.1
<i>Tristaniopsis laurina</i> (Sm.) Peter G. Wilson & J.T. Waterh.	EF041514.1	AF184710.2	AY498818.1
<i>Ugni molinae</i> Turcz.	AM234143.1	AY525142.1	AY498819
<i>Uromyrtus australis</i> A.J. Scott	–	AY527230.1	AY498820.1
<i>Verticordia pennigera</i> Endl.	–	AF489402.2	AY498821.1

Taxon	ITS	GenBank accession	
		<i>matK</i>	<i>ndhF</i>
<i>Vochysia hondurensis</i> Sprague (Vochysiaceae)	–	AY572446.1	AY498832
<i>Waterhousea floribunda</i> (F. Muell.) B. Hyland	AY187221.2	DQ088620.1	DQ088531.1
<i>Waterhousea hedraiophylla</i> (F. Muell.) B. Hyland	AY187222.2	DQ088621.1	DQ088532.1
<i>Xanthomyrtus papuana</i> Merr. & L.M. Perry	AM234147.1	AF368226.2	–
<i>Xanthostemon chrysanthus</i> (F.Muell.) Benth.	EF041515.1	AF368227.2	EU410135.1

Table S2. Data matrix used for character state optimisation

Characters: **1** Colpal morphology: asyncolpate (0); syncolpate (1); parasyncolpate with arcuate colpi (2); parasyncolpate with angular colpi (3); brevicolpate (4); syndemicolpate (5); parasyncolpate with inverse arcuate colpi (6); unicolpate (7). **2** Exine pattern: psilate (0); granulate (1); granulate/scabrate (2); scabrate (3); verrucate/scabrate (4); verrucate (5); rugulate (6); rugulate with pollenkit (7); vermiculate (8); perforate (9). **3** Apocolpium island type: none (0); closely fitting polar island (1); small irregular polar island (2); granules on the polar membrane (3). **4** SEM Width: 6–10 (0); 10–14 (1); 14–18 (2); 18–22 (3); 22–28 (4); 28–38 (5); 38–50 (6). **5** SEM Length: 6–10 (0); 10–14 (1); 14–18 (2); 18–22 (3); 22–28 (4); 28–38 (5); 38–50 (6). **6** Colpus/length ratio: none (0); 0–20 (1); 20–40 (2); 40–50 (3); 50–65 (4); 65–95 (5); 95–100 (6)

Taxon	Characters					
	1	2	3	4	5	6
<i>Acca sellowiana</i>	3	2	2, 3	2	2	3
<i>Acmena divaricata</i>	7	0, 6	0	2	2	6
<i>Acmena divaricata</i> 2	7	0, 6	0	2	2	6
<i>Acmena graveolens</i>	7	0	0	2	2	6
<i>Acmena mackinnoniana</i>	7	0, 6	0	2	2	6
<i>Acmena smithii</i>	2	0, 6	0	2	1	2
<i>Acmena smithii</i> 2	2	0, 6	0	2	1	2
<i>Acmenospera claviform</i>	3	4, 5	1	2	2	2
<i>Actinodium cunninghamii</i>	0	0	0	1	1	0
<i>Agonis flexuosa</i>	1	4	0	1	1	4
<i>Amomyrtus meli</i>	4	2	0	4	4	2
<i>Anetholea anisata</i>	2	1	0/2	1	1	4
<i>Angophora costata</i>	2	5, 6	0	4	4	3
<i>Angophora hispida</i>	1, 2, 5	0, 6	0/2	4	4	3
<i>Archirhodomyrtus beckleri</i>	4	1	0	3	3	2
<i>Arillastrum gummiferum</i>	3	6	0	0	1	2
<i>Asteromyrtus symphyocarpa</i>	1	6	0	2	2	4
<i>Babingtonia cunninghamii</i>	5, 6	0	0	1	1	1
<i>Babingtonia densifolia</i>	1, 6	0, 6	0	0	0	0
<i>Babingtonia jucunda</i>	0, 1, 5	0, 6	0	1	1	0
<i>Babingtonia tozerensis</i>	5, 6	0	0	1	1	3
<i>Backhousia citriodora</i>	2, 3	6	0	2	2	3
<i>Backhousia myrtifolia</i>	2	3, 6	0	2	2	4
<i>Baeckea frutescens</i>	5	0	0	1	1	0
<i>Baeckea ovalifolia</i>	0, 1	0, 3, 5	0	1	1	2
<i>Beaufortia orbifolia</i>	2	2, 3	0/2	3	3	3
<i>Blepharocalyx cruckshanksii</i>	1, 4	2	0	2	2	3
<i>Blepharocalyx salicifolius</i>	4	4, 5	0	1	1	2
<i>Blepharocalyx tweediei</i>	4	4, 5	0	1	1	2
<i>Callistemon polandii</i>	3	6	0, 1	2	2	3

