Supporting Information

Article title: The Australian temperate flora has no global analogue – diversification dynamics and the evolution of old biodiversity hotspots

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Supplementary Methods

Genbank sequences were imported into Geneious v. 9.1.5 (Kearse, M., Moir, R., et al. 2012) and aligned using the MUSCLE plugin (Edgar, R.C. 2004) with default parameters, and manually checked and adjusted (Table S1). For divergence-age estimates, all BEAST analyses were run on the CIPRES Science Gateway portal (Miller, M.A., Pfeiffer, W., et al. 2010).

Sampling fraction for each phylogeny was specified based on the sampling fraction in Table S2, for BAMM, DDD, TreePar, and CoMET analyses. In addition to explicitly specifying the sampling fraction of our phylogeny in these diversification analyses to account for incomplete sampling, we also accounted for this by running BAMM analyses across a range of different global sampling fractions following the approach of Gubry-Rangin, C., Kratsch, C., et al. (2015), of groups that showed a shift in radiation –Haemodoraceae, *Pomaderris*, *Cassinia, Persoonia* (**Figs. S4).** Additional BAMM analyses were conducted with the following sampling fractions: 20%, 50%, 80%, 100%. For the BAMM analyses, post-run visualisations were conducted using the R package BAMMTools v2.5.0 (Rabosky, D.L., Grundler, M., et al. 2014).

Lineage-through-time (LTT) plots for each phylogeny was constructed using the 'ltt' function in the phytools package (Revell, 2012) in R. The LTT derived from each empirical phylogeny was then plotted and compared with 100 simulated LTTs under the pure-birth model with the same number of species, using the function 'pbtree' in phytools. The γ statistic of Pybus, O.G. and Harvey, P.H. (2000) was also computed using the 'ltt' function in phytools. The γ statistic and visualisation of empirical

LTT with simulated pure-birth LTTs allowed us to assess whether each of the different plant groups had undergone an early radiation, constant diversification, or recent radiation.

For the diversification rate comparisons, the subset of species-rich genera were only obtained for SWA/SEA and tropical rainforest regions as other biodiversity hotspots either lack large endemic species-rich lineages (i.e. high species richness within the regions were derived from a divesrity of different medium-small genera) or a paucity of adequate molecular phylogenetic studies have been conducted on those groups. Nevertheless, this did not significantly affect our results, as the average diversification rate of the SWA flora was even lower than the subset obtained from species-rich SWA groups only.

Supplementary Results and Discussion

BAMM results from additional sampling fraction regimes

Diversification rate shifts detected in the four groups (see main text) were also present across all other sampling fraction regimes (Fig. S4).

Group-specific diversification dynamics

For the assessment of speciation rates through time, we had relied on the BAMM estimates given that it consistently gave the most conservative estimate out of the other analyses (TreePar, CoMET) that we had included in this study for this metric. Many of the declines in speciation rates noted in both TreePar and CoMET and not in BAMM were near the present (i.e. 1–2 Ma) and hence were most likely artifacts of incomplete sampling rather than real shifts in speciation rates (Cusimano, N. and Renner, S.S. 2010) (Table S18).

From our TreePar analyses, all significant shifts in diversification except for three detected in TreePar were negative shifts in diversification towards the present (**Fig. S5).** The three groups that showed a significant positive shift in diversification through time include two SWA-specific groups (*Daviesia, Anigozanthos–Conostylis* clade) and one SEA-specific group (*Dianella*).

Other shifts in diversification were recent slowdowns and might not be real due to incomplete lineage sampling and the effects of protracted speciation (Cusimano, N. and Renner, S.S. 2010). However, we did also detect older slowdowns from LTT of near-complete species-level phylogenies of SWA-specific groups. These include *Calytrix,* which slowed in diversification during the late Miocene (*c.* 13

Ma) towards the present, and *Daviesia* which showed a decline *c.* 5 Ma (**Fig. S6**). Slowdowns in speciation rates were also observed for *Calytrix* and *Daviesia* from our CoMET analyses, corroborating our TreePar results (**Figs. S3, S5).**

Phylogenetic Niche Conservatism in the Australian flora

The gradual aridification of the continent since the Miocene plays an important role over much of the Australian biota (e.g. Brennan, I.G. and Oliver, P.M. 2017, Hancock, L.P., Obbens, F., et al. 2018). Paleorecords indicate the expansion of xeromorphic vegetation from the centre of the continent, with movement of more mesic elements towards the continental coastal fringe (Hill, R.S. 1998, Hill, R. and Brodribb, T. 2001, Hill, R.S. 2001, Hill, R.S. 2004, Macphail, M. 2007). The relatively old age and constant diversification of sclerophyllous SWA and SEA floras might be explained partly by their migration outwards, as they track their respective biomes avoiding large-scale extinction. There has been a growing body of evidence that phylogenetic niche conservatism (PNC) is present across many of these Australian plant lineages (Jabaily, R.S., Shepherd, K.A., et al. 2014, Cardillo, M., Weston, P.H., et al. 2017, Hancock, L.P., Obbens, F., et al. 2018, Nauheimer, L., Schley, R.J., et al. 2018). PNC both accounts for the survival of sclerophyllous and rainforests lineages as they track the mesic biomes, as well as the paucity of transitions between mesic and arid biomes in the Australian flora. This is in contrast to other regions where transitions to different biomes have spurred radiations (Fahr, J. and Kalko, E.K. 2011, Holstein, N. and Renner, S.S. 2011, Pérez, F., Lavandero, N., et al. 2020). As aridity further intensified during the Pliocene *c.* 3 Ma across Australia, a slow down in diversification is witnessed across many sclerophyllous lineages in this study (**Figs. S3, S5–S7).** A decrease in speciation rates during this time period shown in this study further corroborates this phenomenon for several groups, especially those found in SWA (**Figs. 5, S1**). These declines in diversification coincided with the intensifying aridification period in the Pliocene as sclerophyllous mesic biomes contract in the expense of more arid vegetation, and may also partly explain the low diversification rate of the flora (Byrne, M., Yeates, D.K., et al. 2008). Radiations of arid-adapted taxa during this period at the expense of scleromorphic groups should be expected, but the diversification of the Australian arid flora is currently poorly understood. Further studies on species-rich xeromorphic groups should yield further insights on this topic. More recent Quaternary diversification dynamics and population genetic studies would be critical in determining whether recent speciation declines could be attributed to responses to environmental drivers or are an artefact of incomplete sampling.

Supplementary Tables and Figures

Table S1. Sampled groups with source of study and gene regions used.

Table S2. Sampling of each group, represented by percentage (%) sampled out of the total species for each phylogeny and subclade.

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Table S6. Diversification rate estimated with moderate relative extinction rates ($\kappa = 0.5$), of SWA/SEA, other Australian biomes, tropical rainforest regions, and other biodiversity hotspots.

Table S7. Average speciation rates of SWA/SEA and other biodiversity hotspots.

Table S8. Average stem age (Ma) and diversification rate of SWA/SEA and other biodiversity hotspots, and summary statistics for correlation tests between diversification rates and stem age (Ma) across SWA/SEA and other global biodiversity hotspots.

Tabel S9. Average speciation rates of SWA/SEA and Australian biomes, and summary statistics for correlation tests between diversification rates and stem age (Ma) across SWA/SEA and other Australian regions.

Table S10. Speciation rates for each of group, region-specific groups, and summary statistics for differences in speciation rates between SWA and SEA.

Table S11. Summary statistics from STRAPP analyses for each plant group with p-values.

Table S12. Best model out of the 36 implemented in GeoHiSSE for each group, determined based on the model with the highest AIC weight.

Table S13. The oldest stem age (Ma) of SWA and SEA clades for each group and summary statistics for correlation tests between tip-specific speciation rates (STRAPP) and stem age (Ma).

Table S14. Summary statistics for chi-square tests on meta-dataset.

Table S15. Individual results for each group: BAMM speciation rate towards present, diversification shifts in TreePar, and speciation shifts in CoMET.

Table S16. Best DDD model out nine implemented in DDD for each group, based on weighted AICs.

Table S17. γ statistic values for each group, along with their significance.
adrenalin

Figure S1a. Diversification dynamics of region-specific plant groups categorised as SWA-majority, SEA-majority, and evenly distributed across SWA and SEA. Proportion of region-specific groups showing proportion of region-specific groups that have higher STRAPP tip-specific speciation rates in SWA (green), SEA (yellow), other regions (pink), or have equal speciation rates across SWA and SEA (blue).

Figure S1b. Diversification dynamics of region-specific plant groups categorised as SWA-majority, SEA-majority, and evenly distributed across SWA and SEA. Number of region-specific groups showing declining speciation rates towards present estimated through BAMM (green), increasing speciation rates (pink), constant (yellow), and variable (blue).

Figure 1c. Diversification dynamics of region-specific plant groups categorised as SWA-majority, SEA-majority, and evenly distributed across SWA and SEA. Number of region-specific groups showing density-dependent diversification (DDD; green), pure-birth constant diversification (BD; yellow), protracted speciation (PD; pink), and time-dependent diversification (blue).

Figure S2. Diversification dynamics of region-specific plant groups categorised as SWA-majority, SEA-majority, and evenly distributed across SWA and SEA. Proportion of region-specific groups showing negative (significant $p < 0.05$; dark red), negative (non-significant; pale red), positive (significant $p < 0.05$; yellow), and positive (non-significant; blue) y statistic values.

Figure S3. CoMET analyses summary results under the mass extinction survival probability threshold of 0.5: speciation and extinction rates over time (Ma), and their posterior probabilities, and mass extinction Bayes Factor and posterior probability. For the other extinction thresholds (0.2, 0.8) included in this study please refer to the full dataset repository.

Figure S4. BAMM 95% credible rate shift configurations for groups that showed a radiation shift, under different global sampling fraction regimes: 20%, 40%, 50%, 80%, 100%. F = probability; percentage of samples in posterior assigned to shift configurations.

Figure S5. TreePar diversification through time plots and 2Ma sliced TreePar diversification through time plots.

Figure S6. Lineage-through-time plot visualised over actual phylogeny and 100 simulated LTTs under constant birth-death model.

Figure S7. BAMM speciation rate towards the present (Ma) and distributions of speciation rates (sp sp^{-1} My^{-1}) derived from STRAPP.

Table S1 Sampled groups with source of study and gene regions used. Table lines demarcate different families and highlighted sections in colour represent subclades within a phylogeny.

No.	Phylogenies	Genera or clade	Source	Plastid genes	Nuclear genes
1	1	*Adenanthos* (Proteaceae)	own study	**	ITS
2	2	*Calytrix* (Myrtaceae)	own study	*atpB, ndhF, matK,*	ITS
3	3	**Pomaderreae** (Rhamnaceae)	own study	*ndhF, matK, rpl16, trnL*	ITS
4		*Pomaderris* (Rhamnacae)	own study	n/a	30 loci
5		*Stenanthemum* (Rhamnaceae)	own study	*ndhF, matK, rpl16, trnL*	ITS
6		*Trymalium* (Rhamnaceae)	own study	*ndhF, matK, rpl16, trnL*	ITS
7	4	*Gastrolobium* (Fabaceae)	Chandler, G.T., Bayer, R.J., et al. (2001)	*matK, psbA-trnH*	ETS
8	5	*Daviesia* (Fabaceae)	Crisp, M.D., Cayzer, L., et al. (2017)	*ndhF, trnL*	ITS
9	6	*Pultenaea* (Fabaceae)	Orthia, L., Crisp, M., et al. (2005)	*ndhF, trnL-F*	n/a
10	7	*Banksia* (Proteaceae)	Cardillo, M. and Pratt, R. (2013)	*rpl16, psbA-trnH, trnT-trnL*	n/a
11	8	*Persoonia* (Proteaceae)	Holmes, G.D., Weston, P.H., et al. (2018)	*trnL-trnF*	ITS
12	9	*Hakea* (Proteaceae)	Cardillo, M., Weston, P.H., et al. (2017)	n/a	450 loci
13	10	*Cassinia* & *Ozothamnus* (Asteraceae)	Schmidt-Lebuhn, A.N. and Constable, L. (2013)	*matK-psbA, psbA-trnH, ycf6-pbsM*	ITS, ETS
14		*Cassinia* (Asteraceae)	Schmidt-Lebuhn, A.N. and Constable, L. (2013)	*matK-psbA, psbA-trnH, ycf6-pbsM*	ITS, ETS
15	11	**Haemodoraceae**	Hopper, S.D., Smith, R.J., et al. (2009)	*matK, trnL-trnF*	n/a
16		*Haemodorum*	Hopper et al. (2009)	*matK, trnL-trnF*	n/a
17		*Anigozanthos–Tribonanthes*	Hopper et al. (2009)	*matK, trnL-trnF*	n/a
18		*Anigozanthos*	Hopper et al. (2009)	*matK, trnL-trnF*	n/a
19		*Conostylis*	Hopper et al. (2009)	*matK, trnL-trnF*	n/a
20	12	*Dianella* (Asphodelaceae)	Muscat, K.M., Ladiges, P.Y., et al.	*rpl14-rpl36, rps16-trnK, trnQ-rps16*	ITS, ETS

			(2019)		
21	13	*Prostanthera* (Lamiaeae)	Wilson, T.C., Conn, B.J., et al. (2012)	*ndhF-rpl32, trnT-trnL*	ETS
22	14	*Casuarina–Allocasuarina* (Casuarinaceae)	Steane, D.A., Wilson, K.L., et al. (2003)	*matK*	n/a
23	15	*Callitris** (Cupressaceae)	Larter, M., Pfautsch, S., et al. (2017)	*rbcL, matK, trnL, psbB, petB*	ITS, needly, leafy

Table S1 Continued.

