

Supplemental Information to:

Generalists link peaks in the shifting
adaptive landscape of Australia's dragon lizards

Document S1. Figures S1–S12 and Tables S1–S7

Figures

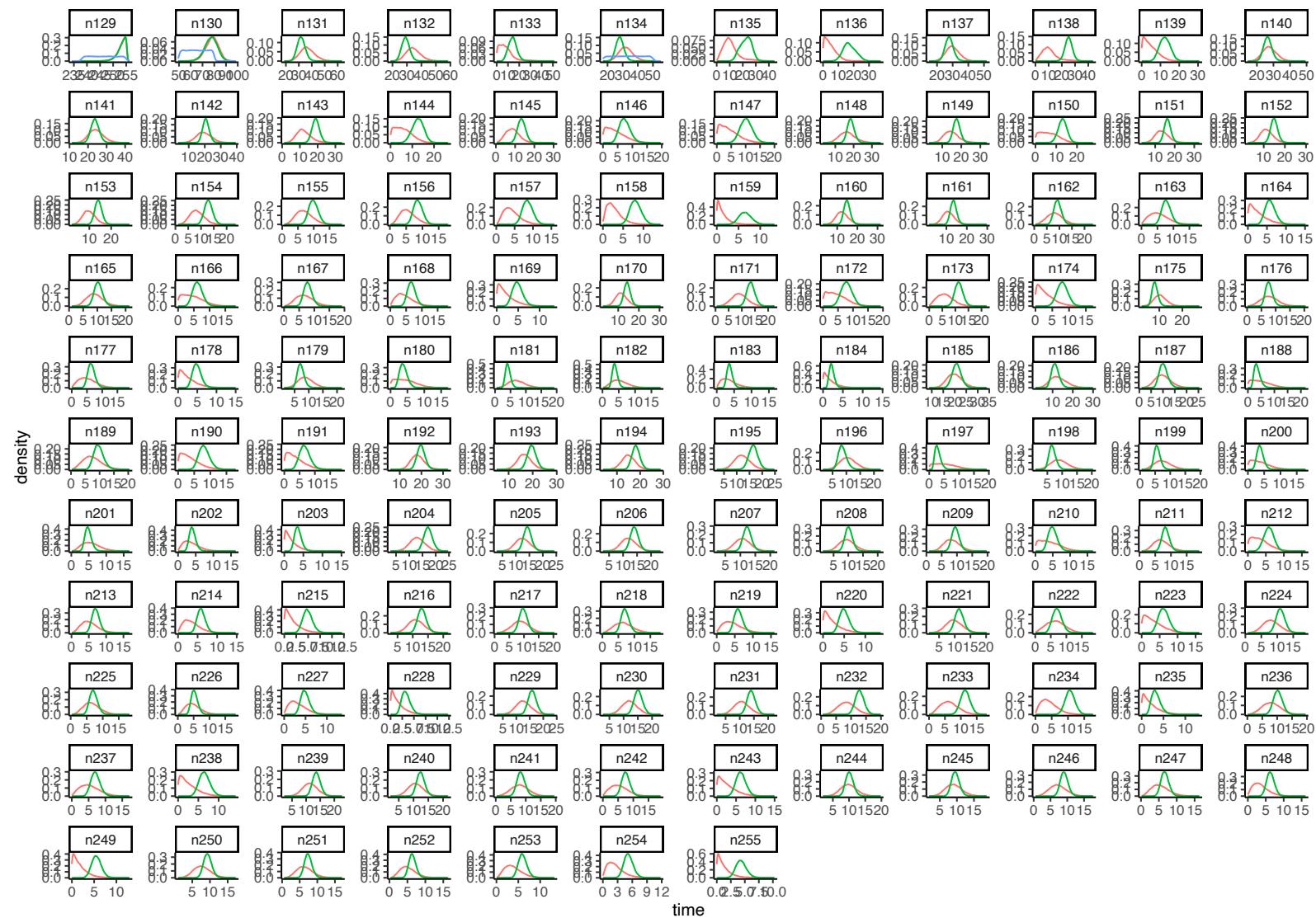


Figure S1. Plots of applied priors (blue), effective priors (pink), and posteriors (green) for each node in the tree indicate reasonable behavior. Node numbers correspond to the phylogeny plotted below, plotted with ape, where n129 is the root node. The effective prior (pink) shows how the interaction of multiple priors can shape the expected ages for a given node. This can be seen when comparing input (blue) and effective (pink) priors on any calibrated node (e.g. n129, n130, n134).

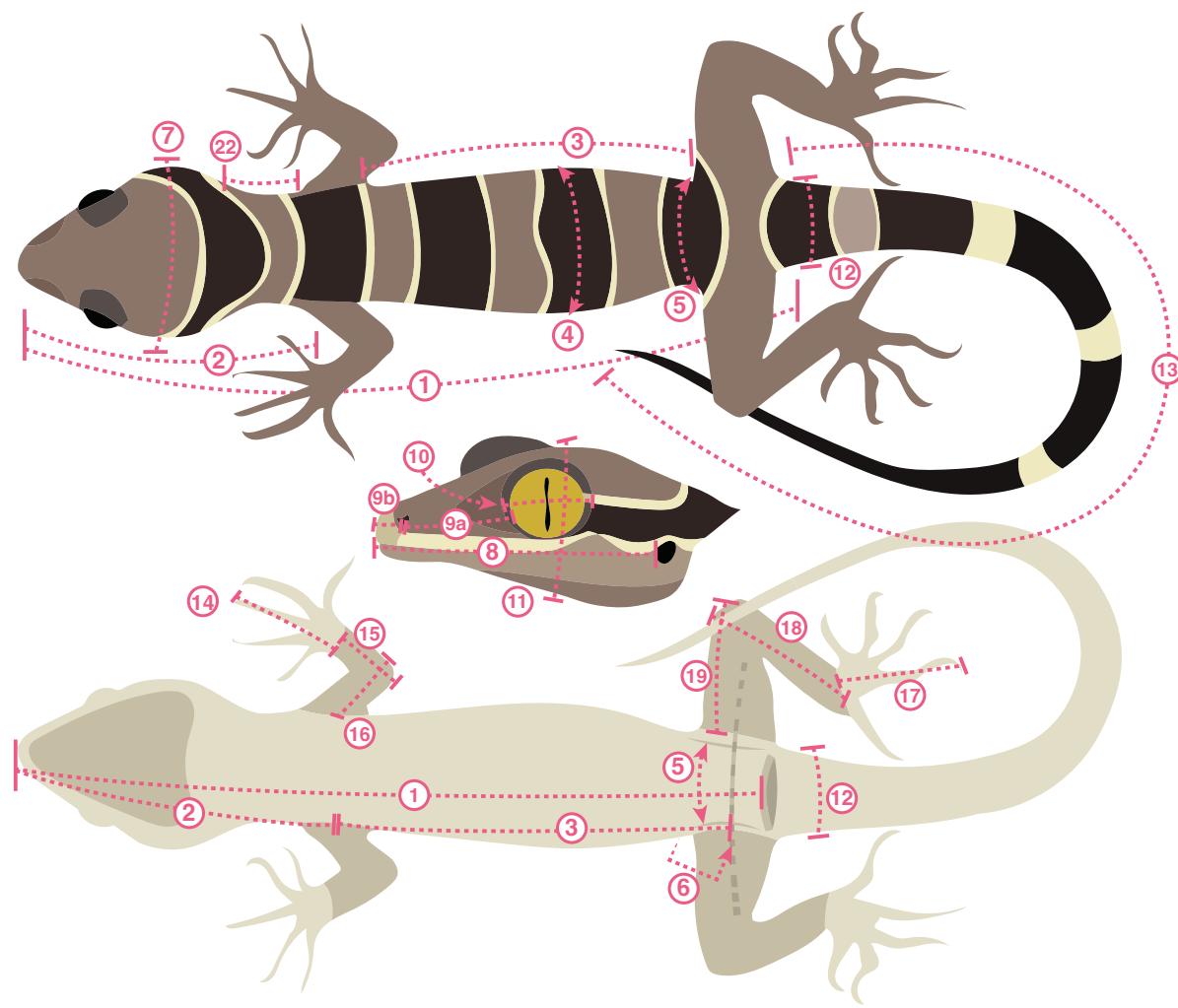


Figure S2. Schematic of morphological measurements taken and outlined in Table S3.

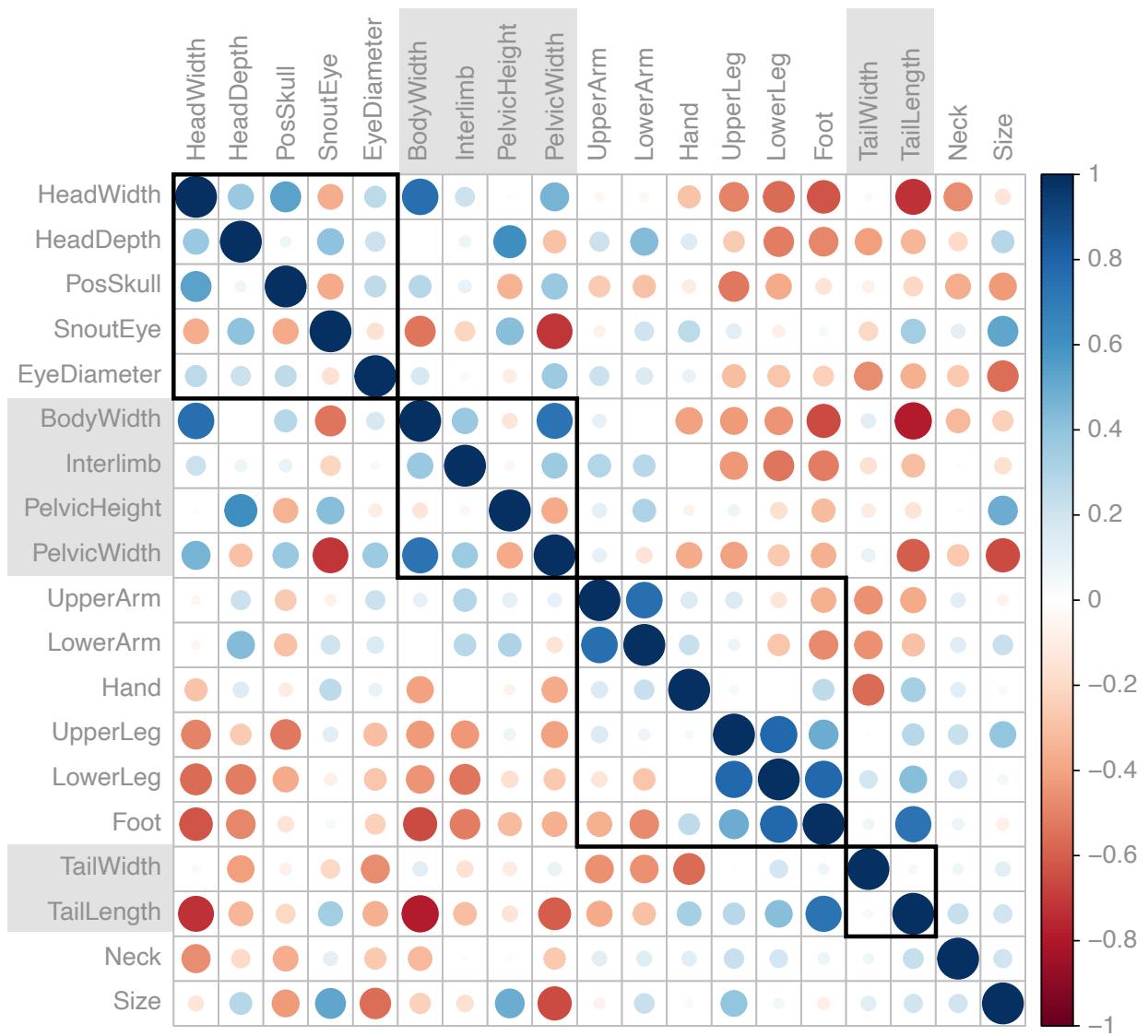


Figure S3. Plot of size-corrected trait correlations with traits grouped by the morphological module they correspond to (either head, body, limb, or tail). Blues indicate positive correlations, red indicate negative correlations, with saturation indicating increasing intensity.