Taxon	Characters					
	1	2	3	4	5	6
<i>Calothamnus validus</i>	1	3, 6	0	2	1	4
<i>Calyptranthes concinna</i>	4	2	0	2	2	2
<i>Calyptranthes pallens</i>	4	1, 5	0	2	2	2
<i>Calytrix tetragona</i>	1, 2, 4	0, 3	0	2	2	4
<i>Campomanesia guazumifolia</i>	4	2	0	3	3	2
<i>Chamelaucium uncinatum</i>	0	0, 6	0	4	3	1
<i>Choricarpia subargentea</i>	1, 2	1, 3	0	2	2	4
<i>Cloezia floribunda</i>	2	6	0	1	1	4
<i>Corymbia variegata</i>	1, 2	0, 6	0	4	4	4
<i>Darwinia fascicularis</i>	0	0, 6	0	3	3	1
<i>Decaspermum humile</i>	3	1	3	2	1	2
<i>Eucalyptopsis papuana</i>	3	6	0	1	1	2
<i>Eucalyptus curtisii</i>	3	0, 6, 8	0/2	2	2	3
<i>Eucalyptus globulus</i>	3	4, 6	0/1	3	3	2
<i>Eugenia uniflora</i>	1, 4	2	0	2	3	2
<i>Euryomyrtus ramosissima</i>	1	1	0	1	0	4
<i>Heteropyxis natalensis</i>	2	4, 6	1	2	2	3
<i>Hexachlamys edulis</i>	4	2	0	2	2	2
<i>Homalocalyx aurea</i>	1	5	0, 2	3	3	3
<i>Homoranthus darwinioides</i>	0	0	0	3	3	0
<i>Kjellbergiodendron celebicum</i>	2, 4	0, 6	0	2	2	3
<i>Kunzea capitata</i>	1, 2	3, 6	0	2	2	4
<i>Legrandia concinna</i>	4	2	0	3	3	2
<i>Leptospermum scoparium</i>	1	6	0	1	1	4
<i>Leptospermum spectabile</i>	3	6	0	2	2	3
<i>Leptospermum trinervium</i>	1	5	0	2	2	4
<i>Lindsayomyrtus racemoides</i>	1	2, 3	3	1	1	3
<i>Lophomyrtus bullata</i>	3, 4	2	3	2	2	2
<i>Lophostemon confertus</i>	2	4, 6	0	1	1	3
<i>Lophostemon confertus 2</i>	2	4, 6	0	1	1	3
<i>Luma apiculata</i>	4	2	0	1	1	2
<i>Lysicarpus angustifolius</i>	3	4, 6	0	2	1	4
<i>Melaleuca nesophila</i>	3	2	1	1	1	2
<i>Melaleuca viridiflora</i>	3	4, 6	1	2	2	2
<i>Melaleuca viridiflora 2</i>	3	4, 6	1	2	2	2
<i>Metrosideros carminea</i>	3	4, 6	2	1	1	3
<i>Metrosideros diffusa</i>	3	6	1	1	1	2
<i>Metrosideros macropus</i>	3	6, 8	1, 2	2	2	3
<i>Metrosideros nervulosa</i>	3	6	2	3	3	3
<i>Micromyrtus ciliata</i>	1, 2	5	0	1	1	3
<i>Myrceugenia leptospermoides</i>	4	2	0	1	2	2
<i>Myrciaria vexator</i>	4	4	0	2	2	2
<i>Myrteola nummularia</i>	4	2	0	2	2	2

Taxon	Characters					
	1	2	3	4	5	6
<i>Myrtus communis</i>	4	2	0	1	1	2
<i>Myrtus communis</i> 2	4	2	0	1	1	2
<i>Neomyrtus pedunculata</i>	4	2	0	2	2	2
<i>Ochrosperma lineare</i>	1	3	0	1	0	5
<i>Ochrosperma oligomerum</i>	1	3	0	0	0	4
<i>Osbornia octodonta</i>	3	6	0	2	2	4
<i>Pericalymma ellipticum</i>	1	5	0, 1	3	3	4
<i>Pileanthus filifolius</i>	7	0, 6	0	5	3	6
<i>Pilidiostigma papuanum</i>	4	2	0	3	3	2
<i>Piliocalyx concinnus</i>	2	0	0	2	2	2
<i>Pimenta racemosa</i>	4	2	0	1	2	2
<i>Psidium cattleianum</i>	4	4, 5, 6	0	4	4	2
<i>Psiloxylon mauritianum</i>	3	4, 6	1	1	1	2
<i>Qualea grandiflora</i>	4	9	0	4	4	1
<i>Rhodammia argentea</i>	4	2	0	1	1	2
<i>Rhodomyrtus macrocarpa</i>	4	2	0	4	4	2
<i>Sphaerantia chartacea</i>	3	1, 2	0	1	1	3
<i>Stockwellia quadrifida</i>	2, 3	1, 2	0/2	1	1	2
<i>Syncarpia glomulifera</i>	2	6	0	2	2	4
<i>Syzygium aromaticum</i>	3	4	1	2	2	2
<i>Syzygium australe</i>	2	0, 6, 7	0	1	1	4
<i>Syzygium cumini</i>	3	0, 6	0	1	1	3
<i>Syzygium maire</i>	3	6	2	1	1	2
<i>Syzygium samarangense</i>	2	0, 6	0	1	1	3
<i>Syzygium wilsonii</i>	3	3, 6	1	2	1	3
<i>Tepualia stipularis</i>	7	5, 6	0	3	1	6
<i>Thaleropia queenslandica</i>	0	0, 6	0	0	0	0
<i>Thryptomene saxicola</i>	5, 6	6	0	1	1	2
<i>Tristania neriifolia</i>	0	0, 6	0	0	0	0
<i>Tristaniopsis laurina</i>	3	0, 6	0	1	1	2
<i>Ugni molinae</i>	4	2, 4	0	1	1	1
<i>Uromyrtus australis</i>	4	2	0	1	1	1
<i>Verticordia pennigera</i>	0	2	0	3	3	1
<i>Vochysia hondurensis</i>	4	3	0	?	?	?
<i>Waterhousea floribunda</i>	2	4, 6	0, 2, 3	1	1	3
<i>Waterhousea hedraiophylla</i>	2	6	0	1	1	3
<i>Xanthomyrtus papuana</i>	2	4, 6	0	2	1	3
<i>Xanthostemon chrysanthus</i>	3	4, 6	1	2	2	2