No.	Phylogenies	Genera or clade	Source	Plastid genes	Nuclear genes
24	16	**Loganiaceae**	Foster, C.S., Ho, S.Y., et al. (2014)	*petD, rps16*	n/a
25		*Logania–Orianthera*	Foster, C.S., Ho, S.Y., et al. (2014)	*petD, rps16*	n/a
26		*Orianthera*	Foster, C.S., Ho, S.Y., et al. (2014)	*petD, rps16*	n/a
27	17	*Zieria* (Rutaceae)	Barrett, R.A., Bayly, M.J., et al. (2018)	n/a	ITS,ETS
28	18	*Correa* (Rutaceae)	French, P.A., Brown, G.K., et al. (2016)	n/a	ITS
29	19	*Acacia* (Fabaceae)	Mishler, B.D., Knerr, N., et al. (2014)	*rpl32-trnL, matK, psbA-trnH, trnL, trnL-F*	ITS,ETS
30		*Acacia* subtree2 (SEA) *sensu*. Renner, M.A., Foster, C.S., et al. (2020)	Mishler, B.D., Knerr, N., et al. (2014)	*rpl32-trnL, matK, psbA-trnH, trnL, trnL-F*	ITS,ETS
31	20	Eucalypts (Myrtaceae)	González-Orozco, C.E., Pollock, L.J., et al. (2016)	*matK, npsbA*	ITS, ETS
32		*Eucalyptus* (Myrtaceae)	González-Orozco, C.E., Pollock, L.J., et al. (2016)	*matK, npsbA*	ITS, ETS
33		*Corymbia* (Myrtaceae)	González-Orozco, C.E., Pollock, L.J., et al. (2016)	*matK, npsbA*	ITS, ETS
34	21	**Goodeniaceae**	Gardner, A.G., Sessa, E.B., et al. (2016)	*trnL, matK*	n/a
35		*Dampiera* (Goodeniaceae)	Gardner, A.G., Sessa, E.B., et al. (2016)	*trnL, matK*	n/a
36	22	**Styphelieae** (Ericaceae)	Puente-Lelièvre, C., Hislop, M., et al. (2016)	*atpB, rbcL, matK*	ITS

*indicates a non-flowering gymnosperm group

***some nuclear/chloroplast excluded due to topology conflicts (sig) e.g. Zieria, Correa, Adenanthos.

Table S2 Sampling of each group, represented by percentage (%) sampled out of the total species for each phylogeny and subclade. Highlighted sections in colour represent subclades within a phylogeny. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications. Bolded % values indicate values below the 50% threshold.

Phylogenies	Genera or clade	total species	sampling	% sampled
1	*Adenanthos* (Proteaceae)	33	24	73
2	*Calytrix* (Myrtaceae)	90	72	80
3	**Pomaderreae** (Rhamnaceae)	231	192	83
	Pomaderris (Rhamnacae)	75	75	100
	Stenanthemum (Rhamnaceae)	31	29	94
	Trymalium (Rhamnaceae)	13	13	100
4	*Gastrolobium* (Fabaceae)	112	95	85
5	*Daviesia* (Fabaceae)	126	112	89
6	*Pultenaea* (Fabaceae)	131	56	**43**
7	*Banksia* (Proteaceae)	170	170	100
8	*Persoonia* (Proteaceae)	103	93	90
9	*Hakea* (Proteaceae)	150	146	97
10	*Cassinia* & *Ozothamnus* (Asteraceae)	152	98	64
	Cassinia (Asteraceae)	44	33	75
11	**Haemodoraceae**	171	151	88
	Haemodorum	24	15	63
	Anigozanthos–Tribonanthes	67	59	88
	Anigozanthos	11	9	82
	Conostylis	45	45	100
12	*Dianella* (Asphodelaceae)	30	30	100
13	*Prostanthera* (Lamiaeae)	104	66	63
14	*Casuarina–Allocasuarina* (Casuarinaceae)	79	64	81
15	*Callitris** (Cupressaceae)	22	22	100
16	**Loganiaceae**	137	69	50
	Logania–Orianthera	73	37	51
	Orianthera	13	13	100
17	*Zieria* (Rutaceae)	60	58	97
18	*Correa* (Rutaceae)	12	12	100
19	*Acacia* (Fabaceae)	1000	510	51
	Acacia subtree2 (SEA) *sensu*. Renner et al. (2020)	71	71	100
20	Eucalypts (Myrtaceae)	700	683	98
	Eucalyptus (Myrtaceae)	600	598	100
	Corymbia (Myrtaceae)	101	74	73
21	**Goodeniaceae**	436	216	50
	Dampiera (Goodeniaceae)	71	37	52
22	**Styphelieae** (Ericaceae)	428	242	57

*indicates a non-flowering gymnosperm group

Table S3a Calibration priors used in Beauti for the dated BEAST phylogenies. Fossil or secondary calibrations followed those used in the listed references. Bolded node constraints indicate enforced monophyly, with crown group enforced when stems are bolded. Bolded clades indicate families or infrafamilial (e.g. tribal/subfamilial) classifications.

Genera or clade	Age (Ma)	Node constrained	Prior distribution	M	S	Offset	References
Gastrolobium (Fabaceae)	23.5	**stem**	log-normal	1.8	0.3	18	Nge, F.J., Biffin, E., et al. (2020)
Daviesia (Fabaceae)	43.9	stem	log-normal	1.7	0.4	39	Cook, L.G., Hardy, N.B., et al. (2015)
	28.2	**crown**	log-normal	2	0.3	22.7	
Pultenaea (Fabaceae)	48.5	Mirbelioids crown	log-normal	1.8	0.1	4.5	Nge, F.J., Biffin, E., et al. (2020)
	n/a	***Pultenaea s.l.***	n/a	n/a	n/a	n/a	
Persoonia (Proteaceae)	49	**stem**	log-normal	1.8	0.4	44	Sauquet, H., Weston, P.H., et al. (2009)
Cassinia & *Ozothamnus* (Asteraceae)	14	**stem**	log-normal	1.8	0.4	9.5	Nie, Z.L., Funk, V.A., et al. (2016)
	n/a	***Ozothamnus***	n/a	n/a	n/a	n/a	
Haemodoraceae	81	**crown**	log-normal	1.8	0.3	79.2	Janssen, T. and Bremer, K. (2004), Hopper, S.D., Smith, R.J., et al. (2009)
	n/a	***Conostylis–Blancoa***	n/a	n/a	n/a	n/a	
Dianella (Asphodelaceae)	10	**stem**	log-normal	1.8	0.4	4.5	McLay, T.G.B. and Bayly, M.J. (2016)
Prostanthera (Lamiaeae)	30	**stem**	log-normal	1.8	0.4	25	Yao, G., Drew, B.T., et al. (2016)
Casuarina–Allocasuarina (Casuarinaceae)	82.8	**stem**	log-normal	1.8	0.3	76.5	Xiang, X.-G., Wang, W., et al. (2014)
	25.7	***Allocasuarina* crown**	uniform	14[A]	33[B]	n/a	
	29.6	***Casuarina* crown**	uniform	17[A]	38[B]	n/a	
Zieria (Rutaceae)	22	**stem**	log-normal	1.8	0.32	16	Bayly, M.J., Holmes, G.D., et al. (2013)
Correa (Rutaceae)	22	**stem**	log-normal	1.8	0.3	16.5	Bayly, M.J., Holmes, G.D., et al. (2013)

Acacia (Fabaceae)	23	**stem**	log-normal	0.01	10	23	Miller, J.T., Murphy, D.J., et al. (2013)

[A]lower bound, [B]upper bound.

Table S3a Continued.

Genera or clade	**Age (Ma)**	**Node constrained**	**Prior distribution**	**M**	**S**	**Offset**	**References**
Eucalypts (Myrtaceae)	53.2	**stem**	exponential	1.03	n/a	53.2	Thornhill, A.H. and Macphail, M. (2012), Thornhill, A.H., Ho, S.Y., et al. (2015)
Eucalyptus (Myrtaceae)	33.9	**stem**	exponential	0.89	n/a	33.9	
Corymbia (Myrtaceae)	46.7	**stem**	exponential	2.17	n/a	45	
Goodeniaceae	67.3 (90–53)	**stem**	log-normal	1.8	0.3	61.8	Jabaily, R.S., Shepherd, K.A., et al. (2014)
		Scaevola	n/a	n/a	n/a	n/a	
Styphelieae	22.66–32.61	**stem**	log-normal	1.8	0.4	19	Puente-Lelièvre, C., Harrington, M.G., et al. (2013)

Table S3b Available dated phylogenies sourced from published studies. Bolded clades indicate families or infrafamilial (e.g. tribal/subfamilial) classifications.

Genera or clade	**References**
Banksia (Proteaceae)	Cardillo, M. and Pratt, R. (2013)
Hakea (Proteaceae)	Cardillo, M., Weston, P.H., et al. (2017)
*Callitris** (Cupressaceae)	Larter, M., Pfautsch, S., et al. (2017)
Loganiaceae	Foster, C.S., Ho, S.Y., et al. (2014)

*indicates a non-flowering gymnosperm group

Table S4 MCMC generations, sampling frequency, and ESS convergence of BEAST runs for each phylogeny. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications.

Genera or clade	MCMC generations	Sampling frequency	ESS Convergence*
Gastrolobium (Fabaceae)	20 million	1000	399
Daviesia (Fabaceae)	40 million	1000	651
Pultenaea (Fabaceae)	20 million	1000	487
Persoonia (Proteaceae)	20 million	1000	291
Cassinia & *Ozothamnus* (Asteraceae)	20 million	1000	586
Haemodoraceae	70 million	1000	813
Dianella (Asphodelaceae)	20 million	1000	3316
Prostanthera (Lamiaeae)	20 million	1000	466
Casuarina–Allocasuarina (Casuarinaceae)	20 million	1000	765
Zieria (Rutaceae)	20 million	1000	685
Correa (Rutaceae)	10 million	1000	1385
Goodeniaceae	300 million	1000	196
Styphelieae	100 million	1000	904
Calytrix (Mytaceae)	200 million	1000	966
Adenanthos (Proteaceae)	30 million	1000	4756
Pomaderreae	200 million	1000	284

*Values derived from the first BEAST run, second run values not shown as the range is similar.

Table S5a SWA-majority groups, i.e. groups with 50% or more of their extant species found in SWA. The more conservative 70% cut-off threshold is highlighted in blue, with groups below the threshold highlighted in red. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications. Groups with identical phylogeny numbers are from the same phylogeny.

Phylogenies	Genera or clade	SW species	SE species	%SW	%SE	SW:SE ratio
11	*Anigozanthos* (Haemodoraceae)	11	0	100.0	0.0	n/a
11	*Conostylis* (Haemodoraceae)	45	0	100.0	0.0	n/a
11	*Anigozanthos–Tribonanthes*	66	0	98.5	0.0	n/a
4	*Gastrolobium* (Fabaceae)	109	0	97.3	0.0	n/a
1	*Adenanthos* (Proteaceae)	31	2	93.9	6.1	15.5
3	*Trymalium* (Rhamnaceae)	12	1	92.3	7.7	12.0
7	*Banksia* (Proteaceae)	156	16	91.8	9.4	9.8
16	*Orianthera* (Loganiaceae)	10	2	76.9	15.4	5.0
3	*Stenanthemum* (Rhamnaceae)	23	4	74.2	12.9	5.8
5	*Daviesia* (Fabaceae)	93	36	73.8	28.6	2.6
11	**Haemodoraceae**	76	5	73.1	4.8	15.2
21	*Dampiera* (Goodeniaceae)	51	14	71.8	19.7	3.6
22	**Styphelieae (Ericaceae)**	274	138	64.0	32.2	2.0
9	*Hakea* (Proteaceae)	95	43	63.3	28.7	2.2
2	*Calytrix* (Myrtaceae)	56	9	61.5	9.9	6.2
15	*Callitris** (Cupressaceae)	10	13	50.0	65.0	0.8

*indicates a non-flowering gymnosperm group

Table S5b SEA-majority groups, i.e. groups with 50% or more of their extant species found in SEA. The more conservative 70% cut-off threshold is highlighted in blue, with groups below the threshold highlighted in red. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications. Groups with identical phylogeny numbers are from the same phylogeny.

Phylogenies	Genera or clade	SW species	SE species	%SW	%SE	SW:SE ratio
18	*Correa* (Rutaceae)	1	12	8.3	100.0	0.1
19	*Acacia* subtree2 (Fabaceae)	1	69	1.4	97.2	0.0
10	*Cassinia* (Asteraceae)	1	42	2.3	95.5	0.0
10	*Cassinia* & *Ozothamnus* (Asteraceae)	8	91	7.8	88.3	0.1
3	*Pomaderris* (Rhamnacae)	6	63	8.0	84.0	0.1
17	*Zieria* (Rutaceae)	0	49	0.0	83.1	0.0
6	*Pultenaea* (Fabaceae)	32	104	24.4	79.4	0.3
13	*Prostanthera* (Lamiaeae)	23	74	22.1	71.2	0.3
15	*Callitris** (Cupressaceae)	10	13	50.0	65.0	0.8
12	*Dianella* (Asphodelaceae)	2	17	6.7	56.7	0.1
8	*Persoonia* (Proteaceae)	42	58	40.8	56.3	0.7
3	**Pomaderreae (Rhamnaceae)**	100	122	43.3	52.8	0.8
14	*Casuarina–Allocasuarina* (Casuarinaceae)	27	40	34.2	50.6	0.7

*indicates a non-flowering gymnosperm group

Table S5c Groups with equal numbers of species in both SWA and SEA, represented by SW:SE and SE:SW ratios (rounded to nearest integer). Groups that also fall in the SEA-majority category are highlighted in green. Groups that fall in both SEA & SWA-majority categories are highlighted in red. Highlighted groups are not included in the 'temperate Au no overlap' category (see main text). Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications.