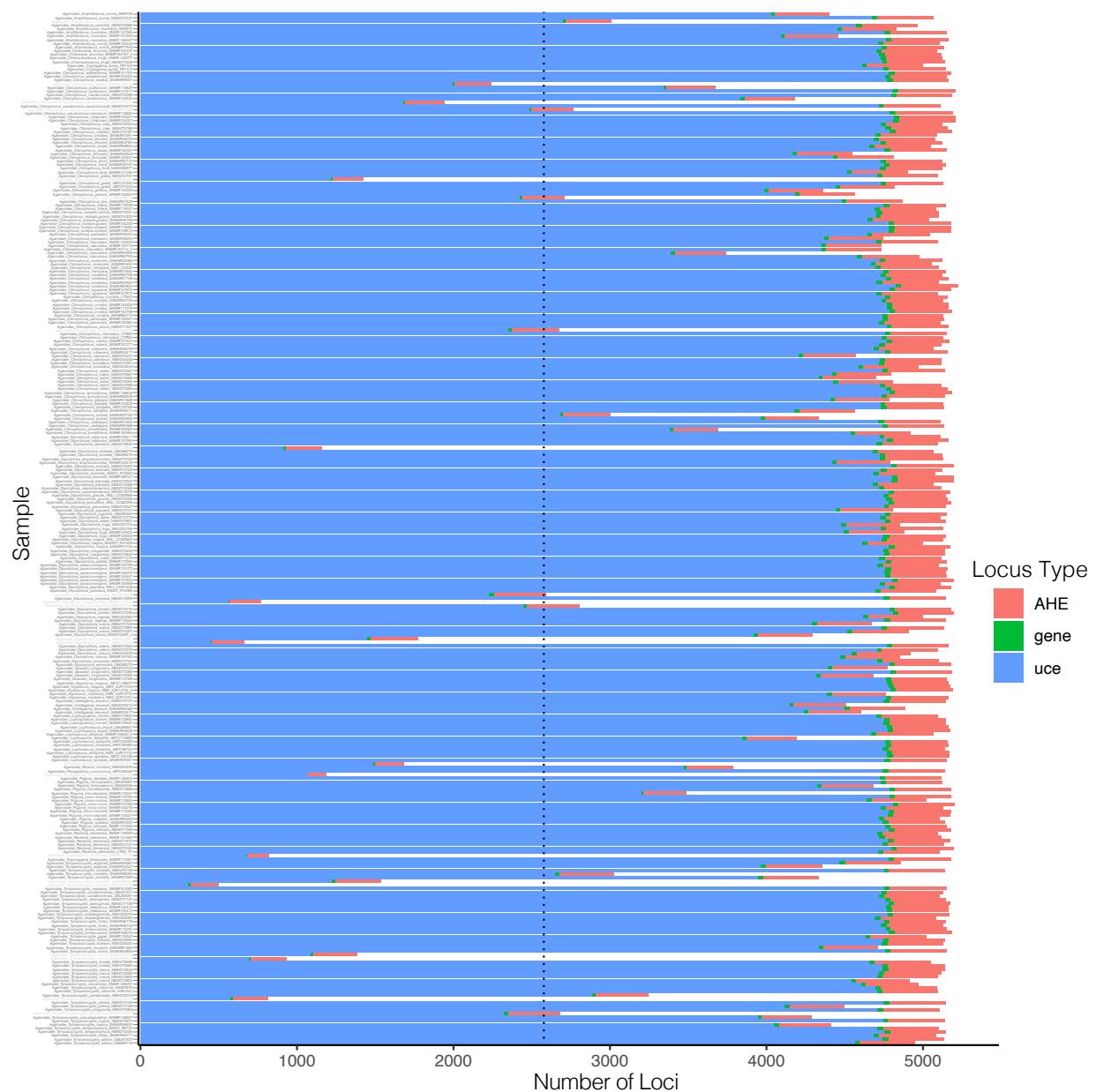


Figure S4. Locus type and number summarized by sample for newly sequenced samples. Dotted line indicates 50% of targeted sequences recovered. Samples in grey text at left were not included in final analyses.

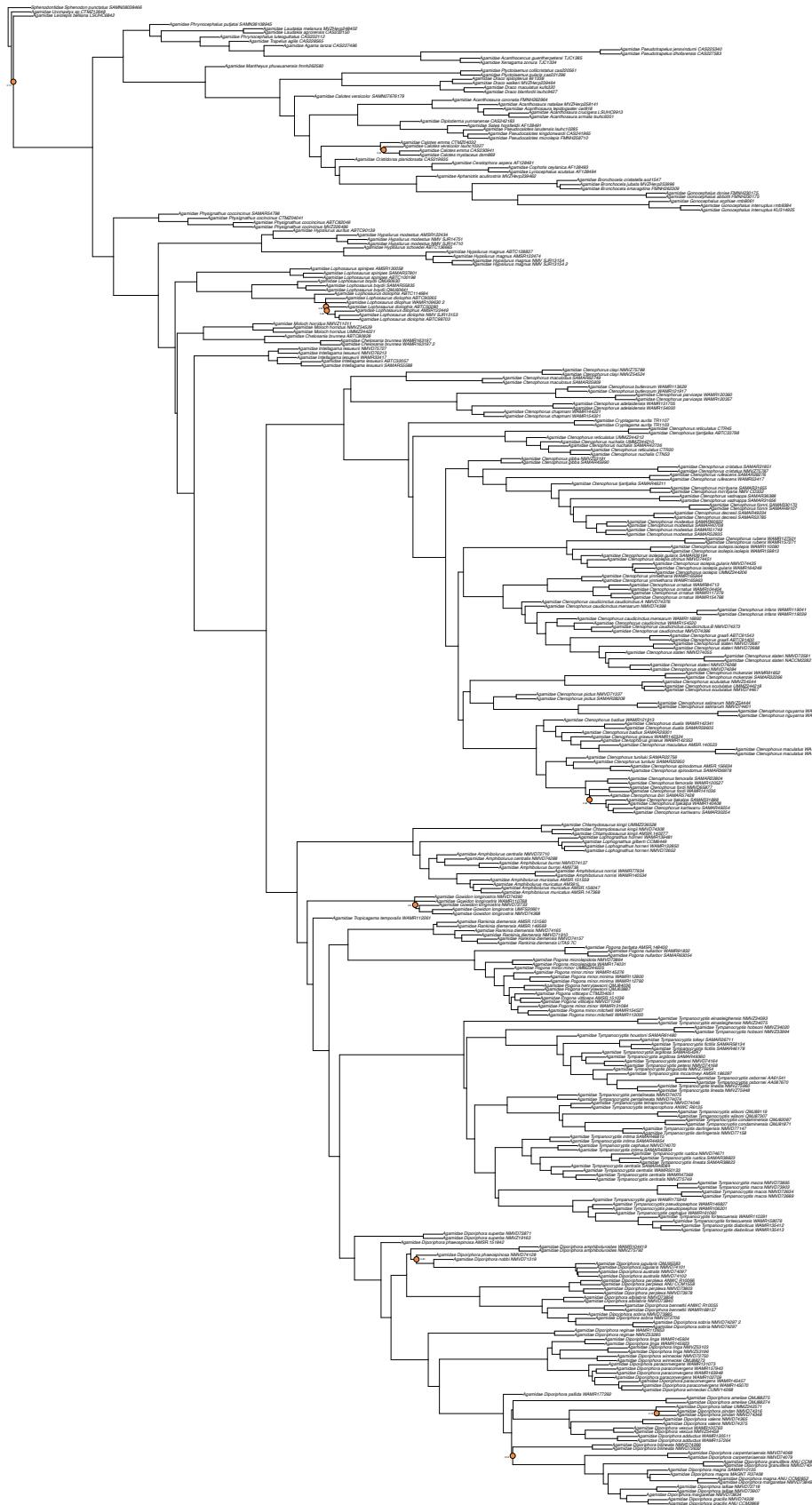


Figure S5. Species tree from weighted ASTRAL-hybrid including all samples sequenced and agamid outgroups. Local posterior probabilities are 1 for all nodes except those indicated by an orange circle.

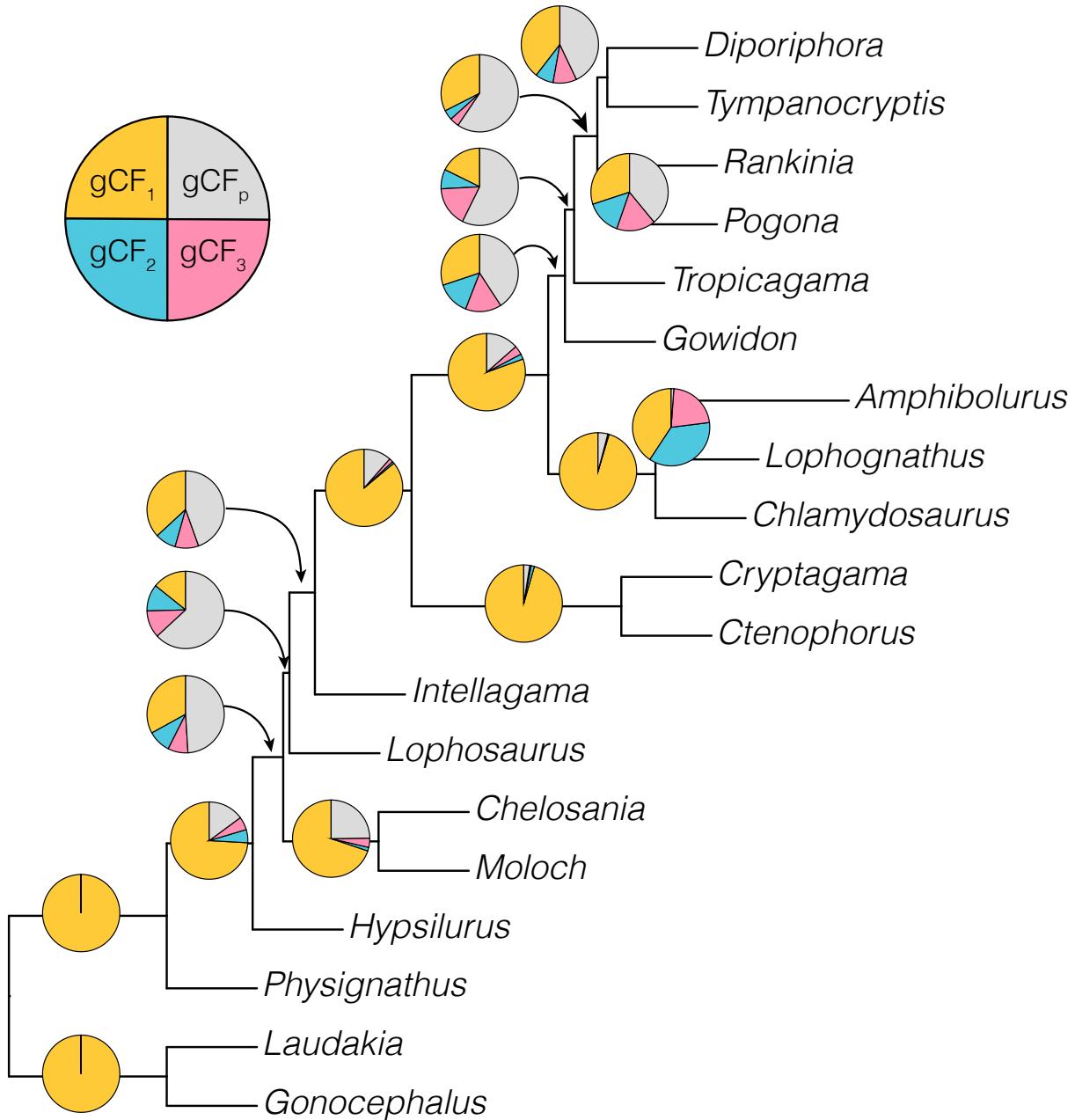


Figure S6. Phylogeny of the Amphibolurinae showing intergeneric relationships and support across individual loci. Gene concordance factors (gCF) show the proportion of gene trees which support a given bifurcation. Pie charts on branches indicate the percent of loci which support the presented bifurcation (gCF₁, orange), one of each of the two other most common resolutions (gCF₂, blue; gCF₃, pink) or all other possibilities (gCF_p, grey). Areas of low concordance (e.g. placement of *Lophosaurus*) indicate topological uncertainty, likely as a result of high levels of incomplete lineage sorting.

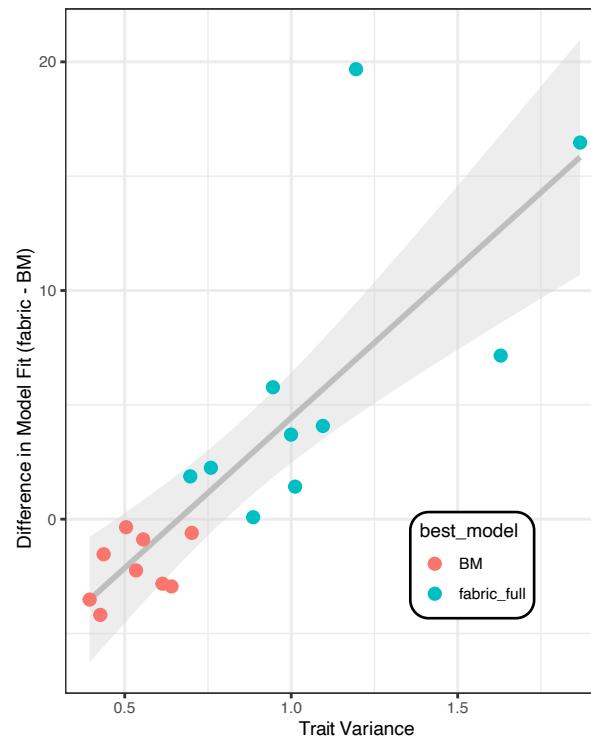
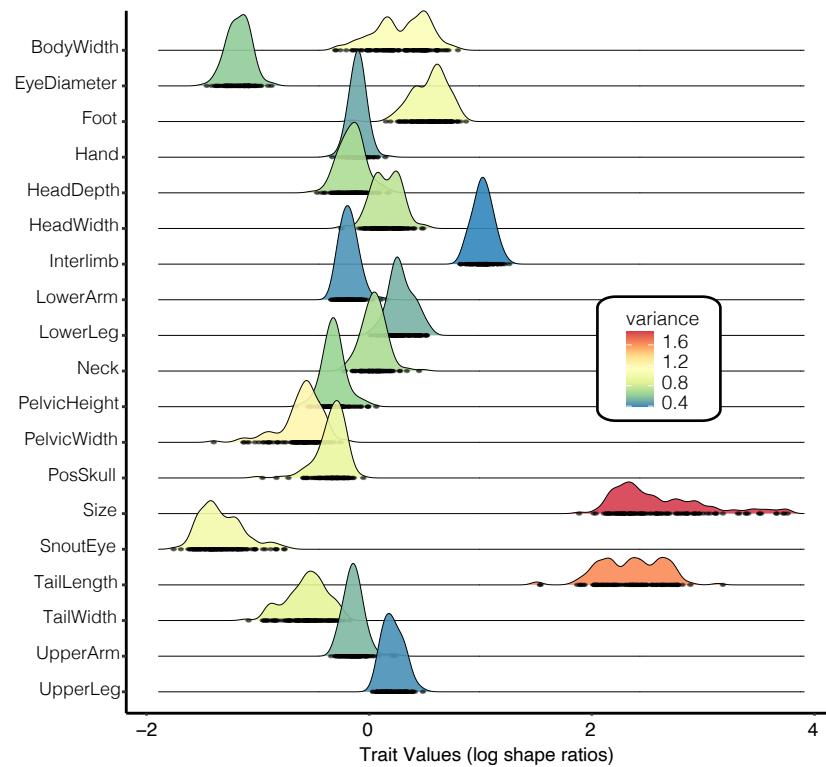


Figure S7. Individual traits show different levels of variance among amphibolurine species, with the greatest variances occurring in size (geometric mean) and tail length. Some traits, such as hand length and upper arm length show vanishingly small variation once corrected for absolute size. (Right) Traits with higher variances are more likely to fit the fabric model, which better partitions large changes in trait values.

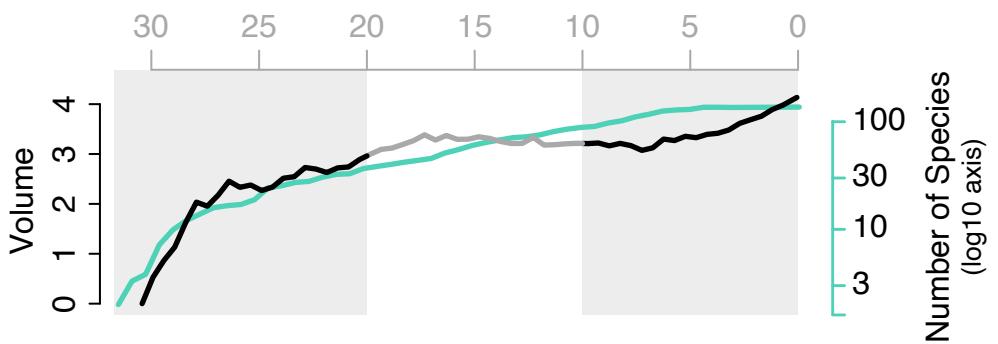


Figure S8. The Amphibolurinae hypervolume expands early and late in their evolution, with a period of niche packing in the Miocene. Diversification and morphological expansion are coupled in the early radiation of dragon lizards, but are largely decoupled from the Miocene onwards.