Phylogenies	Genera or clade	SW:SE ratio	SE:SW ratio	%SW	%SE
8	*Persoonia* (Proteaceae)	0.7	1.4	40.8	56.3
14	*Casuarina–Allocasuarina* (Casuarinaceae)	0.7	1.5	34.2	50.6
19	*Acacia* (Fabaceae)	0.7	1.4	30.1	41.3
15	*Callitris** (Cupressaceae)	0.8	1.3	50.0	65.0
3	**Pomaderreae (Rhamnaceae)**	0.8	1.2	43.3	52.8
20	Eucalypts (Myrtaceae)	0.9	1.1	40.3	43.0
20	*Eucalyptus* (Myrtaceae)	1.0	1.0	45.5	44.1
16	**Loganiaceae**	1.1	0.9	27.0	24.8
16	*Logania–Orianthera* (Loganiaceae)	1.8	0.6	39.7	21.9
11	*Haemodorum* (Haemodoraceae)	2.0	0.5	41.7	20.8

*indicates a non-flowering gymnosperm group

Table S6a Diversification rate estimated with moderate relative extinction rates (κ = 0.5), of SWA/SEA species rich genera (> 40 spp.) sourced from Nge et al. (2020).

region	**genera**	**family**	**total species**	**SW%**	**SE%**	**stem age (Ma)**	**div. 0.5**
SWA	*Banksia*	Proteaceae	170	92	9	61	0.0729265
SWA	*Petrophile*	Proteaceae	66	88	9	56	0.06270617
SWA	*Conospermum*	Proteaceae	53	81	19	41	0.08038627
SWA	*Dampiera*	Goodeniaceae	71	72	20	39.4	0.09095226
SWA	*Chamelaucium*	Myrtaceae	39	95	0	24.77	0.120942
SWA	*Verticordia*	Myrtaceae	102	94	0	24.77	0.1591272
SWA	*Gastrolobium*	Fabaceae	112	97	0	23.5	0.1716698
SWA	*Dryandra*	Proteaceae	94	100	0	20	0.1930365
SWA	*Conostylis*	Haemodoraceae	45	100	0	17.7	0.1771466
SWA	*Thysanotus*	Asparagaceae	58	78	19	17.2	0.1967669
SWA	*Darwinia*	Myrtaceae	71	83	18	16.31	0.219713
SWA	*Andersonia*	Ericaceae	41	100	0	12.9	0.2360095
SWA	*Drosera* Section *Lamprolepis* (pygmy droseras)	Droseraceae	44	80	0	11	0.2830468
SWA	*Leucopogon*	Ericaceae	249	78	21	10.8	0.4470661
SWA	*Diuris*	Orchidaceae	71	72	21	10.5	0.3412875
SEA	*Prostanthera*	Lamiaceae	104	22	71	29.5	0.1342649
SEA	*Pultenaea*	Fabaceae	131	24	79	25	0.1675862
SEA	*Zieria*	Rutaceae	59	0	83	22	0.1545999
SEA	*Pomaderris*	Rhamnaceae	75	8	84	20.6	0.1765819
SEA	*Ozothamnus*	Asteraceae	54	13	81	13	0.2549374
SEA	*Epacris*	Ericaceae	53	0	92	8.3	0.3970888
SEA	*Cassinia*	Asteraceae	44	2	95	4	0.7783788

Table S6b Diversification rate of species rich genera (> 40 spp.) of the Australian arid flora and genera of Gondwanan rainforest elements, with moderate relative extinction rates ($\kappa = 0.5$). Note diversification rate of Gondwanan rainforest lineages were not based on species-rich lineages as there are no extant species rich genera or groups found in this biome.

Region	Lineage	Family	species	stem age (Ma)	div. rate (0.5)	references
arid	*Ptilotus*	Amaranthaceae	120	20	0.2162	(Hammer, T. 2019)
arid	*Calandrinia*	Montiaceae	74	30	0.1208	(Hancock, L.P., Obbens, F., et al. 2018)
arid	*Atriplex*	Amaranthaceae	50	6	0.5398	(Kadereit, G., Mavrodiev, E.V., et al. 2010)
arid	*Triodia*	Poaceae	69	20	0.1778	(Toon, A., Crisp, M., et al. 2015)
arid	*Eremophila* s.l.	Scrophulariaceae	280	10.7	0.4622	(Navarro-Pérez, M.L., López, J., et al. 2013)
arid	*Acacia*	Fabaceae	60	9	0.3797	This study
rainforest	*Tasmannia*	Winteraceae	10	69.97	0.0244	(Thomas, N., Bruhl, J.J., et al. 2014)
rainforest	*Elaeocarpus holopetalus*	Elaeocarpaceae	1	45.46	0.0000	(Phoon, S.-N. 2015)
rainforest	*Elaeocarpus* node 22	Elaeocarpaceae	8	34.72	0.0433	(Phoon, S.-N. 2015)
rainforest	*Elaeocarpus* node 60	Elaeocarpaceae	16	20.51	0.1043	(Phoon, S.-N. 2015)
rainforest	*Elaeocarpus* node 112	Elaeocarpaceae	12	15.81	0.1184	(Phoon, S.-N. 2015)
rainforest	*Agathis* Au	Araucariaceae	3	39.8	0.0174	(Klaus, K.V. and Matzke, N.J. 2020)
rainforest	*Wollemia–Agathis* clade	Araucariaceae	4	50	0.0183	(Klaus, K.V. and

						Matzke, N.J. 2020)
rainforest	*Podocarpus*	Podocarpaceae	7	39.8	0.0348	(Klaus, K.V. and Matzke, N.J. 2020)
rainforest	*Araucaria*	Araucariaceae	4	54.4	0.0168	(Klaus, K.V. and Matzke, N.J. 2020)
rainforest	*Richea*	Ericaceae	11	17.1	0.1048	(Wagstaff, S.J., Dawson, M.I., et al. 2010)
rainforest	*Dracophyllum*	Ericaceae	6	17.1	0.0733	(Wagstaff, S.J., Dawson, M.I., et al. 2010)
rainforest	*Drymophila*	Alstroemeriaceae	2	24	0.0169	(Vinnersten, A. and Bremer, K. 2001)
rainforest	*Musgravea*	Proteaceae	2	9.1	0.0446	(Sauquet, H., Weston, P.H., et al. 2009)
rainforest	*Austromuellera*	Proteaceae	2	9.1	0.0446	(Sauquet, H., Weston, P.H., et al. 2009)
rainforest	*Buckinghamia*	Proteaceae	2	35.1	0.0116	(Sauquet, H., Weston, P.H., et al. 2009)
rainforest	*Darlingia*	Proteaceae	2	16.3	0.0249	(Sauquet, H., Weston, P.H., et al. 2009)
rainforest	*Hollandaea*	Proteaceae	4	5.5	0.1666	(Sauquet, H., Weston, P.H., et al. 2009)
rainforest	*Backhousia* s.l.	Myrtaceae	11	46.5	0.0385	(Harrington, M.G., Jackes, B.R., et al.

						2012)
rainforest	*Choricarpia*	Myrtaceae	2	15	0.0270	(Harrington, M.G., Jackes, B.R., et al. 2012)

Table S6c Diversification rate of species rich genera (> 100 spp.) of the three main global tropical rainforest regions (SE Asia, Afrotropics, and Neotropics), estimated with moderate relative extinction rates (κ = 0.5). Most species-rich genera in the Afrotropics were determined using the checklist from Sosef, M.S., Dauby, G., et al. (2017), Neotropics from Cardoso, D., Särkinen, T., et al. (2017), and SE Asia from Cámara-Leret, R., Frodin, D.G., et al. (2020).

Region	Lineage	Family	species	stem age (Ma)	div. rate (0.5)	references
SE Asia	*Cyrtandra*	Gesneriaceae	800	16	0.3745	(Atkins, H.J., Bramley, G.L., et al. 2020)
SE Asia	*Calamus*	Arecaceae	440	24	0.2248	(Couvreur, T.L., Forest, F., et al. 2011)
SE Asia	Syzygieae	Myrtaceae	1189	26.4	0.2420	(Biffin, E., Lucas, E.J., et al. 2010)
SE Asia	Myrteae (*Eugenia* 1050+ spp.)	Myrtaceae	2379	35	0.2023	(Biffin, E., Lucas, E.J., et al. 2010)
SE Asia	*Helicia*	Proteaceae	110	5	0.8033	(Sauquet, H., Weston, P.H., et al. 2009)
SE Asia	*Begonia*	Begoniaceae	n/a	n/a	0.6100	(Moonlight, P.W., Richardson, J.E., et al. 2015)
SE Asia	*Hoya*	Apocynaceae	300	9	0.5571	(Liede-Schumann, S., Kong, H., et al. 2012)
SE Asia	*Bulbophyllum*	Orchidaceae	1564	20	0.3331	(Gamisch, A. and Comes, H.P. 2019)
SE Asia	*Gartnera*	Rubiaceae	16	3.9	0.5487	(Malcomber, S.T. 2002)
SE Asia	*Licuala*	Arecaceae	134	16	0.2633	(Baker, W.J. and Couvreur, T.L. 2013)
SE Asia	*Pinanga*	Arecaceae	131	12	0.3491	(Baker, W.J. and Couvreur, T.L. 2013)
SE Asia	*Daemonorops*	Arecaceae	101	31.69	0.1241	(Baker, W.J. and

						Couvreur, T.L. 2013)
SE Asia	*Hedyotis*	Rubiaceae	180	21.67	0.2079	(Neupane, S., Lewis, P.O., et al. 2017)
SE Asia	*Rhaphidophora*	Araceae	100	32	0.1226	
SE Asia	Dipterocarpaceae	Asia (mainly) & Africa	695	35.6	0.1644	(Magallón, S., Gómez-Acevedo, S., et al. 2015)
SE Asia	*Phalaenopsis*	Orchidaceae	70	9.54	0.3742	(Givnish, T.J., Spalink, D., et al. 2016)
SE Asia	*Dendrobium*	Orchidaceae	1800	13.52	0.5032	(Givnish, T.J., Spalink, D., et al. 2016)
Afrotropics	*Begonia*	Begoniaceae	n/a	n/a	0.2300	(Moonlight, P.W., Richardson, J.E., et al. 2015)
Afrotropics	*Impatiens* A3 clade (half of phylogeny)	Balsaminaceae	110*	5	0.8033	(Janssens, S.B., Knox, E.B., et al. 2009)
Afrotropics	*Bulbophyllum*	Orchidaceae	80	13	0.2847	(Gamisch, A. and Comes, H.P. 2019)
Afrotropics	*Bulbophyllum* Madagascar subset	Orchidaceae	210	17.6	0.2647	(Gamisch, A. and Comes, H.P. 2019)
Afrotropics	*Dypsis* (Madagascar)	Arecaceae	140	13.4	0.3176	(Baker, W.J. and Couvreur, T.L. 2013)
Afrotropics	Streptocarpinae (*Streptocarpus, Sainpaulia, Acanthema* etc.)	Gesneriaceae	200	41	0.1124	(Roalson, E.H. and Roberts, W.R. 2016)
Afrotropics	Polystachyinae subtribe (Vandeae tribe)	Orchidaceae	230	29	0.1638	(Givnish, T.J., Spalink, D., et al. 2015)
Afrotropics	*Polystachya*	Orchidaceae	224	27	0.1749	(Givnish, T.J., Spalink, D., et al. 2016)
Afrotropics	*Combretum*	Combretaceae	300	48.2	0.1040	(Magallón, S., Gómez-Acevedo, S., et al. 2015)

Afrotropics	*Rinorea*	Violaceae	280	54	0.0866	(Xi, Z., Ruhfel, B.R., et al. 2012)
Afrotropics	*Aerangis*	Orchidaceae	50	7.62	0.4250	(Givnish, T.J., Spalink, D., et al. 2016)
Afrotropics	*Diphananthe*	Orchidaceae	33	7.62	0.3718	(Givnish, T.J., Spalink, D., et al. 2016)
Afrotropics	Angraecinae	Orchidaceae	445	13.25	0.4081	(Givnish, T.J., Spalink, D., et al. 2016)
Afrotropics	*Angraecum* Madagascar Clade II	Orchidaceae	220	15.5	0.3035	(Andriananjamanantsoa, H.N., Engberg, S., et al. 2016)
Neotropics	*Begonia*	Begoniaceae	n/a	n/a	0.5000	(Moonlight, P.W., Richardson, J.E., et al. 2015)
Neotropics	*Bulbophyllum*	Orchidaceae	94	13	0.2970	(Gamisch, A. and Comes, H.P. 2019)
Neotropics	*Inga*	Fabaceae	300	10	0.5014	(Richardson, J.E., Pennington, R.T., et al. 2001)
Neotropics	*Gautteria*	Annonaceae	265	11.4	0.4290	(Erkens, R.H., Chatrou, L.W., et al. 2007)
Neotropics	*Anthurium*	Araceae	900	27	0.2263	(Carlsen, M.M. 2011)
Neotropics	*Anthurium* core Clade B	Araceae	898		0.5820	(Carlsen, M.M. 2011)
Neotropics	core Tillandsioids	Bromeliaceae	1236	15.2	0.4228	(Givnish, T.J., Barfuss, M.H., et al. 2011)
Neotropics	Tank epiphytes (Bromelioideae)	Bromeliaceae	629	5.8	0.9918	(Givnish, T.J., Barfuss, M.H., et al. 2011)
Neotropics	Brazilian shield (Bromelioideae)	Bromeliaceae	753	9.4	0.6311	(Givnish, T.J., Barfuss, M.H., et al.