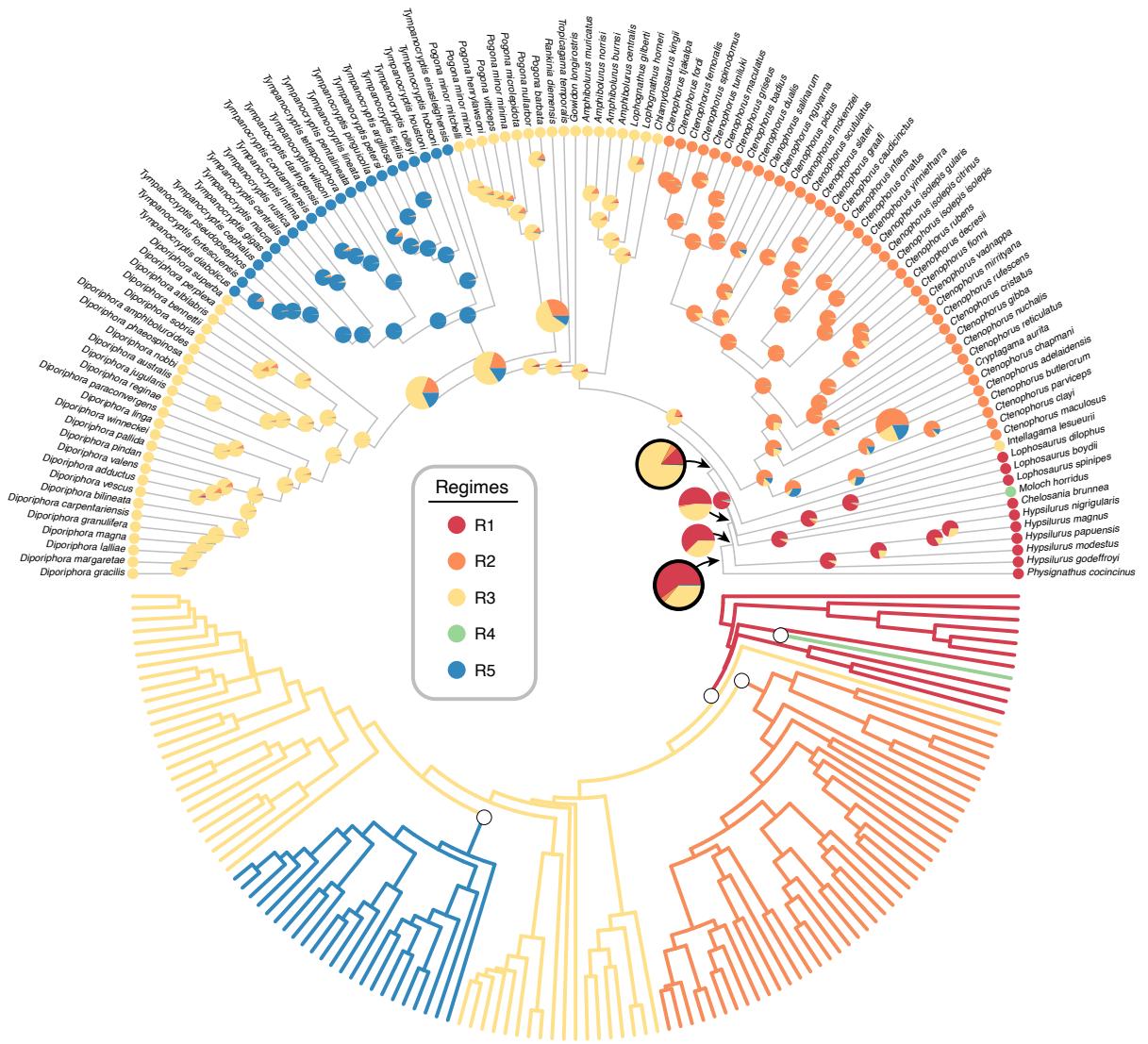


Figure S9. Adaptive peaks corresponding to morphological regimes identified under a multi-optima OU model in PhyloEM and applied to ancestral taxa using randomForests. (Bottom) Tree shows the preferred 5 regime model estimated from all 19 size corrected morphological traits, with regime shifts denoted by small white circles. (Top) Tree shows the preferred 5 regimes including likelihoods for ancestors as estimated by randomForest. The amphibolurine MRCA is estimated as a *Hypsilurus*/*Lophosaurus*-like arboreal dragon and the Australian MRCA is estimated as a semiarboreal generalist lizard (both indicated with black outline to pie).

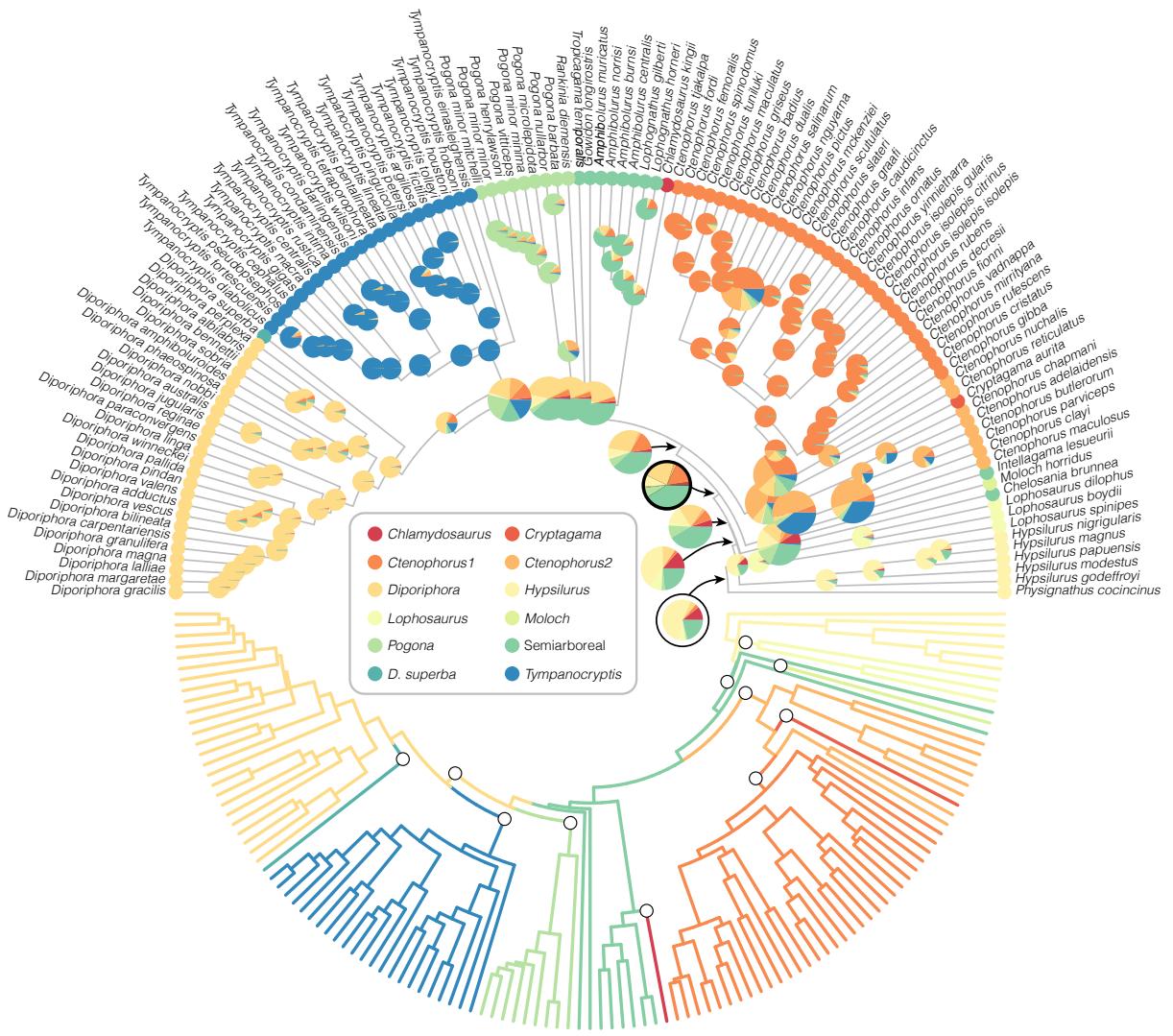


Figure S10. Adaptive peaks corresponding to morphological regimes identified under a multi-optima OU model in *PhyloEM* and applied to ancestral taxa using randomForests. (Bottom) Tree shows the preferred 12 regime model estimated from the first 6 PC axes of the morphological data, with regime shifts denoted by small white circles. (Top) Tree shows the preferred 12 regimes including likelihoods for ancestors as estimated by randomForest. The amphibolurine MRCA is estimated as a *Hypsilurus*-like arboreal dragon and the Australian MRCA is estimated as a semiarboreal lizard (both indicated with black outline to pie).

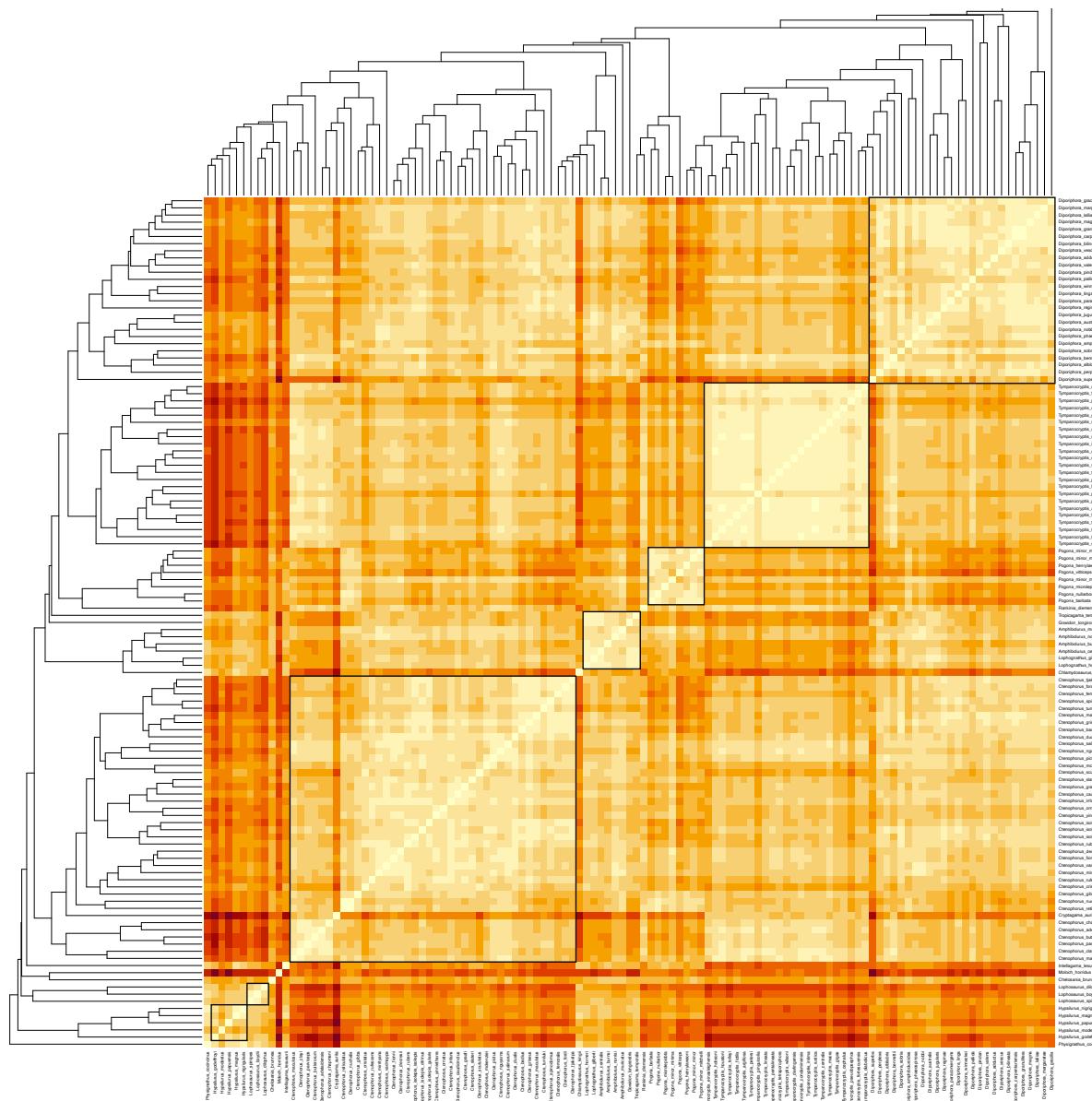


Figure S11. Heatmap of multivariate morphological euclidean distance among all pairs of amphibolurines. This presentation highlights the conservative evolution of *Tymanocryptis* along with the relative dissimilarity of novel species like *Chlamydosaurus* (more similar to *Lophosaurus/Hypsilurus*), *Ctenophorus aurita* (more similar to *Tymanocryptis*), and Moloch. Black boxes along the diagonal delineate genera or clades of morphologically similar taxa.

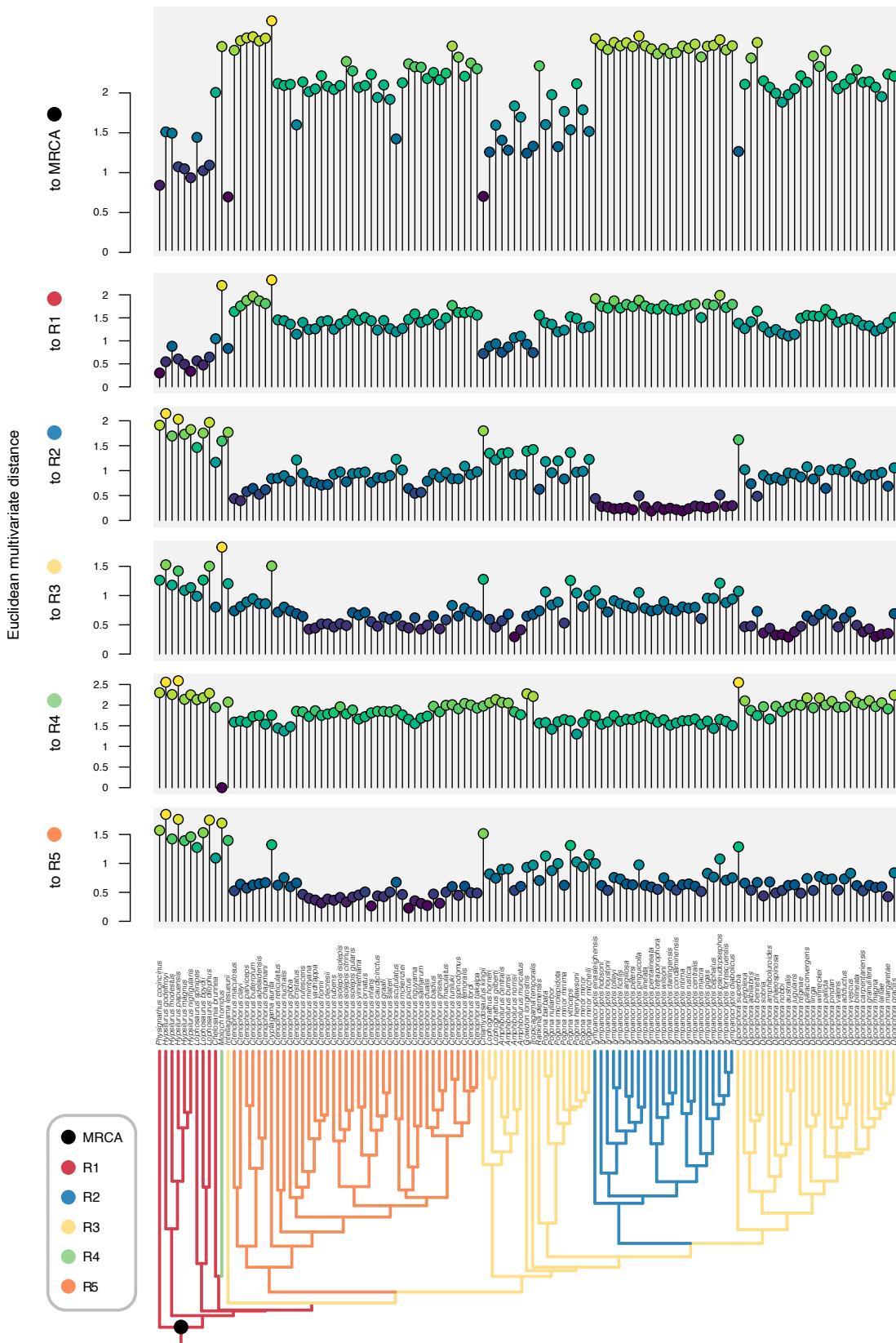


Figure S12. See caption below.

Figure S12. Multivariate Euclidean distance estimated between each extant species and estimated optima, as well as to the amphibolurine MRCA. Tree at bottom is colored according to the $k = 5$ model of morphological optima. Lollipop plots above show morphological distance between each extant species and the amphibolurine MRCA (black), primarily arboreal regime 1 (red), regime 2 (blue; *Tymanocryptis*), the primarily generalist regime 3 (yellow), regime 4 (green; *Moloch*), and regime 5 (orange; *Ctenophorus*). Based on this metric and our measured traits, the amphibolurine MRCA was most morphologically similar to *Intellagama*, *Physignathus*, and *Chlamydosaurus*. Terrestrial forms like *Ctenophorus aurita*, the *Ctenophorus adelaiedensis* group, and *Tymanocryptis* are likely highly derived and morphologically distinct from the MRCA.