						2011)
Neotropics	Pleurothallidinae (*Pleurothallis, Masdevallia, Restrepia, Dilomilis* etc.)	Orchidaceae	4000	25.1	0.3028	(Givnish, T.J., Spalink, D., et al. 2016)
Neotropics	*Masdevallia*	Orchidaceae	500	9.4	0.5876	(Givnish, T.J., Spalink, D., et al. 2016)
Neotropics	*Pleurothallis*	Orchidaceae	1240	9.4	0.6841	(Givnish, T.J., Spalink, D., et al. 2016)
Neotropics	*Epidendrum*	Orchidaceae	1500	8.77	0.7549	(Givnish, T.J., Spalink, D., et al. 2016)
Neotropics	Laeliinae	Orchidaceae	1788	15.3	0.4442	(Givnish, T.J., Spalink, D., et al. 2016)
Neotropics	*Oncidium*	Orchidaceae	330	18.15	0.2815	(Givnish, T.J., Spalink, D., et al. 2016)

* a conservative estimate of species richness based on Grey-Wilson, C. (1980).

Table S6d Diversification rate of lineages found across other biodiversity hotspots estimated with moderate relative extinction rates (κ = 0.5). These regions include other Mediterranean hotspots, oceanic islands, and young mountainous regions. Plant groups with available diversification rates estimates were sourced from Hughes, C.E. and Atchison, G.W. (2015) and Chen, Y.-S., Deng, T., et al. (2018).

Region	Lineage	Family	species	stem age (Ma)	div. rate (0.5)	References
Himalaya	*Delphinium + Oligophyllum*	Ranunculaceae	300	9.875	0.5080	(Jabbour, F. and Renner, S.S. 2012)
Himalaya	*Delphinium* subg. *Aconitum*	Ranunculaceae	250	7.9	0.6117	(Jabbour, F. and Renner, S.S. 2012)
Himalaya	*Rheum*	Polygonaceae	55	10.95	0.3043	(Sun, Y., Wang, A., et al. 2012)
Himalaya	*Ligularia–Parasenecio* complex	Asteraceae	200	10.85	0.4249	(Liu, J.-Q., Wang, Y.-J., et al. 2006)
Himalaya	*Rhodiola*	Crassulaceae	60	5	0.6835	(Zhang, J.-Q., Meng, S.-Y., et al. 2014)
Himalaya	*Rhododendron* subg. *Hymenanthes*	Ericaceae	215	4	1.1705	(Milne, R.I., Davies, C., et al. 2010)
Himalaya	*Isodon*	Lamiaceae	70	5	0.7139	(Yu, X.-Q., Maki, M., et al. 2014)
Himalaya	*Delphinium*	Ranunculaceae	120	5.8	0.7074	(Jabbour, F. and Renner, S.S. 2012)
Himalaya	*Sausurrea*	Asteraceae	175	10.5	0.4264	(Wang, Y.-J., Susanna, A., et al. 2009)
New Zealand	*Ourisia*	Plantaginaceae	13	0.85	2.2893	(Meudt, H.M., Lockhart, P.J., et al. 2009)
New Zealand	*Pachycladon*	Brassicaceae	11	1	1.7918	(Joly, S., Heenan, P.B., et al. 2014)
New Zealand	*Mysotis*	Boraginaceae	35	5	0.5781	(Winkworth, R.C., Grau, J., et al. 2002)
New Zealand	*Ranunculus*	Ranuculaceae	16	5	0.4280	(Lockhart, P.J., McLenachan, P.A., et al. 2001)
East Africa	*Lobelia telekii* clade	Campanulaceae	5	3	0.3662	(Knox, E.B. and Li, C. 2017)
East Africa	*Lobelia* giant *(L.mildbradeii* clade)	Campanulaceae	10	5	0.3409	(Knox, E.B. and Li, C. 2017)
East Africa	*Dendrosenecio*	Asteraceae	15	3	0.6931	(Knox, E.B. and Palmer, J.D. 1995)
East Africa	*Stoebe*	Asteraceae	3	2	0.3466	(Bergh, N.G. and Linder, H.P. 2009)
East Africa	*Alchemilla* dwarf shrub	Rosaceae	9	2	0.8047	(Gehrke, B., Bräuchler, C., et al.

	clade					2008)
East Africa	*Hypericum*	Hypericaceae	20	4.8	0.4899	(Meseguer, A.S., Aldasoro, J.J., et al. 2013)
New Guinea	*Rhodendron* Section *Schistanthe*	Ericaceae	29	5	0.5416	(Brown, G.K., Nelson, G., et al. 2006)
Madagascar	*Bulbophyllum* (Madagascar subset)	Orchidaceae	210	17.6	0.2647	(Gamisch, A. and Comes, H.P. 2019)
Madagascar	*Dypsis*	Arecaceae	140	13.4	0.3176	(Baker, W.J. and Couvreur, T.L. 2013)
Madagascar	*Angraecum* Madagascar Clade II	Orchidaceae	220	15.5	0.3035	(Andriananjamanantsoa, H.N., Engberg, S., et al. 2016)

Table S6e Diversification rate of lineages found across other biodiversity hotspots estimated with moderate relative extinction rates (κ = 0.5). These regions include other Mediterranean hotspots, oceanic islands, and young mountainous regions. These diversification rate estimates were sourced from Madriñán, S., Cortés, A.J., et al. (2013).

Region	Lineage	Family	species	stem age (Ma)	div. rate (0.5)
California	*Calochortus*	Liliaceae	38	7.3	0.3
California	*Calycadenia*	Asteraceae	11	7.64	0.15
California	*Ceanothus*	Rhamnaceae	44	13.9	0.17
California	*Gilia*	Polemoniaceae	39	12.11	0.19
California	*Linanthus-*	Polemoniaceae	23	17.58	0.1
California	*Lithophragma*	Saxifragaceae	10	1.47	0.745
Cape flora	*Crotalarieae*	Fabaceae	633	44	0.11
Cape flora	*Ehrharta*	Poaceae	15	36.44	0.04
Cape flora	*Heliophileae* s.l.	Brassicaceae	59	2.6	1.01
Cape flora	*Moraea*	Iridaceae	127	24.25	0.14
Cape flora	*Muraltia*	Polygalaceae	55	10.89	0.235
Cape flora	*Pelargonium*	Geraniaceae	160	12.23	0.295
Cape flora	*Pentaschistis*	Poaceae	64	5.55	0.485
Cape flora	*Phylica*	Rhamnaceae	150	7.4	0.475
Cape flora	*Protea*	Proteaceae	70	17.7	0.155
Cape flora	*Restionaceae*	Restionaceae	350	43.83	0.1
Cape flora	*Satyrium*	Orchidaceae	63	14.38	0.185
Cape flora	*Tribolium-*	Poaceae	24	4.33	0.415
Cape flora	*Zaluzianskya*	Scrophuliaraceae	9	3.03	0.34
Succulent Karoo	Core *Aizoaceae*	Aizoaceae	1563	3.8	1.535
Succulent Karoo	*Ehrharta*	Poaceae	13	10	0.13
Succulent Karoo	*Heliophileae*	Brassicaceae	18	1.49	1.05
Succulent Karoo	*Melianthus*	Melianthaceae	3	9.32	0.025
Succulent Karoo	*Moraea*	Iridaceae	65	15.11	0.18
Succulent Karoo	*Muraltia*	Polygalaceae	45	2.51	0.945
Succulent Karoo	*Pelargonium*	Geraniaceae	50	17.36	0.145
Succulent Karoo	*Pentaschistis*	Poaceae	9	1.56	0.65
Succulent Karoo	*Zaluzianskya*	Scrophuliaraceae	19	3.03	0.53
Mediterranean europe	*Aquilegia*	Ranunculaceae	21	2.54	0.67
Mediterranean europe	*Cistus-*	Cistaceae	33	2.11	0.995
Mediterranean europe	*Dianthus*	Caryophyllaceae	200	1.095	3.47
Mediterranean europe	*Erodium*	Geraniaceae	53	24.36	0.1
Mediterranean europe	*Geranium*	Geraniaceae	54	18.41	0.14
Mediterranean europe	*Narcissus*	Amaryllidaceae	80	17.8	0.165
Mediterranean europe	*Reseda*	Resedaceae	5	0.6	0.995
Mediterranean europe	*Ruta*	Rutaceae	9	20	0.055
Cerrado	*Andira*	Fabaceae	3	1.8	0.15
Cerrado	*Lupinus*	Fabaceae	11	1.9	0.62
Cerrado	*Microliceae*	Melastomataceae	180	9.8	0.375

Cerrado	*Mimosa*	Fabaceae	3	1.6	0.16
Cerrado	*Mimosa* 3	Fabaceae	34	4.4	0.48
Cerrado	*Mimosa* 4	Fabaceae	11	1.6	0.735
Cerrado	*Mimosa* 6	Fabaceae	4	0.9	0.5
Cerrado	*Mimosa* 7	Fabaceae	8	3.2	0.29
Cerrado	*Mimosa* 8	Fabaceae	50	4.1	0.605
Cerrado	*Mimosa* 9	Fabaceae	27	8.4	0.23
Hawaii	*Tetramolopium*	Asteraceae	11	0.65	1.8
Hawaii	*Geranium*	Geraniaceae	5	2	0.3
Hawaii	*Hawaiin mints*	Lamiaceae	11	5	0.52
Hawaii	*Hesperomannia*	Asteraceae	5	4.91	0.05
Hawaii	*Kokia*	Malvaceae	57	3	0.15
Hawaii	*Lobelioideae*	Campanulaceae	3	13.6	0.245
Hawaii	*Metrosideros*	Myrtaceae	4	0.75	0.795
Hawaii	*Silversword alliance*	Asteraceae	126	5.2	0.385
Hawaii	*Viola*	Violaceae	5	3.7	0.295
Paramo	*Aragoa*	Plantaginaceae	17	0.42	3.625
Paramo	*Arcytophyllum*	Rubiaceae	14	10.96	0.125
Paramo	*Berberis*	Berberidaceae	32	3.8	3.83
Paramo	*Calceolaria*	Calceolariaceae	65	2.45	1.085
Paramo	*Draba*	Brassicaceae	55	3.05	0.84
Paramo	*Espeletiinae*	Asteraceae	120	4.04	0.815
Paramo	*Festuca*	Poaceae	36	4.28	0.51
Paramo	*Gaultheria*	Ericaceae	19	4.59	0.35
Paramo	*Gentianella*	Gentianaceae	48	2.3	1.055
Paramo	*Halenia*	Gentianaceae	43	0.65	3.59
Paramo	*Jamesonia* +	Pteridaceae	32	7.6	0.27
Paramo	*Lachemilla*	Rosaceae	35	3.66	0.585
Paramo	*Lupinus*	Fabaceae	66	1.47	1.86
Paramo	*Lysipomia*	Campanulaceae	27	8.95	0.215
Paramo	*Oreobolus*	Cyperaceae	5	3.01	0.195
Paramo	*Puya*	Bromeliaceae	46	0.8	2.995
Paramo	*Senecio*	Asteraceae	68	1.52	1.815
Paramo	*Valeriana*	Valerianaceae	53	14.58	0.17

Table S6f Diversification rate estimated with moderate relative extinction rates (κ = 0.5), of all SWA genera across 20 plant families sourced from Nge et al. (2020).

region	genera	total species	SW%	SE%	stem age (Ma)	0.5
SWA	*Kunzea*	60	50	37	33	0.1036
SWA	*Argentipallium*	6	50	0	13	0.0964
SWA	*Sondottia*	2	50	0	2	0.2027
SWA	*Caesia*	12	50	33	33	0.0567
SWA	*Drakaea*	10	50	0	16	0.1065
SWA	*Grevillea*	362	52	35	15.8	0.3292
SWA	*Actinotus*	21	52	38	66	0.0363
SWA	*Logania*	35	54	37	23.12	0.1250
SWA	*Velleia*	21	57	48	21	0.1142
SWA	*Tricoryne*	14	57	36	47	0.0429
SWA	*Cryptandra*	57	58	35	32	0.1052
SWA	*Lepyrodia*	22	59	41	36	0.0678
SWA	*Myriocephalus*	15	60	13	15	0.1386
SWA	*Rhodanthe*	45	60	38	14	0.2240
SWA	*Erymophyllum*	5	60	0	1	1.0986
SWA	*Drummondita*	10	60	0	7	0.2435
SWA	*Scaevola*	83	60	19	30	0.1246
SWA	*Hakea*	150	63	29	17.51	0.2471
SWA	*Lepidosperma*	107	64	30	22.0	0.0228
SWA	*Brachyloma*	17	65	47	5.4	0.4069
SWA	*Platysace*	29	66	24	18	0.1504
SWA	*Strangea*	3	67	33	39	0.0178
SWA	*Millotia*	16	69	44	15	0.1427
SWA	*Laxmannia*	13	69	31	19.1	0.1024
SWA	*Angianthus*	20	70	30	2	1.1757
SWA	*Drosera* Section Erythrorhiza	14	71	29	8	0.2519
SWA	*Tricostularia*	7	71	14	37.0	0.0375
SWA	*Dampiera*	71	72	20	39.4	0.0910
SWA	*Diuris*	71	72	21	10.5	0.3413
SWA	*Schoenus*	107	72	36	51.0	0.0718
SWA	*Lasiopetalum*	48	73	31	5.98	0.5349
SWA	*Stenanthemum*	31	74	13	31	0.0894
SWA	*polianthion*	4	75	25	32	0.0286
SWA	*Xanthosia*	20	75	50	39	0.0603
SWA	*Actinobole*	4	75	25	1	0.9163
SWA	*Orianthera*	13	77	15	17.35	0.1122
SWA	*Thysanotus*	58	78	19	17.2	0.1968
SWA	*Lepidobolus*	9	78	11	15.9	0.1012
SWA	*Acanthocarpus*	9	78	0	11.4	0.1412
SWA	*Leucopogon*	249	78	21	10.8	0.4471

SWA	*Isopogon*	38	79	21	44	0.0675
SWA	*Drosera* Section *Lamprolepis*	44	80	0	11	0.2830
SWA	*Physopsis*	5	80	0	31	0.0354
SWA	*Cyanostegia*	5	80	0	25	0.0439
SWA	*Phyllangium*	5	80	60	16.44	0.0668
SWA	*Lechenaultia*	30	80	3	60.6	0.0452
SWA	*Aotus*	25	80	28	25	0.1026
SWA	*Chordifex*	21	81	19	31	0.0774
SWA	*Conospermum*	53	81	19	41	0.0804
SWA	*Homalocalyx*	11	82	9	34	0.0527
SWA	*Darwinia*	71	83	18	16.31	0.2197
SWA	*Podotheca*	6	83	17	2	0.6264
SWA	*Cyathochaeta*	6	83	17	19.5	0.0642
SWA	*Drosera* Section *Ergaleium*	31	84	16	20	0.1386
SWA	*Petrophile*	66	88	9	56	0.0627
SWA	*Pileanthus*	8	88	0	30.2	0.0498
SWA	*Gnephosis*	17	88	24	11	0.1997
SWA	*Asteridea*	9	89	11	7	0.2299
SWA	*Lambertia*	10	90	10	35	0.0487
SWA	*Sphaerolobium*	22	91	9	49	0.0498
SWA	*Eutaxia*	23	91	9	25	0.0994
SWA	*Banksia*	170	92	9	61	0.0729
SWA	*Trymalium*	13	92	8	27.4	0.0710
SWA	*Astroloma*	32	94	9	10.3	0.2722
SWA	*Adenanthos*	33	94	6	36.7	0.0772
SWA	*Verticordia*	102	94	0	24.77	0.1591
SWA	*Chamelaucium*	39	95	0	24.77	0.1209
SWA	*Chorizema*	26	96	4	22	0.1183
SWA	*Hypocalymma*	33	97	0	31	0.0914
SWA	*Gastrolobium*	112	97	0	23.5	0.1717
SWA	*Thomasia*	39	97	3	5.98	0.5010
SWA	*Franklandia*	2	100	0	79	0.0051
SWA	*Brachysola*	2	100	0	37	0.0110
SWA	*Tremulina*	2	100	0	32	0.0127
SWA	*Platychorda*	2	100	0	31	0.0131
SWA	*Pentapeltis*	2	100	0	30	0.0135
SWA	*Actinodium*	2	100	0	28.68	0.0141
SWA	*Tremandra*	2	100	0	24.3	0.0167
SWA	*Evandra*	2	100	0	23.0	0.0176
SWA	*Alexgeorgea*	3	100	0	36	0.0193
SWA	*Pyrorchis*	2	100	50	18	0.0225
SWA	*Arnocrinum*	3	100	0	27	0.0257
SWA	*Leptocarpus*	3	100	33	26.2	0.0265
SWA	*Papistylus*	2	100	0	13.1	0.0310

SWA	*Stawellia*	2	100	0	13	0.0312
SWA	*Stypandra*	2	100	50	13	0.0312
SWA	*Phlebocarya*	3	100	0	24.5	0.0283
SWA	*Chamaescilla*	4	100	25	34	0.0269
SWA	*Chaetanthus*	3	100	0	22.5	0.0308
SWA	*Stirlingia*	7	100	0	58	0.0239
SWA	*Anthotium*	5	100	0	39.4	0.0279
SWA	*Loxocarya*	5	100	0	35	0.0314
SWA	*Mesomelaena*	5	100	0	35.0	0.0314
SWA	*Tribonanthes*	6	100	0	42	0.0298
SWA	*Geleznowia*	2	100	0	9	0.0451
SWA	*Platytheca*	4	100	0	24.3	0.0377
SWA	*Onychosepalum*	3	100	0	15.2	0.0456
SWA	*Tetraria*	10	100	10	51.0	0.0334
SWA	*Pogonolepis*	2	100	50	7	0.0579
SWA	*Harperia*	4	100	0	17.9	0.0512
SWA	*Urodon*	4	100	0	17.5	0.0524
SWA	*Lawrencella*	2	100	0	6	0.0676
SWA	*Verreauxia*	3	100	0	11.2	0.0619
SWA	*Lachnostachys*	6	100	0	24	0.0522
SWA	*Hemiphora*	5	100	0	19	0.0578
SWA	*Latrobea*	9	100	0	31	0.0519
SWA	*Elythranthera*	2	100	0	5	0.0811
SWA	*Sphenotoma*	7	100	0	23.7	0.0585
SWA	*Chamaexeros*	4	100	0	11.4	0.0804
SWA	*Hypolaena*	8	100	13	22.5	0.0668
SWA	*Siloxerus*	4	100	25	10	0.0916
SWA	*Dithyrostegia*	2	100	0	3	0.1352
SWA	*Hensmania*	3	100	0	5	0.1386
SWA	*Desmocladus*	15	100	7	22.4	0.0928
SWA	*Diplolaena*	15	100	0	22	0.0945
SWA	*Synaphea*	51	100	0	41	0.0795
SWA	*Johnsonia*	6	100	0	9	0.1392
SWA	*Anigozanthos*	11	100	0	13.2	0.1357
SWA	*Drosera* Section *Stolonifera*	10	100	0	8	0.2131
SWA	*Conostylis*	45	100	0	17.7	0.1771
SWA	*Guichenotia*	17	100	0	9.24	0.2378
SWA	*Lysiosepalum*	5	100	0	3	0.3662
SWA	*Dryandra*	94	100	0	20	0.1930
SWA	*Andersonia*	41	100	0	12.9	0.2360
SWA	*Waitzia*	5	100	20	2	0.5493
SWA	*Pithocarpa*	4	100	25	1	0.9163
SWA	*Hyalosperma*	9	100	44	2	0.8047

Table S6g Diversification rate estimated with moderate relative extinction rates (κ = 0.5), of all SEA genera across 20 plant families sourced from Nge et al. (2020).

region	genera	total species	SW%	SE%	stem age (Ma)	0.5
SEA	*Acrothamnus*	6	0	50	8	0.1491
SEA	*Eriostemon*	2	0	50	18	0.0225
SEA	*Sporadanthus*	8	25	50	39	0.0386
SEA	*Cladium*	2	0	50	60	0.0068
SEA	*Strychnos*	4	0	50	38	0.0241
SEA	*Schizacme*	4	0	50	16	0.0557
SEA	*Mackinlaya*	2	0	50	57	0.0071
SEA	*Donatia*	2	0	50	66	0.0061
SEA	*Townsonia*	2	0	50	31	0.0131
SEA	*Orthoceras*	2	0	50	11	0.0386
SEA	*Glossodia*	2	0	50	6	0.0676
SEA	*Drosera* Section *Arcturia*	2	0	50	26	0.0156
SEA	*Eidothea*	2	0	50	86	0.0047
SEA	*Triunia*	4	0	50	35	0.0262
SEA	*Hicksbeachia*	2	0	50	13	0.0317
SEA	*Gahnia*	36	42	53	35	0.0834
SEA	*Persoonia*	103	41	56	14	0.2822
SEA	*Dianella*	30	7	57	9	0.3045
SEA	*Euryomyrtus*	7	25	57	29	0.0559
SEA	*Lomatia*	12	0	58	61	0.0307
SEA	*Arthropodium*	15	33	60	17	0.1209
SEA	*Chrysocephalum*	9	33	67	9	0.1788
SEA	*Leucochrysum*	6	17	67	5	0.2506
SEA	*Anemocarpa*	3	33	67	2	0.3466
SEA	*Crowea*	3	33	67	24	0.0289
SEA	*Oreobolus*	9	0	67	69	0.0233
SEA	*Caustis*	6	50	67	23	0.0779
SEA	*Centella*	3	33	67	16	0.0433
SEA	*Prostanthera*	104	22	71	30	0.1343
SEA	*Leptospermum*	89	21	72	32	0.1190
SEA	*Spyridium*	46	39	72	30	0.1059
SEA	*Orites*	8	0	75	41	0.0367
SEA	*Chloanthes*	4	25	75	19	0.0482
SEA	*Xerochrysum*	12	8	75	9	0.2080
SEA	*Melichrus*	8	13	75	5	0.2785
SEA	*Argyrotegium*	4	0	75	2	0.4581
SEA	*Baumea*	17	59	76	13	0.1726
SEA	*Caladenia*	267	62	77	3	1.9591
SEA	*Westringia*	31	29	77	30	0.0940
SEA	*Pultenaea*	131	24	79	25	0.1676
SEA	*Ozothamnus*	54	13	81	13	0.2549
SEA	*Goodia*	6	33	83	44	0.0285
SEA	*Sannantha*	16	0	83	25	0.0863

SEA	*leptecophylla*	6	0	83	8	0.1491
SEA	*Zieria*	59	0	83	22	0.1546
SEA	*Craspedia*	30	10	83	11	0.2492
SEA	*Pomaderris*	75	8	84	21	0.1766
SEA	*Nematolepis*	7	14	86	19	0.0730
SEA	*Trochocarpa*	8	0	88	7	0.2212
SEA	*Monotoca*	12	8	92	4	0.4532
SEA	*Leionema*	26	0	92	22	0.0939
SEA	*Epacris*	53	0	92	8	0.3971
SEA	*Cassinia*	44	2	95	4	0.7784
SEA	*Symphionema*	2	0	100	59	0.0069
SEA	*Calorophus*	2	0	100	36	0.0113
SEA	*Telopea*	5	0	100	43	0.0255
SEA	*Ochrosperma*	6	0	100	47	0.0268
SEA	*Cyathodes*	3	0	100	19	0.0373
SEA	*Almaleea*	5	0	100	25	0.0439
SEA	*Ixodia*	2	0	100	7	0.0579
SEA	*Stuartina*	2	50	100	6	0.0676
SEA	*Thelionema*	3	0	100	10	0.0693
SEA	*Ewartia*	4	0	100	14	0.0654
SEA	*Baloskion*	8	0	100	28	0.0539
SEA	*Odixia*	2	0	100	5	0.0811
SEA	*Oxylobium*	5	0	100	15	0.0758
SEA	*Pentachondra*	4	0	100	11	0.0848
SEA	*Podolobium*	6	0	100	16	0.0808
SEA	*Rupicola*	4	0	100	8	0.1104
SEA	*Correa*	12	8	100	22	0.0851
SEA	*Platylobium*	9	0	100	16	0.1038
SEA	*Richea*	11	0	100	17	0.1048
SEA	*Sprengelia*	7	0	100	11	0.1284
SEA	*Leptorhynchos*	10	30	100	9	0.1894
SEA	*Eriochlamys*	4	0	100	1	0.9163
SEA	*Leiocarpa*	10	0	100	1	1.7047
SEA	*Costularia*	7	43	100	50	0.0277

Table S7 Average speciation rates of SWA/SEA and other biodiveristy hotspots. Speciation rates of SWA and SEA were obtained from the STRAPP analyses of this study (Table S10a). Speciation rates of other hotspots were obtained using the methods-of-moments approach (Magallón, S. and Sanderson, M.J. 2001) with no relative extinction ($\kappa = 0$). Speciation rate and Stem age (Ma) values are coloured from low–high (blue–red).

Region	speciation rate	stem age (Ma)
SWA	0.180	29.0
SEA	0.220	19.5
California	0.387	10.0
Cape	0.396	17.4
Succulent karoo	0.757	7.1
Cape combine	0.543	13.2
Mediterranean	1.075	10.9
Cerrado	0.585	3.8
Hawaii	0.726	4.3
Paramo	1.880	4.3
African rift	0.695	3.3
Himalaya	0.718	7.8
New Zealand	1.670	3.0
Madagascar	0.340	15.5
New Guinea	0.673	5.0
SE Asia	0.405	21.3
Afrotropics	0.341	25.6
Neotropics	0.575	17.5

Table S8a Average stem age (Ma) and diversification rate of SWA/SEA and other biodiveristy hotspots. Diversification rate estimates were obtained using the methods-of-moments approach (Magallón, S. and Sanderson, M.J. 2001) with moderate relative extinction (κ = 0.5). Diversification rate and Stem age (Ma) values are coloured from low–high (blue–red).

Region	diversification rate (κ = 0.5)	stem age (Ma)
SWA	0.228	29.0
SEA	0.294	19.5
California	0.276	10.0
Cape	0.307	17.4
Succulent karoo	0.577	7.1
Cape combine	0.417	13.2
Mediterranean	0.824	10.9
Cerrado	0.415	3.8
Hawaii	0.504	4.3
Paramo	1.329	4.3
African rift	0.507	3.3
Himalaya radiation	0.617	7.8
New Zealand	1.272	3.0
Madagascar	0.295	15.5
New Guinea	0.542	5.0
SE Asia	0.350	21.3
Afrotropics	0.289	25.6
Neotropics	0.509	17.5

Table S8b Summary statistics for correlation tests between diversification rates and stem age (Ma) across SWA/SEA and other global biodiversity hotspots.

Dataset	Test	p-value	rho	S
hotspots	Spearman's rank	0.00495	-0.643	1592

Table S9a Average speciation rates of SWA/SEA and Australian biomes. Speciation rates of SWA and SEA were obtained from the STRAPP analyses of this study (Table S10a). Speciation rates of other regions were obtained using the methods-of-moments approach (Magallón, S. and Sanderson, M.J. 2001) with no relative extinction ($\kappa = 0$). Speciation rate and Stem age (Ma) values are coloured from low–high (blue–red).

Region	**speciation rate**	**stem age (Ma)**
SWA	0.228	29.0
SEA	0.294	19.5
Arid flora	0.316	14.5
Gondwanan rainforest	0.052	29.8
Temperate Australia (SWA & SEA)	0.261	24.3
Australian average	0.222	23.2

Table S9b Summary statistics for correlation tests between diversification rates and stem age (Ma) across SWA/SEA and other Australian regions.