Software

All software and versions used for *pipesnake* V.12 assembly and analysis of molecular data.

```
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ASTER:  
    astral-hybrid: 1.16.3.4  
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    BBMAP - reformat.sh: '39.01'  
    BBMAP - bbmap.sh: ''  
BLAT:  
    blat: '36'  
CUSTOM_DUMP SOFTWARE VERSIONS:  
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    yaml: '6.0'  
GBLOCKS:  
    gblocks: 0.91b  
IQTREE:  
    iqtreetree: 2.2.6  
MAFFT:  
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MAKE_PRG:  
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MERGE_TREES:  
    BusyBox: v1.22.1  
PARSE_BLAT_RESULTS:  
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PEAR:  
    pear: 0.9.6)  
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PREPARE_ADAPTER:  
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QUALITY_2_ASSEMBLY:  
    python: 3.8.3  
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    ausarg/pipesnake: '1.2'
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Tables

Molecular Sampling (Table S1)

Family	Subfamily	Genus	Species	RegNo	AHE	gene	uce	total_loci	Source
outgroup	—	Gallus	gallus	SAMN15960293	368	38	653	1059	NCBI
Sphenodontidae	—	Sphenodon	punctatus	SAMN08038466	385	39	4992	5416	NCBI
Sphenodontidae	—	Sphenodon	punctatus	SAMN08038466	385	39	4992	5416	NCBI
Varanidae	—	Varanus	komodoensis	SAMN10967258	388	41	4997	5426	NCBI
Dibamidae	—	Dibamus	novaeguineae	ABTC062295	338	0	2	340	Burbrink et al. 2021 (AHE_T212)
Gekkonidae	—	Heteronotia	binoei	CCM8104	388	40	4984	5412	NCBI
Agamidae	Agaminae	Acanthocercus	guentherpetersi	TJC1385	360	35	4791	5186	Title & Singhal et al. (2024)
Agamidae	Agaminae	Agama	lanzai	CAS227496	351	33	4823	5207	Title & Singhal et al. (2024)
Agamidae	Agaminae	Laudakia	agroensis	CAS2232150	362	34	4755	5151	Title & Singhal et al. (2024)
Agamidae	Agaminae	Laudakia	melanura	MVZHerp248402	360	34	4785	5179	Title & Singhal et al. (2024)
Agamidae	Agaminae	Phrynocephalus	luteoguttatus	CAS232112	366	34	4804	5204	Title & Singhal et al. (2024)
Agamidae	Agaminae	Phrynocephalus	putjatai	SAMN38108945	385	40	4891	5316	Title & Singhal et al. (2024)
Agamidae	Agaminae	Pseudotrapelus	dhofarensis	CAS227583	361	34	4803	5198	Title & Singhal et al. (2024)
Agamidae	Agaminae	Pseudotrapelus	jensvindumi	CAS225340	355	36	4782	5173	Title & Singhal et al. (2024)
Agamidae	Agaminae	Trapelus	agilis	CAS228565	25	25	3948	3998	Title & Singhal et al. (2024)
Agamidae	Agaminae	Xenagama	zonura	TJC1334	356	34	4807	5197	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Amphibolurus	burnsi	AM9736	345	28	4027	4400	AusARG_Agamidae
Agamidae	Amphibolurinae	Amphibolurus	burnsi	NMVD74137	356	33	4674	5063	AusARG_Agamidae
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Agamidae	Amphibolurinae	Amphibolurus	muricatus	AMSR.151559	343	26	4088	4457	AusARG_Agamidae
Agamidae	Amphibolurinae	Amphibolurus	muricatus	AMSR.156047	363	34	4763	5160	AusARG_Agamidae
Agamidae	Amphibolurinae	Amphibolurus	norrisi	WAMR140534	362	34	4711	5107	AusARG_Agamidae
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Agamidae	Amphibolurinae	Chelosania	brunnea	ABTC80828	189	9	2970	3168	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Chelosania	brunnea	WAMR163197	357	34	4698	5089	AusARG_Agamidae
Agamidae	Amphibolurinae	Chelosania	brunnea	WAMR163197	364	35	4718	5117	AusARG_Agamidae
Agamidae	Amphibolurinae	Chlamydosaurus	kingii	AMSR.140277	366	34	4725	5125	AusARG_Agamidae
Agamidae	Amphibolurinae	Chlamydosaurus	kingii	NMVD74308	368	33	4737	5138	AusARG_Agamidae
Agamidae	Amphibolurinae	Chlamydosaurus	kingii	UMMZ236528	369	35	4808	5212	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Cryptagama	aurita	TR1103	359	31	4607	4997	AusARG_Agamidae
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Agamidae	Amphibolurinae	Ctenophorus	butlerorum	WAMR113629	313	22	3339	3674	AusARG_Agamidae
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Agamidae	Amphibolurinae	Ctenophorus	caudicinctus.caudicinctus.A	NMVD74376	251	11	1680	1942	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Ctenophorus	caudicinctus.caudicinctus.B	NMVD74373	363	33	4715	5111	AusARG_Agamidae
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Agamidae	Amphibolurinae	Ctenophorus	clayi	NMVZ54524	362	36	4725	5123	AusARG_Agamidae
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(continued)

Family	Subfamily	Genus	Species	RegNo	AHE	gene	uce	total_loci	Source
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Agamidae	Amphibolurinae	Ctenophorus	dialis	SAMAR59605	364	32	4655	5051	AusARG_Agamidae
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Agamidae	Amphibolurinae	Ctenophorus	isolepis	UMMZ244206	360	31	4817	5208	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Ctenophorus	isolepis.citrinus	NMVD74451	362	34	4702	5098	AusARG_Agamidae
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Agamidae	Amphibolurinae	Ctenophorus	nguyarna	WAMR157972	364	34	4784	5182	AusARG_Agamidae
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Agamidae	Amphibolurinae	Ctenophorus	nuchalis	CTN53	366	36	4756	5158	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	nuchalis	SAMAR42726	365	33	4732	5130	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	nuchalis	UMMZ244210	320	23	3998	4341	Title & Singhal et al. (2024)
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Agamidae	Amphibolurinae	Ctenophorus	parviceps	WAMR120357	365	34	4738	5137	AusARG_Agamidae
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Agamidae	Amphibolurinae	Ctenophorus	pictus	NMVD71337	366	33	4765	5164	AusARG_Agamidae

(continued)

Family	Subfamily	Genus	Species	RegNo	AHE	gene	uce	total_loci	Source
Agamidae	Amphibolurinae	Ctenophorus	pictus	SAMAR28208	307	18	2351	2676	AusARG_Agamidae
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Agamidae	Amphibolurinae	Ctenophorus	reticulatus	CTR45	364	35	4731	5130	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	reticulatus	UMMZ244212	355	28	4802	5185	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Ctenophorus	rubens	WAMR127501	365	34	4768	5167	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	rubens	WAMR157271	364	34	4719	5117	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	rufescens	SAMAR28276	354	35	4680	5069	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	rufescens	WAMR53417	366	35	4757	5158	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	salinarum	NMVD74401	337	26	4206	4569	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	salinarum	NMVZ54444	362	33	4723	5118	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	scutulatus	NMVD74467	365	33	4718	5116	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	scutulatus	NMVZ54544	354	29	4587	4970	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	scutulatus	UMMZ244218	357	30	4823	5210	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Ctenophorus	slateri	NACCM2282	371	34	4810	5215	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Ctenophorus	slateri	NMVD72581	364	34	4739	5137	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	slateri	NMVD72687	349	30	4418	4797	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	slateri	NMVD72688	339	27	4331	4697	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	slateri	NMVD74055	355	29	4426	4810	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	slateri	NMVD74268	364	33	4722	5119	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	slateri	NMVD74284	364	34	4761	5159	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	spinodomus	AMSR.156634	368	34	4783	5185	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	spinodomus	SAMAR36978	367	36	4734	5137	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	tjakalpa	SAMAR31888	351	29	4405	4785	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	tjakalpa	WAMR140408	367	33	4726	5126	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	tjantjalka	ABTC33798	367	35	4730	5132	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	tjantjalka	SAMAR46211	357	30	4176	4563	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	tuniluki	SAMAR22756	302	20	2681	3003	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	tuniluki	SAMAR22950	347	30	3959	4336	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	vadnappa	SAMAR31656	364	36	4712	5112	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	vadnappa	SAMAR36388	361	36	4738	5135	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	yinnietharra	WAMR165963	292	18	3383	3693	AusARG_Agamidae
Agamidae	Amphibolurinae	Ctenophorus	yinnietharra	WAMR165964	354	28	4537	4919	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	adductus	WAMR120511	357	31	4721	5109	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	adductus	WAMR157264	359	36	4769	5164	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	albilabris	NMVD73840	359	35	4701	5095	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	albilabris	NMVD73858	234	17	909	1160	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	ameliae	QMJ88274	358	33	4678	5069	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	ameliae	QMJ88275	366	36	4720	5122	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	amphiboluroides	NMVZ75792	369	33	4724	5126	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	amphiboluroides	WAMR104419	339	32	4417	4788	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	australis	NMVD74097	366	34	4795	5195	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	australis	NMVD74102	359	35	4730	5124	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	bennettii	ANWC	359	36	4681	5076	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	bennettii	WAMR168157	363	35	4800	5198	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	bilineata	NMVD72632	361	36	4798	5195	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	bilineata	NMVD74266	358	30	4679	5067	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	carpentariaensis	NMVD74068	363	34	4718	5115	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	carpentariaensis	NMVD74079	362	35	4776	5173	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	gracilis	ANU	364	32	4747	5143	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	gracilis	NMVD74328	360	34	4764	5158	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	granulifera	ANU	363	34	4779	5176	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	granulifera	NMVD74047	362	33	4749	5144	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	jugularis	NMVD74101	338	28	4440	4806	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	jugularis	QMJ95583	360	35	4757	5152	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	lalliae	NMVD72718	352	34	4724	5110	AusARG_Agamidae

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Family	Subfamily	Genus	Species	RegNo	AHE	gene	uce	total_loci	Source