Dataset	Test	p-value	rho	S
Australian biomes	Spearman's rank	0.0833	-1	20

Table S10a Speciation rates from STRAPP. Bolded regions indicate groups that have higher speciation rates in regions containing less species (e.g. SWA-specific majority group having higher speciation rates in SEA). Units are net speciation events per Myr per lineage (sp sp^{-1} My^{-1}). Table lines demarcate different families and highlighted sections in colour represent subclades within a phylogeny. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications.

Genera or clade	**Higher speciation rate**	**STRAPP SWA sp.**	**STRAPP SEA sp.**	**STRAPP Other sp.**
Adenanthos (Proteaceae)	**SWA**	0.1201	0.0961	0.0961
Calytrix (Myrtaceae)	**non-SWA**	0.0853	n/a	0.0935
Pomaderreae (Rhamnaceae)	non-SWA (& SEA)	0.0895	0.1353	0.1409
Pomaderris (Rhamnacae)	**SEA**	0.2674	0.2824	0.2674
Stenanthemum (Rhamnaceae)	**non-SWA**	0.1260	n/a	0.1347
Trymalium (Rhamnaceae)	**non-SWA**	0.1102	n/a	0.1246
Gastrolobium (Fabaceae)	SWA	0.1990	n/a	0.0272
Daviesia (Fabaceae)	**non-SWA**	0.1360	0.1551	0.1567
Pultenaea (Fabaceae)	SEA	0.2440	0.2892	0.2426
Banksia (Proteaceae)	**non-SWA**	0.0853	n/a	0.0909
Persoonia (Proteaceae)	SEA	0.1009	0.1328	0.1328
Hakea (Proteaceae)	**non-SWA**	0.1035	n/a	0.1122
Cassinia & *Ozothamnus* (Asteraceae)	n/a	n/a	0.4024	0.3242
Cassinia (Asteraceae)	n/a	n/a	n/a	n/a
Haemodoraceae	SWA	0.1198	n/a	0.0820
Haemodorum	SWA	0.2852	0.2697	0.1618
Anigozanthos–Tribonanthes	n/a	n/a	n/a	n/a
Anigozanthos	n/a	n/a	n/a	n/a
Conostylis	n/a	n/a	n/a	n/a
Dianella (Asphodelaceae)	equal	n/a	0.3222	0.3297
Prostanthera (Lamiaeae)	**non-SEA**	n/a	0.2025	0.2411
Casuarina–Allocasuarina (Casuarinaceae)	equal	0.1303	n/a	0.1341
*Callitris** (Cupressaceae)	equal	0.1443	0.1408	0.1493
Loganiaceae	**SWA**	0.2632	0.2444	0.2447
Logania–Orianthera	equal	0.2789	0.2795	0.2794
Orianthera	equal	0.3047	0.3070	0.3070
Zieria (Rutaceae)	equal	n/a	0.3198	0.3235
Correa (Rutaceae)	n/a	n/a	n/a	n/a
Acacia (Fabaceae)	SEA	0.2461	0.3268	0.2496
Acacia subtree2 (SEA) *sensu*. Renner et al. (2020)	n/a	n/a	n/a	n/a
Eucalypts (Myrtaceae)	n/a	n/a	n/a	n/a
Eucalyptus (Myrtaceae)	**SE**	0.2995	0.3100	0.3044
Corymbia (Myrtaceae)	equal	0.2429	0.2355	0.2350
Goodeniaceae	**non-SW**	0.1546	0.1507	0.1659
Dampiera (Goodeniaceae)	**SE**	0.1541	0.1657	0.1585
Styphelieae (Ericaceae)	equal	0.2566	0.2529	0.2503

Table S10b Average speciation rates from STRAPP according to region-specific groups. Units are net speciation events per Myr per lineage (sp sp^{-1} My^{-1}).

Average	STRAPP SW sp.	STRAPP SE sp.	STRAPP Other sp.
all combined	0.182	0.224	0.190
SWA majority	0.150	0.161	0.137
SEA majority	0.174	0.236	0.229
SWA majority 70%	0.151	0.157	0.131
SEA majority 70%	0.251	0.299	0.280

Table S10c Speciation rates derived from the methods-of-moments approach (with relative extinction rate of 0) for clades that post-dates the Eocene–Oligocene boundary. Units for speciation rates are net speciation events per Myr per lineage (sp sp^{-1} My^{-1}).

Genera or clade	Region	Speciation rate	Species no.	Stem (Ma)
Haemodorum (Haemodoraceae)	SWA	0.161	10	10
Orianthera (Loganiaceae)	SWA	0.089	29	30.2
Adenanthos (Proteaceae)	SWA	0.120	33	23.4
*Callitris** (Cupressaceae)	SWA	0.058	10	27.8
Correa (Rutaceae)	SEA	0.081	12	22
Acacia subtree2 (Fabaceae)	SEA	0.714	71	5
Cassinia (Asteraceae)	SEA	0.761	42	4
Cassinia & Ozothamnus	SEA	0.308	91	12.4
Pomaderris (Rhamnaceae)	SEA	0.198	63	17.4
Zieria (Rutaceae)	SEA	0.145	49	22
Pultenaea (Fabaceae)	SEA	0.180	104	21.9
Prostanthera (Lamiaceae)	SEA	0.117	74	30.8
*Callitris** (Cupressaceae)	SEA	0.066	12	28.2
Dianella (Asphodelaceae)	SEA	0.324	17	6.6
Persoonia (Proteaceae)	SEA	0.148	58	22.8

*indicates a non-flowering gymnosperm group

Table S10d Summary statistics for differences in speciation rates between SWA and SEA obtained from STRAPP and the methods-of-moments approach. Units are net speciation events per Myr per lineage (sp sp^{-1} My^{-1}). Values shown for p-values * represent significance levels of $p < 0.05$.

Dataset	Test	p-value	df	chi-square
all combined	Kruskal-Wallis	0.1545	2	3.7348
combined, exclude other regions	Kruskal-Wallis	0.05*	1	3.8416
combined post E–O boundary, exclude other	Kruskal-Wallis	0.9456	1	0.0047
SE majority	ANOVA	0.3270	2	n/a
SE majority, exclude other regions	ANOVA	0.1820	1	n/a
SW majority, exclude other regions	Kruskal-Wallis	0.8011	1	0.0635
methods-of-moments post E–O boundary	Wilcoxon	0.0336*	n/a	n/a

Table S11 Summary statistics from STRAPP analyses with p-values. Table lines demarcate different families and highlighted sections in colour represent subclades within a phylogeny. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications.

Genera or clade	rho estimate	p-value
Adenanthos (Proteaceae)	-0.003	0.999
Calytrix (Myrtaceae)	0.005	0.993
Pomaderreae (Rhamnaceae)	-0.748	0.931
Pomaderris (Rhamnacae)		
Stenanthemum (Rhamnaceae)	-0.004	0.997
Trymalium (Rhamnaceae)	0.004	0.996
Gastrolobium (Fabaceae)	0.000	0.994
Daviesia (Fabaceae)	-0.007	0.906
Pultenaea (Fabaceae)	0.641	0.965
Banksia (Proteaceae)	-0.002	0.995
Persoonia (Proteaceae)	-0.417	0.892
Hakea (Proteaceae)	-0.001	0.998
Cassinia & *Ozothamnus* (Asteraceae)	0.270	0.869
Cassinia (Asteraceae)	n/a	n/a
Haemodoraceae	0.270	0.857
Haemodorum	-0.001	0.989
Anigozanthos–Tribonanthes	n/a	n/a
Anigozanthos	n/a	n/a
Conostylis	n/a	n/a
Dianella (Asphodelaceae)	-0.054	0.942
Prostanthera (Lamiaeae)	0.008	0.997
Casuarina–Allocasuarina (Casuarinaceae)	-0.071	0.984
*Callitris** (Cupressaceae)	0.009	0.997
Loganiaceae	0.012	0.995
Logania–Orianthera	-0.005	0.998
Orianthera	-0.013	0.992
Zieria (Rutaceae)	-0.003	0.990
Correa (Rutaceae)	n/a	n/a
Acacia (Fabaceae)	0.465	0.421
Acacia subtree2 (SEA) *sensu*. Renner et al. (2020)	n/a	n/a
Eucalypts (Myrtaceae)	n/a	n/a
Eucalyptus (Myrtaceae)	-0.057	0.747
Corymbia (Myrtaceae)	0.003	0.991
Goodeniaceae	-0.150	0.926
Dampiera (Goodeniaceae)	0.000	0.998
Styphelieae (Ericaceae)	0.089	0.963

*indicates a non-flowering gymnosperm group

Table S12 Best model out of the 36 implemented in GeoHiSSE for each group, determined based on the model with the highest AIC weight. Table lines demarcate different families and highlighted sections in colour represent subclades within a phylogeny. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications. . For specifications and details of the 36 models refer to Caetano, D.S., O'Meara, B.C., et al. (2018). ** indicates significant range-dependent diversification (GeoSSE model).

Genera or clade	**GeoHiSSE SWA**	**GeoHiSSE SEA**
Adenanthos (Proteaceae)	1	n/a
Calytrix (Myrtaceae)	4**	3
Pomaderreae (Rhamnaceae)	24	4
Pomaderris (Rhamnacae)	2,20**	
Stenanthemum (Rhamnaceae)	1	n/a
Trymalium (Rhamnaceae)	1	1
Gastrolobium (Fabaceae)	2,20**	n/a
Daviesia (Fabaceae)	15	15
Pultenaea (Fabaceae)	18	4, 18
Banksia (Proteaceae)	13	1
Persoonia (Proteaceae)	14	14
Hakea (Proteaceae)		
Cassinia & *Ozothamnus* (Asteraceae)	n/a	15
Cassinia (Asteraceae)	n/a	n/a
Haemodoraceae	n/a	n/a
Haemodorum	1	7
Anigozanthos–Tribonanthes	n/a	n/a
Anigozanthos	n/a	n/a
Conostylis	n/a	n/a
Dianella (Asphodelaceae)	n/a	18
Prostanthera (Lamiaeae)	3	3
Casuarina–Allocasuarina (Casuarinaceae)	18	4
*Callitris** (Cupressaceae)	13	1
Loganiaceae	1	1
Logania–Orianthera	1	1
Orianthera	7,13	7
Zieria (Rutaceae)	n/a	7
Correa (Rutaceae)	n/a	n/a
Acacia (Fabaceae)	4	5
Acacia subtree2 (SEA) *sensu*. Renner et al. (2020)	n/a	21
Eucalypts (Myrtaceae)	17	17
Eucalyptus (Myrtaceae)	16	17
Corymbia (Myrtaceae)	14	18
Goodeniaceae	4	4
Dampiera (Goodeniaceae)	13	1

Styphelieae (Ericaceae)	18	18

*indicates a non-flowering gymnosperm group

Table S13a The oldest stem age (Ma) of SWA and SEA clades for each group, with 95% confidence intervals. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications.

Genera or clade	SWA stem (Ma)	lower 95%	upper 95%	SEA stem (Ma)	lower 95%	upper 95%
Haemodoraceae	81.1	78	84	8.7	2.5	15.3
Banksia (Proteaceae)	60	n/a	n/a	23	n/a	n/a
Daviesia (Fabaceae)	45	38	53	26.5	18.9	33
Calytrix (Myrtaceae)	40.8	36.4	45.4	25.9	20.2	31
Dampiera (Goodeniaceae)	40.3	30	51.5	12.3	4.9	22.7
Trymalium (Rhamnaceae)	34.9	26.1	43.6	20.7	12.5	29.7
*Callitris** (Cupressaceae)	27.8	0	0	28.2	0	0
Adenanthos (Proteaceae)	23.4	23.1	25.6	13.3	6.2	21.3
Styphelieae	20.2	15.9	26.2	23	18.5	28.6
Persoonia (Proteaceae)	49	46	54	22.8	12.2	33.4
Pultenaea (Fabaceae)	47.5	42	50	21.9	15.5	26.9
Casuarina–Allocasuarina	25.3	19.5	30.2	29.1	23.5	33
Pomaderris (Rhamnaceae)	23.3	16.8	27.3	17.4	12.1	22.4
Correa (Rutaceae)	2	0.6	3.7	22.4	20.2	32.7
Prostanthera (Lamiaceae)	11.6	7.6	15.8	30.8	27.3	35.5
Cassinia & *Ozothamnus*	9.9	4.6	15.8	12.4	7.2	17
Dianella (Asphodelaceae)	7.5	4.4	11	6.6	3.9	9.8
Cassinia (Asteraceae)	0.7	0.08	1.6	4.1	2.1	6.4
Eucalyptus (Myrtaceae)	34.8	0	0	18.4	0	0
Loganiaceae	26.1	0	0	22.48	0	0
Logania–Orianthera	16.7	0	0	22.48	0	0
Haemodorum (Haemodoraceae)	10.4	5.6	16.1	8.7	2.5	15.3

*indicates a non-flowering gymnosperm group

Table S13b Summary statistics for correlation tests between tip-specific speciation rates (STRAPP) and stem age (Ma).

Dataset	Test	p-value	rho	S
SWA majority groups	Spearman's rank	0.0082	-0.65	1120
SEA majority groups	Spearman's rank	0.1449	-0.38	939.4
SWA majority, post E–O boundary	Pearson's	0.1100	-0.61	n/a

Table S14 Summary statistics for chi-square tests on meta-dataset. Complete dataset refers to all six categories: SWA & SEA 50% majority, SWA & SEA 70% majority, temperate Au, and temperate Au with no overlap. Values shown for p-values: '*' represent significance levels of $p < 0.05$, '**' represent significance levels of $p < 0.01$, '***' represent significance levels of $p < 0.001$.