Agamidae	Amphibolurinae	Diporiphora	lalliae	NMVD73907	359	32	4756	5147	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	lalliae	UMMZ242571	360	34	4779	5173	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Diporiphora	linga	NMVZ53103	344	29	4476	4849	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	linga	NMVZ53196	364	34	4729	5127	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	linga	WAMR145923	356	36	4489	4881	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	linga	WAMR145924	365	35	4747	5147	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	magna	ANU	361	34	4734	5129	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	magna	MAGNT	358	32	4610	5000	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	magna	SAMAR10135	360	35	4780	5175	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	margaretae	NMVD73834	360	35	4744	5139	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	margaretae	NMVD73849	358	34	4748	5140	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	nobbi	NMVD71319	363	36	4718	5117	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	pallida	WAMR177292	358	34	4760	5152	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	paraconvergens	WAMR102709	360	34	4708	5102	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	paraconvergens	WAMR131073	361	35	4758	5154	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	paraconvergens	WAMR145070	360	36	4752	5148	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	paraconvergens	WAMR145457	363	35	4754	5152	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	paraconvergens	WAMR157943	360	35	4800	5195	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	paraconvergens	WAMR163948	357	32	4723	5112	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	perplexa	ANU	363	34	4782	5179	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	perplexa	ANWC	358	33	4694	5085	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	perplexa	NMVD73803	336	29	2227	2592	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	perplexa	NMVD73978	362	35	4747	5144	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	phaeospinosa	AMSR.151842	203	11	560	774	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	phaeospinosa	NMVD74128	336	27	2443	2806	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	pindan	NMVD74316	360	35	4784	5179	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	pindan	NMVD74348	357	35	4806	5198	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	reginae	NMVZ53285	351	31	4617	4999	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	reginae	WAMR112653	356	36	4752	5144	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	sobria	NMVD72706	350	33	4290	4673	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	sobria	NMVD73985	362	34	4735	5131	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	sobria	NMVD74297	360	34	4514	4908	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	sobria	NMVD74297	344	29	3917	4290	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	superba	NMVD73871	302	21	1448	1771	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	superba	NMVZ19163	206	11	447	664	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	valens	NMVD74365	359	35	4767	5161	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	valens	NMVD74375	357	32	4704	5093	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	vescus	NMVZ54459	347	30	4543	4920	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	vescus	WAMR100763	355	34	4466	4855	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	winneckei	CUMV14268	362	33	4816	5211	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Diporiphora	winneckei	NMVD72750	362	34	4704	5100	AusARG_Agamidae
Agamidae	Amphibolurinae	Diporiphora	winneckei	QMJ88273	362	35	4783	5180	AusARG_Agamidae
Agamidae	Amphibolurinae	Gowidon	longirostris	NMVD72733	354	28	4391	4773	AusARG_Agamidae
Agamidae	Amphibolurinae	Gowidon	longirostris	NMVD74368	361	36	4789	5186	AusARG_Agamidae
Agamidae	Amphibolurinae	Gowidon	longirostris	NMVD74390	335	30	4315	4680	AusARG_Agamidae
Agamidae	Amphibolurinae	Gowidon	longirostris	UMFS20601	368	35	4814	5217	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Gowidon	longirostris	WAMR110768	360	35	4759	5154	AusARG_Agamidae
Agamidae	Amphibolurinae	Hypsilurus	auritus	ABTC90139	370	33	4804	5207	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Hypsilurus	magnus	ABTC128837	363	35	4765	5163	AusARG_Agamidae
Agamidae	Amphibolurinae	Hypsilurus	magnus	AMSR122474	367	35	4859	5261	Singhal et al. 2021
Agamidae	Amphibolurinae	Hypsilurus	magnus	NMV	361	36	4776	5173	AusARG_Agamidae
Agamidae	Amphibolurinae	Hypsilurus	magnus	NMV	366	35	4790	5191	AusARG_Agamidae
Agamidae	Amphibolurinae	Hypsilurus	modestus	AMSR122434	367	34	4588	4989	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Hypsilurus	modestus	NMV	349	29	4386	4764	AusARG_Agamidae
Agamidae	Amphibolurinae	Hypsilurus	modestus	NMV	367	34	4761	5162	AusARG_Agamidae

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Family	Subfamily	Genus	Species	RegNo	AHE	gene	uce	total_loci	Source
Agamidae	Amphibolurinae	Hypsilurus	schoodei	ABTC136665	365	34	4825	5224	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Intellagama	lesueuri	ABTC32057	373	34	4863	5270	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Intellagama	lesueuri	NMVD75727	361	34	4747	5142	AusARG_Agamidae
Agamidae	Amphibolurinae	Intellagama	lesueuri	NMVD76213	336	26	4146	4508	AusARG_Agamidae
Agamidae	Amphibolurinae	Intellagama	lesueuri	SAMAR55588	352	33	4499	4884	AusARG_Agamidae
Agamidae	Amphibolurinae	Intellagama	lesueuri	WAMR33417	341	28	4237	4606	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophognathus	gilberti	CCM6449	369	36	4832	5237	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Lophognathus	horneri	NMVD72652	361	35	4697	5093	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophognathus	horneri	WAMR132850	363	34	4749	5146	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophognathus	horneri	WAMR139481	365	35	4746	5146	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophosaurus	boydii	QMJ60630	368	33	4461	4862	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Lophosaurus	boydii	QMJ60641	364	35	4766	5165	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophosaurus	boydii	SAMAR55835	364	35	4772	5171	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophosaurus	dilophus	AMSR122449	369	34	4772	5175	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Lophosaurus	dilophis	ABTC114684	322	25	3845	4192	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophosaurus	dilophis	ABTC50280	365	35	4755	5155	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophosaurus	dilophis	ABTC90265	363	36	4761	5160	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophosaurus	dilophis	ABTC98703	364	36	4741	5141	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophosaurus	dilophis	NMV	365	35	4767	5167	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophosaurus	spinipes	ABTC100198	363	36	4770	5169	AusARG_Agamidae
Agamidae	Amphibolurinae	Lophosaurus	spinipes	AMSR130058	368	33	4497	4898	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Lophosaurus	spinipes	SAMAR37801	361	35	4753	5149	AusARG_Agamidae
Agamidae	Amphibolurinae	Moloch	horridus	NMVZ11011	186	8	1488	1682	AusARG_Agamidae
Agamidae	Amphibolurinae	Moloch	horridus	NMVZ54529	297	20	3470	3787	AusARG_Agamidae
Agamidae	Amphibolurinae	Moloch	horridus	UMMZ244221	336	26	4678	5040	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Physignathus	coccincinus	ABTC82049	365	36	4741	5142	AusARG_Agamidae
Agamidae	Amphibolurinae	Physignathus	coccincinus	SAMAR54798	118	3	1067	1188	AusARG_Agamidae
Agamidae	Amphibolurinae	Physignathus	cocincinus	CTMZ04041	337	0	1	338	Burbrink et al. 2021 (AHE_T212)
Agamidae	Amphibolurinae	Physignathus	cocincinus	MVZZ26496	371	34	4799	5204	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Pogona	barbata	AMSR.148400	360	36	4722	5118	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	henrylawsoni	QMJ63887	360	36	4725	5121	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	henrylawsoni	QMJ84036	338	30	4319	4687	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	microlepidota	NMVD73864	361	36	4783	5180	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	microlepidota	WAMR174031	275	15	3199	3489	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	minor.minima	WAMR112792	363	35	4783	5181	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	minor.minima	WAMR112800	352	32	4638	5022	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	minor.minor	UMMZ244225	294	17	4387	4698	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Pogona	minor.minor	WAMR131084	363	36	4804	5203	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	minor.minor	WAMR145276	364	33	4730	5127	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	minor.mitelli	WAMR113000	370	35	4776	5181	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	minor.mitelli	WAMR154527	363	36	4773	5172	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	nullarbor	SAMAR63054	356	35	4715	5106	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	nullarbor	WAMR91832	364	35	4741	5140	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	vitticeps	AMSR.151036	360	36	4755	5151	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	vitticeps	CTMZ04051	358	0	2	360	Burbrink et al. 2021 (AHE_T212)
Agamidae	Amphibolurinae	Pogona	vitticeps	NMVD71349	365	36	4781	5182	AusARG_Agamidae
Agamidae	Amphibolurinae	Pogona	vitticeps	SAMEA2300447	388	41	4999	5428	NCBI
Agamidae	Amphibolurinae	Pogona	vitticeps	SAMEA2300447	388	41	4999	5428	NCBI
Agamidae	Amphibolurinae	Rankinia	diemensis	AMSR.149569	358	33	4706	5097	AusARG_Agamidae
Agamidae	Amphibolurinae	Rankinia	diemensis	AMSR.151560	362	36	4718	5116	AusARG_Agamidae
Agamidae	Amphibolurinae	Rankinia	diemensis	NMVD71910	363	35	4775	5173	AusARG_Agamidae
Agamidae	Amphibolurinae	Rankinia	diemensis	NMVD74157	360	35	4739	5134	AusARG_Agamidae
Agamidae	Amphibolurinae	Rankinia	diemensis	NMVD74165	363	34	4796	5193	AusARG_Agamidae
Agamidae	Amphibolurinae	Rankinia	diemensis	UTAS	364	34	4710	5108	AusARG_Agamidae
Agamidae	Amphibolurinae	Tropicagama	temporalis	AMSR.121164	144	5	674	823	AusARG_Agamidae

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Family	Subfamily	Genus	Species	RegNo	AHE	gene	uce	total_loci	Source
Agamidae	Amphibolurinae	Tropicagama	temporalis	WAMR112261	367	35	4778	5180	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	argillosa	SAMAR49360	360	35	4464	4859	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	argillosa	SAMAR54247	364	32	3961	4357	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	centralis	NMVZ75749	359	33	4749	5141	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	centralis	SAMAR46084	348	30	2648	3026	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	centralis	WAMR47369	360	33	3944	4337	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	centralis	WAMR50133	295	21	1221	1537	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	cephalus	NMVD74070	183	13	304	500	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	cephalus	WAMR161060	366	33	4751	5150	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	condaminensis	QMJ81871	359	34	4734	5127	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	condaminensis	QMJ82087	360	34	4714	5108	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	darlingensis	NMVD77147	359	34	4755	5148	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	darlingensis	NMVD77158	361	34	4779	5174	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	diabolicus	WAMR135412	367	35	4760	5162	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	diabolicus	WAMR135413	362	32	4770	5164	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	einasleighensis	NMVZ34075	360	34	4774	5168	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	einasleighensis	NMVZ34093	359	36	4690	5085	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	fictilis	SAMAR46178	361	36	4749	5146	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	fictilis	SAMAR58134	365	36	4729	5130	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	fortescuensis	WAMR110291	360	33	4760	5153	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	fortescuensis	WAMR158076	367	35	4781	5183	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	gigas	WAMR175943	359	32	4631	5022	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	hobsoni	NMVZ33994	361	35	4745	5141	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	hobsoni	NMVZ34020	359	35	4736	5130	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	houstoni	SAMAR61480	348	29	4333	4710	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	intima	SAMAR42854	360	35	4755	5150	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	intima	SAMAR44954	281	16	1086	1383	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	intima	SAMAR46815	231	14	690	935	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	lineata	NMVZ75948	360	35	4654	5049	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	lineata	NMVZ75960	366	34	4740	5140	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	lineata	SAMAR38823	371	33	4698	5102	Title & Singhal et al. (2024)
Agamidae	Amphibolurinae	Tymanocryptis	macra	NMVD72634	361	36	4740	5137	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	macra	NMVD72689	364	34	4717	5115	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	macra	NMVD73895	358	35	4704	5097	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	macra	NMVD73903	344	28	4541	4913	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	mccartneyi	AMSR.186297	339	31	4601	4971	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	pentalineata	NMVD74074	338	24	2884	3246	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	pentalineata	NMVD74075	230	16	572	818	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	petersi	NMVD74164	361	35	4747	5143	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	petersi	NMVD74168	354	30	4115	4499	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	pinguicolla	NMVZ75954	361	34	4707	5102	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	pseudopsephos	WAMR106201	333	26	2323	2682	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	pseudopsephos	WAMR146827	316	24	3945	4285	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	rustica	NMVD74671	364	33	4743	5140	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	rustica	SAMAR38823	337	29	4048	4414	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	tetraborophora	ANWC	359	34	4708	5101	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	tetraborophora	NMVD74046	357	34	4753	5144	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	tolleyi	SAMAR26711	364	36	4681	5081	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	wilsoni	QMJ87307	357	35	4741	5133	AusARG_Agamidae