Dataset	p-value
STRAPP complete	2.20e-16 ***
STRAPP SWA & SEA 50% majority only	2.20e-16 ***
BAMM speciation complete	2.20e-16 ***
BAMM speciation SWA & SEA 50% majority only	5.83e-12 ***
DDD complete	2.20e-16 ***
DDD SWA & SEA 50% majority only	4.38e-5 ***
γ statistic complete	7.82e-5 ***
γ statistic SWA & SEA 50% majority only	0.86
stem age complete	0.0497 *

Table S15 Individual results for each group: BAMM speciation rate towards present, diversification shifts in TreePar, and speciation shifts in CoMET. Positive shifts in diversification detected in TreePar are bolded. TreePar 2 Ma slice represent analyses of phylogenies with tips in 2 Ma slice from present trimmed to account for PBD. Table lines demarcate different families and highlighted sections in colour represent subclades within a phylogeny. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications.

Genera or clade	BAMM speciation	TreePar	TreePar 2 Ma	CoMET
Adenanthos (Proteaceae)	decline	0	n/a	0
Calytrix (Myrtaceae)	decline	1	1	1
Pomaderreae (Rhamnaceae)	decline	1	0	0
Pomaderris (Rhamnacae)	constant	1	0	0
Stenanthemum (Rhamnaceae)	constant	0	n/a	0
Trymalium (Rhamnaceae)	decline	0	n/a	0
Gastrolobium (Fabaceae)	decline	0	0	0
Daviesia (Fabaceae)	decline	**3**	1	1
Pultenaea (Fabaceae)	decline	0	0	0
Banksia (Proteaceae)	decline	1	0	0
Persoonia (Proteaceae)	increase	1	0	0
Hakea (Proteaceae)	decline	1	1	1
Cassinia & *Ozothamnus* (Asteraceae)	increase	0	0	0
Cassinia (Asteraceae)	increase	0	0	0
Haemodoraceae	increase	0	n/a	1
Haemodorum	constant	0	n/a	0
Anigozanthos–Tribonanthes	increase	**1 (increase)**	n/a	1
Anigozanthos	constant	0	n/a	~
Conostylis	decline	1	0	~
Dianella (Asphodelaceae)	increase	**1 (increase)**	1 (increase)	0
Prostanthera (Lamiaeae)	decline	1	0	0
Casuarina–Allocasuarina (Casuarinaceae)	constant	0	0	0
*Callitris** (Cupressaceae)	decline	0	n/a	0
Loganiaceae	increase	0	n/a	0
Logania–Orianthera	constant	0	n/a	0
Orianthera	constant	0	n/a	~
Zieria (Rutaceae)	constant	0	n/a	0
Correa (Rutaceae)	constant	0	n/a	1

Acacia (Fabaceae)	variable, decrease	0	0	1
Acacia subtree2 (SEA) *sensu*. Renner et al. (2020)	constant	1	~	~
Eucalypts (Myrtaceae)	increase	3	2 (increase)	1
Eucalyptus (Myrtaceae)	increase	2	0	0
Corymbia (Myrtaceae)	constant	0	0	1
Goodeniaceae	increase	0	1	0
Dampiera (Goodeniaceae)	decrease	0	n/a	1
Styphelieae (Ericaceae)	decline	1	0	0

Table S16 Best DDD model out nine implemented in DDD for each group, based on weighted AICs. Multiple models are listed when they have comparable best AIC weights. Models that include density-dependent as one of the best models for the respective group are bolded. ':' indicate the second-best model after the best model was eliminated from subsequent analyses. DDD 2Ma slice represent analyses of phylogenies with tips in 2 Ma slice from present trimmed to account for PBD. Table lines demarcate different families and highlighted sections in colour represent subclades within a phylogeny. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications.

Genera or clade	DDD	DDD 2Ma slice
Adenanthos (Proteaceae)	**TDL3, DDLS1, DDLS1.3, PBD**	**TDL3, DDLS1, DDLS1.3**
Calytrix (Myrtaceae)	**DDLS1, DDLS1.3**	n/a
Pomaderreae (Rhamnaceae)	PBD	BD, TDL1, TDL3
Pomaderris (Rhamnacae)	PBD	BD, TDL1, TDL3
Stenanthemum (Rhamnaceae)	PBD	PBD: TDL3
Trymalium (Rhamnaceae)	**DDLS1, DDLS1.3**	**DDLS1, DDLS1.3**
Gastrolobium (Fabaceae)	PBD	TDL3, PBD
Daviesia (Fabaceae)	**DDLE3**	**PBD: TDL3, DDLS1, LS1.3**
Pultenaea (Fabaceae)	**DDXS2.2**	**DDXS2**
Banksia (Proteaceae)	PBD	**DDLS1, DDLS1.3**
Persoonia (Proteaceae)	PBD: TDL3, DDLS1, 1.3	TDL3
Hakea (Proteaceae)	**PBD: DDLS1**	TDL3
Cassinia & *Ozothamnus* (Asteraceae)	PBD	**DDLS1, DDLS1.3**
Cassinia (Asteraceae)	PBD	BD, TDL1
Haemodoraceae	PBD: BD, TDL1	PBD: BD, TDL1
Haemodorum	BD, TDL1, TDL3	n/a
Anigozanthos–Tribonanthes	PBD	PBD: BD, TDL1
Anigozanthos	BD, TDL1	n/a
Conostylis	**DDXS2**	n/a
Dianella (Asphodelaceae)	BD, TDL1	DDLS1, DDLS1.3
Prostanthera (Lamiaeae)	PBD	**DDLS1, DDLS1.3**
Casuarina–Allocasuarina (Casuarinaceae)	PBD	**DDLS3**
*Callitris** (Cupressaceae)	**DDLS1, DDLS1.3**	**DDLS1, DDLS1.3**

Loganiaceae	BD, TDL1	n/a
Logania–Orianthera	BD, TDL1	n/a
Orianthera	BD, TDL1	n/a
Zieria (Rutaceae)	PBD: TDL3,TDL1, BD	PBD: TDL3
Correa (Rutaceae)	**DDLS1, DDLS1.3**	n/a
Acacia (Fabaceae)	TDL3	BD, TDL1
Acacia subtree2 (SEA) *sensu*. Renner et al. (2020)	PBD	BD, TDL1
Eucalypts (Myrtaceae)	**DDLS1.3: PBD**	BD, TDL1
Eucalyptus (Myrtaceae)	PBD: TDL3, DDLS1	BD, TDL1
Corymbia (Myrtaceae)	PBD	**DDLS1, DDLS1.3**

Table S16. Continued.

Genera or clade	DDD	DDD 2Ma slice
Goodeniaceae	PBD	BD, TDL1
Dampiera (Goodeniaceae)	TDL3	TDL3
Styphelieae (Ericaceae)	PBD	PBD: TDL3

Table S17 γ statistic values for each group, along with their significance. Positive γ statistic values are shown in bold. Values shown for p-values: '*' represent significance levels of $p < 0.05$, '**' represent significance levels of $p < 0.01$, '***' represent significance levels of $p < 0.001$. Table lines demarcate different families and highlighted sections in colour represent subclades within a phylogeny. Bolded groups indicate families or infrafamilial (e.g. tribal/subfamilial) classifications.

Genera or clade	γ statistic	p-value significance
Adenanthos (Proteaceae)	-2.216	***
Calytrix (Myrtaceae)	-3.888	***
Pomaderreae (Rhamnaceae)	-3.558	***
Pomaderris (Rhamnacae)	-2.023	*
Stenanthemum (Rhamnaceae)	-1.532	non-sig
Trymalium (Rhamnaceae)	-1.721	non-sig
Gastrolobium (Fabaceae)	-4.935	*
Daviesia (Fabaceae)	-5.664	***
Pultenaea (Fabaceae)	-1.507	non-sig
Banksia (Proteaceae)	-0.977	non-sig
Persoonia (Proteaceae)	-3.190	**
Hakea (Proteaceae)	-5.406	***
Cassinia & *Ozothamnus* (Asteraceae)	-1.274	non-sig
Cassinia (Asteraceae)	-3.310	***
Haemodoraceae	-0.539	non-sig
Haemodorum	-0.375	non-sig
Anigozanthos–Tribonanthes	-0.539	non-sig
Anigozanthos	**0.495**	non-sig
Conostylis	-2.927	***

Dianella (Asphodelaceae)	-0.193	non-sig
Prostanthera (Lamiaeae)	-4.349	***
Casuarina–Allocasuarina (Casuarinaceae)	-1.730	non-sig
*Callitris** (Cupressaceae)	**0.286**	non-sig
Loganiaceae	**0.544**	non-sig
Logania–Orianthera	**0.427**	non-sig
Orianthera	**0.436**	non-sig
Zieria (Rutaceae)	-0.625	non-sig
Correa (Rutaceae)	**0.966**	non-sig
Acacia (Fabaceae)	-6.539	***
Acacia subtree2 (SEA) *sensu*. Renner et al. (2020)	-3.590	***
Eucalypts (Myrtaceae)	-7.805	***
Eucalyptus (Myrtaceae)	-11.622	***
Corymbia (Myrtaceae)	-1.811	non-sig
Goodeniaceae	-1.062	non-sig
Dampiera (Goodeniaceae)	-3.159	***
Styphelieae (Ericaceae)	-4.604	***

Table S18. BAMM, CoMET speciation rates, and TreePar diversification rate shifts through time, for each group. Dissimilar results between BAMM and CoMET/TreePar are highlighted in bold. * marks recent declines in speciation rates that are likely artefactual due to incomplete sampling. n/a in TreePar results indicate that no significant diversification shifts were detected for the group.

Genera or clade	BAMM speciation	CoMET speciation rate	TreePar
Adenanthos (Proteaceae)	decline	gradual decline from 15 Ma	n/a
Calytrix (Myrtaceae)	decline	notable decline from 15 Ma	decline at 12 Ma
Pomaderreae (Rhamnaceae)	decline	notable decline from 4 Ma*	decline at 1 Ma*
Pomaderris (Rhamnacae)	constant	n/a	decline at 1 Ma*
Stenanthemum (Rhamnaceae)	constant	**notable decline at 4 Ma***	n/a
Trymalium (Rhamnaceae)	decline	gradual decline	n/a
Gastrolobium	decline	notable decline at 5 Ma	n/a

(Fabaceae)			
Daviesia (Fabaceae)	decline	increase at 15 Ma followed by decrease at 6 Ma	increase at 15 Ma, folowed by decrease at 5 Ma
Pultenaea (Fabaceae)	decline	variable, notable decrease at 13 Ma followed by increase then gradual decrease	n/a
Banksia (Proteaceae)	decline	notable decline at 3 Ma*	decline at 1 Ma*
Persoonia (Proteaceae)	increase	decline from 10 Ma	decline at 2 Ma
Hakea (Proteaceae)	decline	gradual decline from 15 Ma	decline at 10 Ma
Cassinia & *Ozothamnus* (Asteraceae)	increase	**notable decline at 1 Ma***	n/a
Cassinia (Asteraceae)	increase	n/a	n/a
Haemodoraceae	increase	increase at 10 Ma followed by decline at 5 Ma	n/a
Haemodorum	constant	constant	n/a
Anigozanthos–Tribonanthes	increase	increase at 10 Ma, followed by decline at 3 Ma	increase at 8 Ma
Anigozanthos	constant	n/a	n/a
Conostylis	decline	n/a	n/a
Dianella (Asphodelaceae)	increase	increase at 7 Ma, followed by decline at 2 Ma	increase at 5 Ma
Prostanthera (Lamiaeae)	decline	notable decline at 2 Ma*	decline at 2.5 Ma
Casuarina–Allocasuarina (Casuarinaceae)	constant	**notable decline at 2 Ma***	n/a
*Callitris** (Cupressaceae)	decline	**constant**	n/a
Loganiaceae	increase	n/a	n/a
Logania–Orianthera	constant	constant	n/a
Orianthera	constant	n/a	n/a
Zieria (Rutaceae)	constant	variable, decrease at 5 Ma	n/a
Correa (Rutaceae)	constant	constant	n/a
Acacia (Fabaceae)	variable, decrease	variable, decline at 2 Ma *	n/a
Acacia subtree2 (SEA) *sensu*. Renner et al. (2020)	constant	n/a	**decline at 1 Ma***
Eucalypts (Myrtaceae)	increase	variable, increase at 10 ma, followed by decline at 2 Ma*	increase at 10 Ma, followed by decline at 1 Ma
Eucalyptus (Myrtaceae)	increase	decline at 3 Ma*	decline at 2 Ma*
Corymbia (Myrtaceae)	constant	variable, decrease at 14 Ma, followed by	n/a

		increase at 7 Ma, then decline at 3 Ma*	
Goodeniaceae	increase	decline at 2 Ma*	n/a
Dampiera (Goodeniaceae)	decrease	gradual decline from 20 Ma	n/a
Styphelieae (Ericaceae)	decline	decline at 2 Ma*	decline at 1.5 Ma

Fig. S1a. Summary

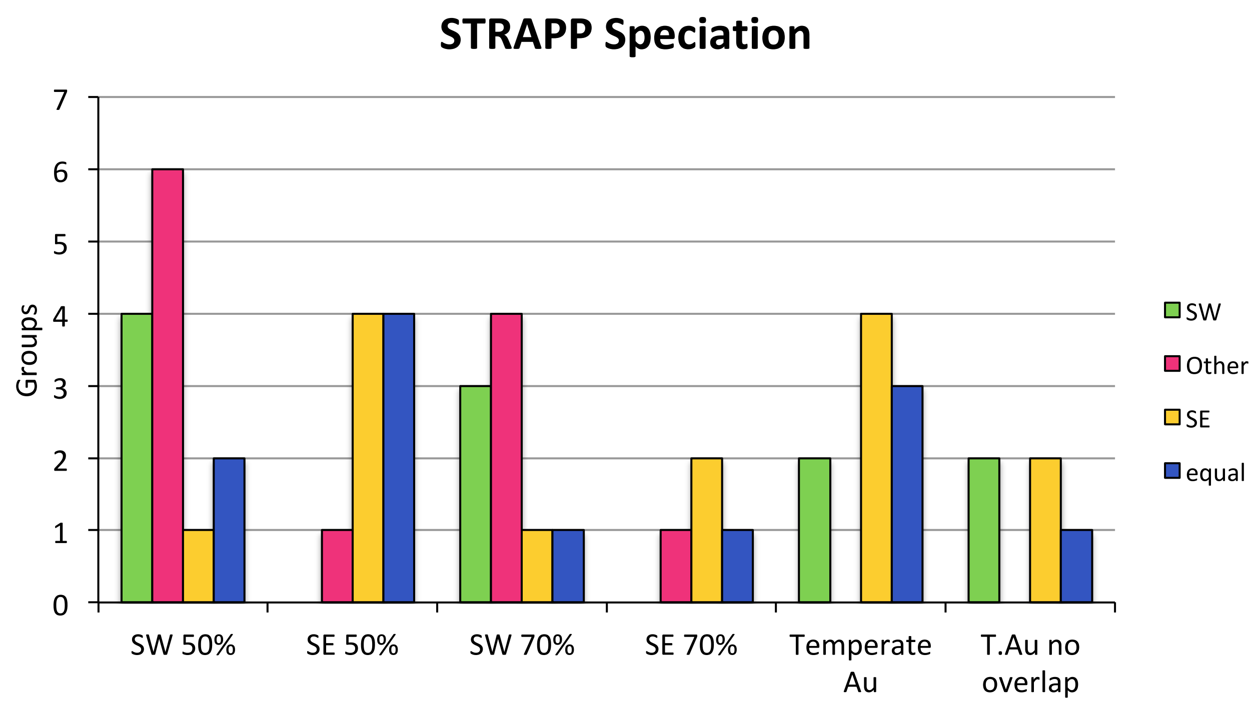


Fig. S1b. Summary BAMM

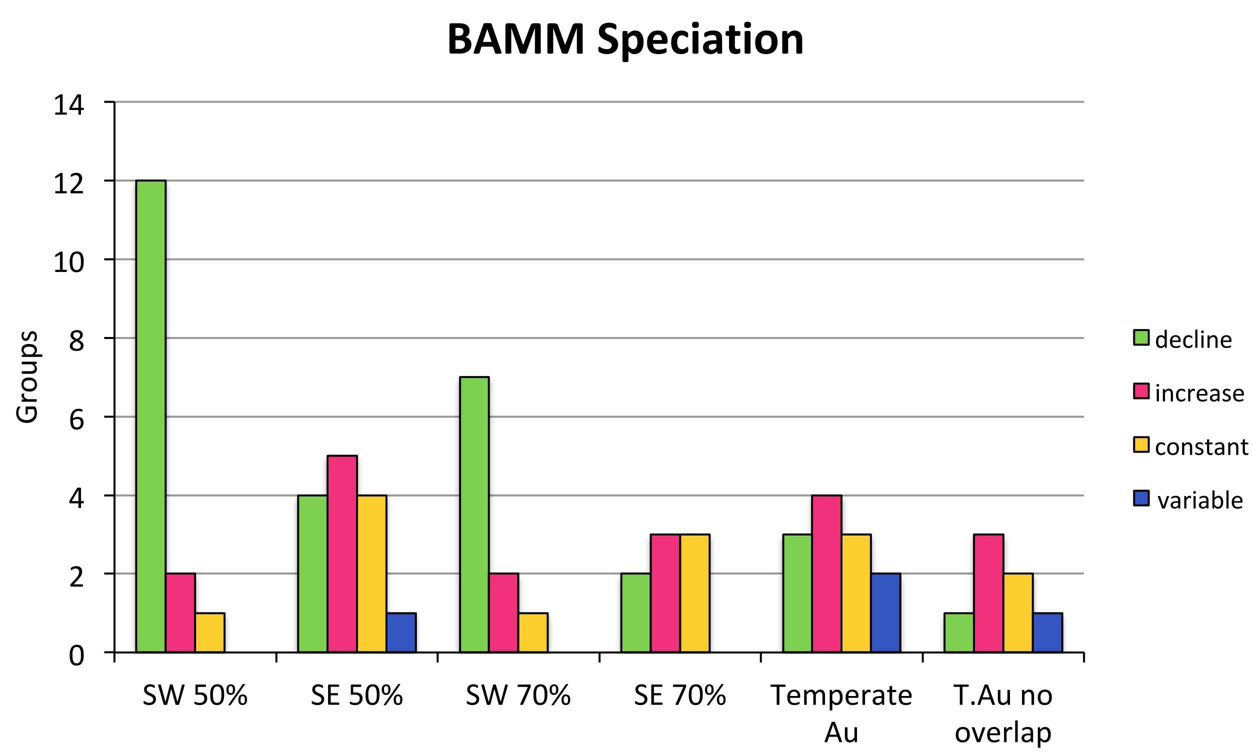


Fig. S1c. Summary DDD

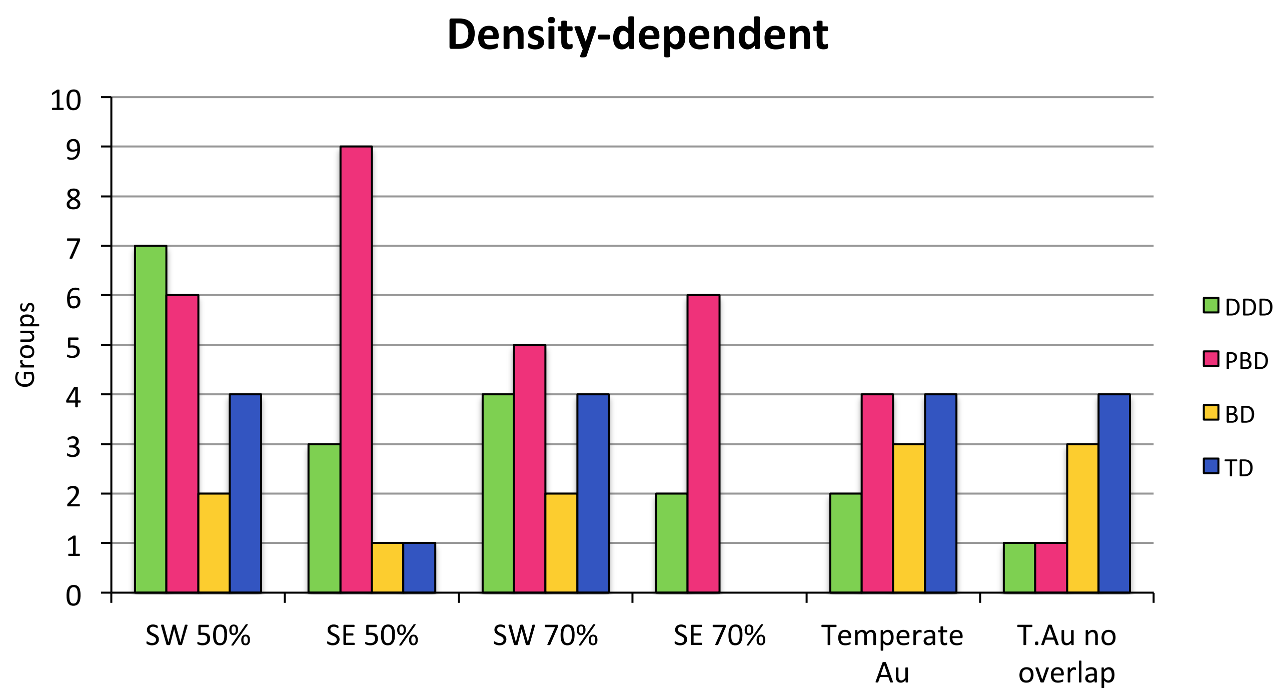


Fig. S1d. Summary γ statistic

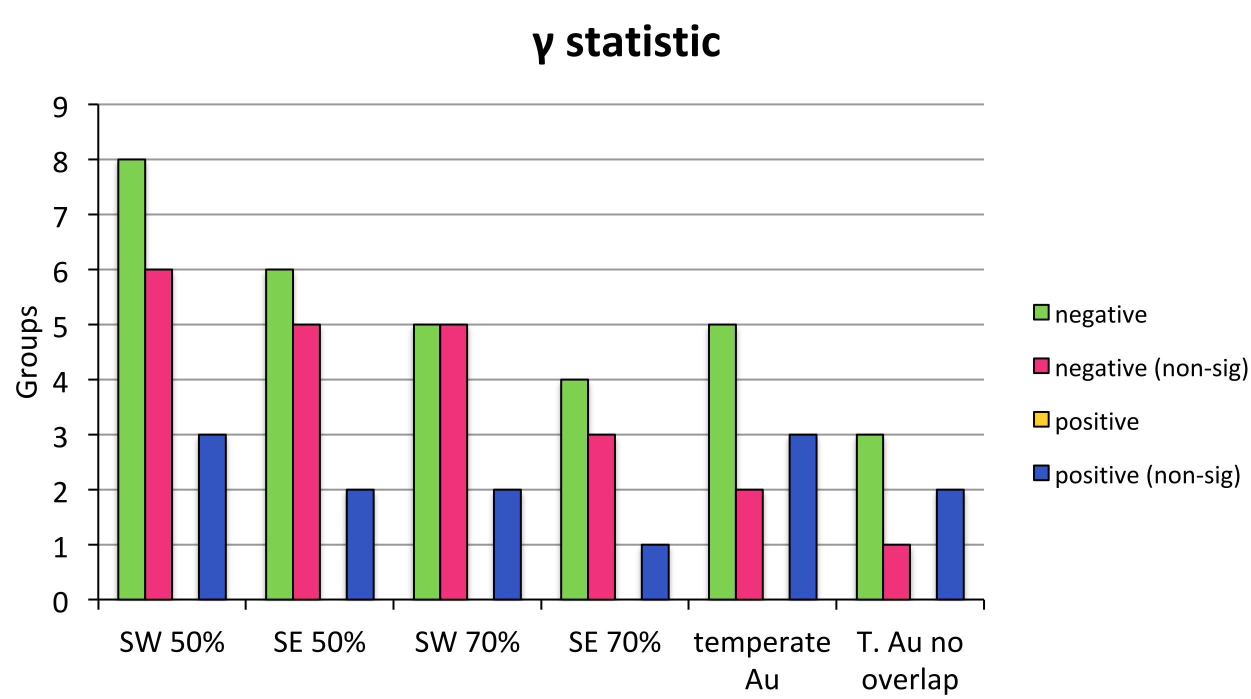
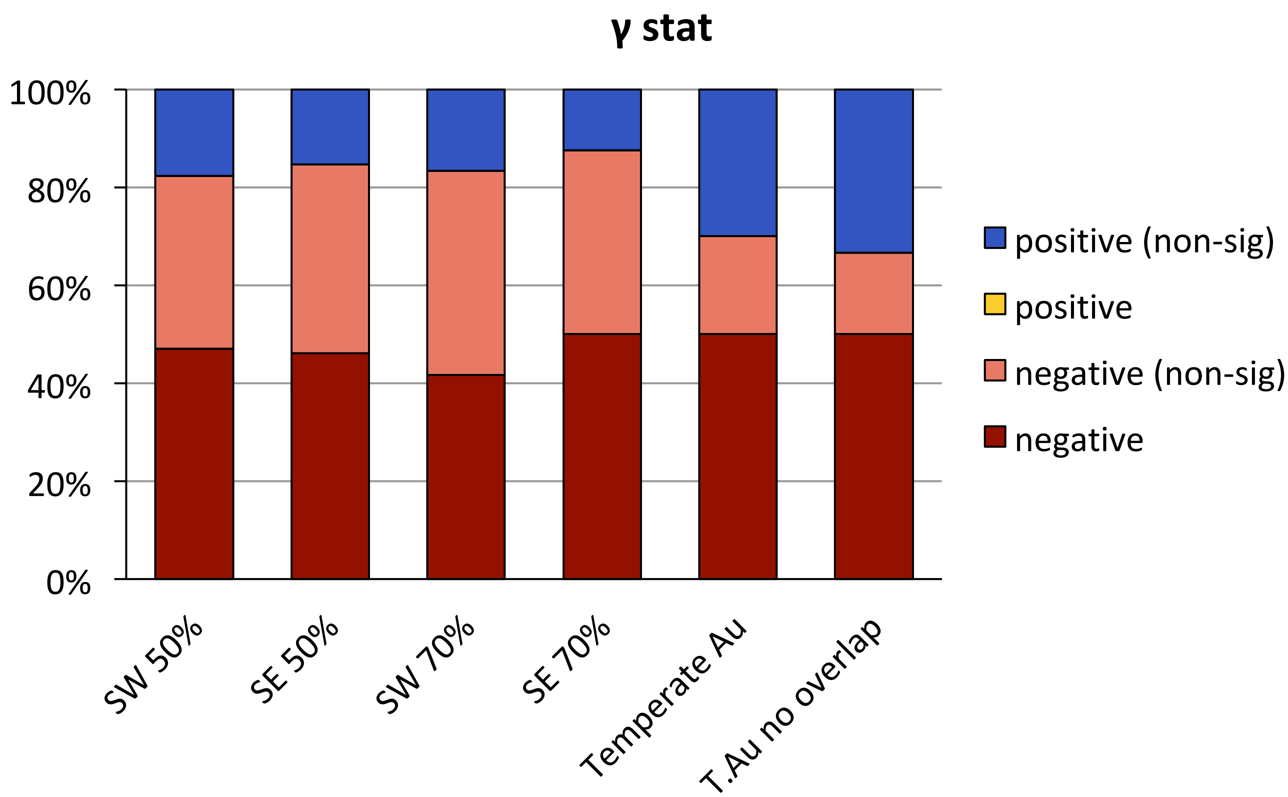


Fig. S2. Summary γ statistic



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