Agamidae	Amphibolurinae	Tymanocryptis	wilsoni	QMJ89119	353	31	4564	4948	AusARG_Agamidae
Agamidae	Draconinae	Acanthosaura	armata	lsuhc9351	16	0	4128	4144	Title & Singhal et al. (2024)
Agamidae	Draconinae	Acanthosaura	coronata	FMNH262964	359	35	4798	5192	Title & Singhal et al. (2024)
Agamidae	Draconinae	Acanthosaura	crucigera	LSUHC9913	354	0	1	355	Burbrink et al. 2021 (AHE_T212)
Agamidae	Draconinae	Acanthosaura	lepidogaster	cwl818	14	0	3873	3887	Title & Singhal et al. (2024)
Agamidae	Draconinae	Acanthosaura	nataliae	MVZHerp258141	349	30	4659	5038	Title & Singhal et al. (2024)

(continued)

Family	Subfamily	Genus	Species	RegNo	AHE	gene	uce	total_loci	Source
Agamidae	Draconinae	Aphaniotis	acutirostris	MVZHerp239462	351	35	4820	5206	Title & Singhal et al. (2024)
Agamidae	Draconinae	Bronchocela	cristatella	acd1547	15	0	3961	3976	Title & Singhal et al. (2024)
Agamidae	Draconinae	Bronchocela	jubata	MVZHerp253996	359	35	4824	5218	Title & Singhal et al. (2024)
Agamidae	Draconinae	Bronchocela	smaragdina	FMNH262309	355	35	4735	5125	Title & Singhal et al. (2024)
Agamidae	Draconinae	Calotes	emma	CAS230941	27	27	4425	4479	Title & Singhal et al. (2024)
Agamidae	Draconinae	Calotes	emma	CTMZ04032	348	0	2	350	Burbrink et al. 2021 (AHE_T212)
Agamidae	Draconinae	Calotes	mystaceus	dsm869	15	0	3758	3773	Title & Singhal et al. (2024)
Agamidae	Draconinae	Calotes	versicolor	lsuhc10327	16	0	4093	4109	Title & Singhal et al. (2024)
Agamidae	Draconinae	Calotes	versicolor	SAMN07676179	360	36	3848	4244	NCBI
Agamidae	Draconinae	Ceratophora	aspera	AF128491	15	0	3303	3318	Title & Singhal et al. (2024)
Agamidae	Draconinae	Cophotis	ceylanica	AF128493	15	0	3739	3754	Title & Singhal et al. (2024)
Agamidae	Draconinae	Cristidorsa	planidorsata	CAS219935	358	34	4778	5170	Title & Singhal et al. (2024)
Agamidae	Draconinae	Diploderma	yunnanense	CAS242183	360	34	4806	5200	Title & Singhal et al. (2024)
Agamidae	Draconinae	Draco	blanfordii	lsuhc9427	15	0	3838	3853	Title & Singhal et al. (2024)
Agamidae	Draconinae	Draco	maculatus	kufs320	15	0	3906	3921	Title & Singhal et al. (2024)
Agamidae	Draconinae	Draco	spilopterus	elr1338	13	0	3896	3909	Title & Singhal et al. (2024)
Agamidae	Draconinae	Draco	walkeri	MVZHerp239464	342	32	4691	5065	Title & Singhal et al. (2024)
Agamidae	Draconinae	Gonocephalus	abbotti	FMNH230175	368	34	4806	5208	Title & Singhal et al. (2024)
Agamidae	Draconinae	Gonocephalus	doriae	FMNH230175	368	34	4790	5192	Singhal et al. 2021
Agamidae	Draconinae	Gonocephalus	interruptus	KU314925	341	0	1	342	Burbrink et al. 2021 (AHE_T212)
Agamidae	Draconinae	Gonocephalus	interruptus	rmb9384	15	0	4041	4056	Title & Singhal et al. (2024)
Agamidae	Draconinae	Gonocephalus	sophiae	rmb8061	14	0	3975	3989	Title & Singhal et al. (2024)
Agamidae	Draconinae	Lyriocephalus	scutatus	AF128494	16	0	3586	3602	Title & Singhal et al. (2024)
Agamidae	Draconinae	Mantheyus	phuwanensis	fmnh262580	15	0	4072	4087	Title & Singhal et al. (2024)
Agamidae	Draconinae	Pseudocalotes	kingdonwardi	CAS241965	364	33	4786	5183	Title & Singhal et al. (2024)
Agamidae	Draconinae	Pseudocalotes	larutensis	lsuhc10285	15	0	3842	3857	Title & Singhal et al. (2024)
Agamidae	Draconinae	Pseudocalotes	microlepis	FMNH258710	357	32	4843	5232	Title & Singhal et al. (2024)
Agamidae	Draconinae	Ptyctolaemus	collicristatus	cas220561	17	0	3882	3899	Title & Singhal et al. (2024)
Agamidae	Draconinae	Ptyctolaemus	gularis	cas221296	15	0	4041	4056	Title & Singhal et al. (2024)
Agamidae	Draconinae	Salea	horsfieldii	AF128491	16	0	3979	3995	Title & Singhal et al. (2024)
Agamidae	Leiolepinae	Leiolepis	belliana	CAS210725	42	28	4456	4526	Singhal et al. 2021
Agamidae	Leiolepinae	Leiolepis	belliana	LSUHC6842	350	0	1	351	Burbrink et al. 2021 (AHE_T212)
Agamidae	Amphibolurinae	Lophosaurus	dilophus	WAMR109630	365	35	4665	5065	AusARG_Agamidae
Agamidae	Amphibolurinae	Tympanocryptis	osbornei	AA087670	365	34	4693	5092	AusARG_Agamidae
Agamidae	Amphibolurinae	Tympanocryptis	osbornei	AA61541	360	34	4703	5097	AusARG_Agamidae
Agamidae	Uromastyicinae	Uromastyx	sp	CTMZ12648	167	0	0	167	Burbrink et al. 2021 (AHE_T212)
Teiidae	—	Salvator	merianae	SAMN09273531	388	41	5000	5429	NCBI
Scincidae	Lygosominae_Eugongylini	Cryptoblepharus	egeriae	SAMN32772511	388	40	5003	5431	NCBI
Elapidae	—	Hydrophis	elegans	SAMN35787919	385	39	4859	5283	NCBI
Agamidae	Hydrosaurinae	Hydrosaurus	sp	JAM848	—	—	2718	2718	Streicher_Iguania

Fossil Calibrations (Table S2)

Fossil Information	Calibration	Split/Position	Source
Uniform—Sophineta	‘B(2.38,2.55)’	Lepidosauria (Sphenodon + Squamata)	see below
Uniform—Secondary	‘B(0.50,0.80)’	Amphibolurinae + (Agaminae + Draconinae)	Burbrink et al. 2020; Title et al. 2024
Uniform—Riversleigh ‘Physignathus’	‘B(0.17,0.50)’	Hypsilurus + Remaining Australian Amphibolurinae	Covacevich 1990

Note. The root divergence between lepidosaurs (Sphenodon + squamates) is based on the fossil taxa Sophineta cracoviensis (Evans & Bialynicka, 2009), Megachirella wachtleri (Renesto & Posenato, 2003), and the Vellberg Jaw (Jones et al., 2013). These taxa represent stem squamates and rhynchocephalians, and so provide a soft lower bound on the crown divergence of Lepidosauria, with a soft upper bound provided by Protosaurus speneri (von Meyer, 1832).

Table S2. Fossil ages and divergence dating calibrations as implemented in BEAST and MCMCTree, relating to **STAR Methods**. The root divergence between lepidosaurs (*Sphenodon* + squamates) is based on the fossil taxa *Sophineta cracoviensis* (Evans & Bialynicka, 2009), *Megachirella wachtleri* (Renesto & Posenato, 2003), and the Vellberg Jaw (Jones et al., 2013). These taxa represent stem squamates and rhynchocephalians, and so provide a soft lower bound on the crown divergence of Lepidosauria, with a soft upper bound provided by *Protosaurus speneri* (von Meyer, 1832). Fossil *Egernia*, *Proegernia*, and *Tiliqua* samples were implemented as tip calibrations in the combined evidence BEAST analysis shown in Figure S5. Node calibrations A–J implemented in our MCMCTree analysis are shown in Figure S2. All node priors as applied in MCMCTree are soft, allowing estimated ages to pull beyond priors if driven by the data.

Morphological Measurements (Table S3)

No.	Measurement	Abbreviation	Method
1	Snout-vent length	SVL	From the tip of the snout to the vent.
2	Snout-axilla length	SAL	From the tip of the snout to the midpoint of the crease between the fore-limb and the body on the ventral surface.
3	Inter-limb length	ILL	Midpoint of the crease on the ventral surface where the fore-limb connects to the body, to the midpoint of the crease on the ventral surface where the hind-limb connects to the body.
4	Body width	BW	From one lateral side of the body to the other, where possible at the midpoint of the ILL.
5	Pelvic width	PW	From the midpoint of the crease on the ventral surface where the left hind limb connects to the body, to the midpoint of the crease on the ventral surface where the right hind limb connects to the body.
6	Pelvic height	PH	From the top of the dorsal surface where the PW was measured, to the bottom of the ventral surface where the PW was measured.
7	Head width	HW	Widest part of the head from one dorsal-lateral edge to the other edge.
8	Head length	HL	From the nose tip, to the anterior of the ear.
9	Snout length	SN	From the nasal opening to the anterior of the eye.
10	Eye diameter	ED	From one side of the eye to the other.
11	Head depth	HD	From the top of the tallest part of the head on the dorsal surface, to the bottom of the ventral surface under the jaw.
12	Tail width	TW	Measured at the vent, from one dorsal-lateral edge to the other edge.
13	Tail length	TL	Measured from the vent to the tip of the tail.
14	Fore-limb length	FLL	Measured fully extended from the midpoint of the crease on the ventral surface where the front limb connects to the body, to the end of longest toe (claw included).
15	Front foot	FFOOT	From the base of the foot to the end of the longest toe (claw included).
16	Lower front limb	LFL	Measured from the base of the lower fore limb to the juncture where the limb meets the front foot.
17	Upper front limb	UFL	Measured from the crease on the ventral surface where the fore limb connects to the body, to the end of the lower front limb.
18	Hind-limb length	HLL	From the midpoint of the crease on the ventral surface where the hind limb connects

No.	Measurement	Abbreviation	Method
19	Hind foot	HFOOT	to the body, to the end of longest toe (claw included) From the base of the hind foot to the end of the longest toe (claw included)
20	Lower hind limb	LHL	Measured from the top of the knee joint to the heel juncture where the limb meets the front foot.
21	Upper hind limb	UHL	Measured from the crease on the ventral surface where the hind limb connects to the body, to the end of the knee.

Table S3. Morphological measurements collected (21).

No.	Measurement	Shorthand	Method
3	Interlimb length	Interlimb	see Table S3
4	Body width	Body_Width	see Table S3
5	Pelvic width	Pelvic_Width	see Table S3
6	Pelvic height	Pelvic_Height	see Table S3
7	Head width	Head_Width	see Table S3
9	Snout length	Snout_Eye	see Table S3
10	Eye diameter	Eye_Diameter	see Table S3
11	Head depth	Head_Depth	see Table S3
12	Tail width	Tail_Width	see Table S3
13	Tail length	Tail_Length	see Table S3
17	Upper front limb	Upper_Arm	see Table S3
16	Lower front limb	Lower_Arm	see Table S3
15	Front foot	Hand	see Table S3
21	Upper hind limb	Upper_Leg	see Table S3
20	Lower hind limb	Lower_Leg	see Table S3
19	Hind foot	Foot	see Table S3
22	Neck length	Neck	Snout_Axilla - Head_Length
23	Posterior skull	Pos_Skull	Head_Length - (Snout_Eye + Eye_Diameter)
24	Pelvic gap	Pelvic_Gap	Snout_Vent - (Interlimb + Snout_Axilla)

Table S3. Final morphological traits used for phenotypic analyses (19).

BayesTraits Model Fitting Results (Table S4)

trait	fabric	VarRates	fabric_noV	fabric_noB	BM	best_model	variance	disparity	func_div	func_even	BM_rate_constant	delta_fabric_BM
Size	4.347283	-10.49492	-8.786684	-10.34354	-12.12269	fabric_full	1.8677873	0.3648166	0.6508999	0.5574674	0.0036639	16.469968
TailLength	21.370924	11.69656	11.032386	10.25499	14.21709	fabric_full	1.6292760	0.1652216	0.6571144	0.4853009	0.0023428	7.153839
PelvicWidth	84.614148	74.17618	74.079081	74.42456	64.93564	fabric_full	1.1947444	0.0736472	0.5838028	0.4392344	0.0009712	19.678503
BodyWidth	34.199465	26.17027	23.228444	26.83045	30.12197	fabric_full	1.0949751	0.1191263	0.6717122	0.5590405	0.0017699	4.077491
SnoutEye	60.264876	53.71249	51.692876	54.61451	58.84224	fabric_full	1.0117128	0.0788389	0.6385742	0.5250549	0.0010726	1.422641
Foot	87.587220	84.08598	78.497124	83.88982	83.88980	fabric_full	0.9995301	0.0537720	0.6418632	0.4967055	0.0007005	3.697424
PosSkull	96.608958	93.10331	85.893212	91.57044	90.83893	fabric_full	0.9450553	0.0360397	0.6072598	0.4167057	0.0006203	5.770026
TailWidth	53.013935	50.10927	43.404429	50.73475	52.92838	fabric_full	0.8857337	0.0672043	0.6161991	0.5656558	0.0011863	0.085553
HeadWidth	91.758160	88.38046	79.674046	89.04225	89.51111	fabric_full	0.7587556	0.0350892	0.6719401	0.4819992	0.0006389	2.247051
HeadDepth	87.440963	85.72778	76.768466	86.10532	88.04195	BM	0.7012197	0.0278678	0.6198712	0.5107771	0.0006508	-0.600983
Neck	73.415897	70.07112	63.424944	67.14744	71.54452	fabric_full	0.6968378	0.0238528	0.6054567	0.4806514	0.0008705	1.871379
PelvicHeight	105.392370	104.55769	96.044915	102.05399	108.33293	BM	0.6404908	0.0213563	0.5840434	0.4554133	0.0004596	-2.940564
EyeDiameter	99.429377	97.79872	90.032312	98.48655	102.25141	BM	0.6132040	0.0221819	0.6495101	0.5091384	0.0005100	-2.822032
UpperArm	125.932379	123.22714	115.607148	123.15233	126.81728	BM	0.5553347	0.0158573	0.6035020	0.4625320	0.0003338	-0.884904
LowerLeg	128.305167	127.30274	118.832284	125.79280	130.54499	BM	0.5338807	0.0247560	0.6182549	0.5323700	0.0003138	-2.239819
Hand	130.519791	129.97166	120.419049	130.71713	130.87166	BM	0.5040150	0.0095631	0.6086064	0.4474384	0.0003099	-0.351867
LowerArm	150.707693	150.03209	141.357799	148.94942	152.24296	BM	0.4366660	0.0123221	0.6208814	0.5195238	0.0002146	-1.535267
UpperLeg	128.500791	128.39444	119.263162	128.65201	132.68701	BM	0.4265069	0.0168591	0.6497425	0.6060006	0.0002977	-4.186218
Interlimb	120.023773	116.03700	110.894019	119.12322	123.54082	BM	0.3945153	0.0145229	0.6099829	0.5718187	0.0003523	-3.517043