

Table S1. List of *Egernia* group species used for morphometric analysis showing number of individuals per species measured (alive: The University of Queensland, preserved: Queensland Museum) with retreat types from cited references.

Scientific name	Number		Retreat type	References*
	Alive	Preserved		
Non-Australian out-group				
<i>Corucia zebra</i> (Gray, 1856)	1		Trees	3
Cyclodomorphus				
<i>Cyclodomorphus casuarinae</i> (Duméril and Bibron)	3		Vegetation	1
<i>Cyclodomorphus gerrardii</i> (Gray, 1845)	7	3	Vegetation	1
Bellatorias				
<i>Bellatorias frerei</i> (Günther, 1897)	4	10	Hollow logs/ burrows	1, 2
<i>Bellatorias major</i> (Gray, 1845)		10	Hollow logs/ burrows	1, 2, 4
Egernia				
<i>Egernia cunninghami</i> (Gray, 1832)	20	10	Hollow logs/rocks	1, 2
<i>Egernia depressa</i> (Günther, 1875)		1	Hollow logs/rocks	1, 2
<i>Egernia hosmeri</i> (Kinghorn, 1955)		7	Hollow logs/rocks	1, 2
<i>Egernia kingii</i> (Gray, 1838)		1	Burrows	1, 2
<i>Egernia mcpheeii</i> (Wells & Wellington, 1984)		2	Hollow logs/rocks	1, 2
<i>Egernia napoleonis</i> (Gray, 1838)		1	Hollow logs/rocks	1, 2
<i>Egernia richardi</i> (Peters, 1869)		5	Hollow logs/rocks	1, 2
<i>Egernia rugosa</i> (De Vis, 1888)		5	Hollow logs/ burrows	1, 2
<i>Egernia saxatilis</i> (Cogger, 1960)		2	Hollow logs/rocks	1, 2
<i>Egernia stokesii</i> (Gray, 1845)		8	Hollow logs/rocks	1, 2
<i>Egernia striolata</i> (Peters, 1870)	13	10	Hollow logs/rocks	1, 2
Liopholis				
<i>Liopholis inornata</i> (Rosén, 1905)	12	3	Burrows	1, 5
<i>Liopholis modesta</i> (Storr, 1968)		10	Burrows	1, 2, 6
<i>Liopholis striata</i> (Sternfeld, 1919)	6	2	Burrows	1, 5
<i>Liopholis whitii</i> (Lacépède, 1804)		10	Burrows	1, 2, 6
Tiliqua				
<i>Tiliqua nigrolutea</i> (Quoy & Gaimard, 1824)	2		Vegetation	1, 7
<i>Tiliqua occipitalis</i> (Peters, 1863)	2		Vegetation	1
<i>Tiliqua rugosa</i> (Gray, 1825)		6	Vegetation	1, 8
<i>Tiliqua scincoides</i> (White, 1790)	19	7	Vegetation	1

* Reference listed: 1 – Wilson and Swan (2013), 2 – Chapple (2003), 3 – Hagen and Bull (2011), 4 – Klingenberg et al. (2000), 5 – Pianka and Giles (1982), 6 – Chapple et al. (2008), 7 – Sass et al. (2007) and 8 – Kerr et al. (2003).

Table S2. Eigenvalue coefficients of linear discriminants for size-free residual morphometric measurements based on stepwise discriminant analysis.

Variables	LD1	LD2	LD3	LD4
Proportion of variance (%)	67.24	19.73	12.04	0.99
Cumulative proportion (%)	67.24	86.97	99.01	100
Morphometrics				
Hindfoot	-1.57	-0.19	-1.03	1.24
Head length	1.69	-0.89	0.71	-0.33
Pelvic height	-3.11	0.07	0.78	-1.04
Tail width	0.63	-1.53	1.89	0.00
Body width	1.81	-0.88	-0.10	0.20
Head width	0.13	1.57	-1.60	1.45
Upper hindlimb	-2.05	2.98	1.90	-0.55
Upper forelimb	-0.08	-6.66	0.46	-1.85
Lower forelimb	0.82	3.86	-2.25	1.76

Table S3. The net cost of burrowing on a variety of different taxa with available data on temperature and substrate type. *N/A indicates data not stated in study.

Species	Temperature (°C)	Soil type	Mass (g)	Net Cost of Transport (J m ⁻¹)	References
Invertebrates					
<i>Emerita portoricensis</i>	N/A	Wet sand	0.50	0.05	(Ansell and Trueman, 1973)
<i>Donax incarnatus</i>	N/A	Wet sand	0.52	0.5	(Ansell and Trueman, 1973)
<i>Sipunculus nudus</i>	N/A	Wet sand	3.33	3.33	(Trueman and Foster-Smith, 1976)
<i>Nephtys cirrosa</i>	12	Wet sand	0.45	0.38	(Trevor, 1978)
<i>Nereis diversicolor</i>	12	Wet sand	0.61	0.43	(Trevor, 1978)
<i>Arenicola marina</i>	12	Wet sand	10.20	7.65	(Trevor, 1978)
<i>Bullia digitalis</i>	15	Wet sand	4.34	1	(Brown, 1979)
<i>Polyphysia crassa</i>	4	mud	1.60	5.08	(Hunter and Elder, 1989)
<i>Priapulus caudatus</i>	4	mud	2.30	3.61	(Hunter and Elder, 1989)
<i>Tylos granulatus</i>	15	Wet sand	5.70	0.6	(Brown and Trueman, 1996)
<i>Urodacus yaschenkoi</i>		Sand	2.93	153.61	(White, 2001)
<i>Gryllotalpa monanka</i>	19-21	loam sand	0.94	15.73	(White et al., 2008)
<i>Cirriformia moorei</i>	11	Gelatin	0.36	0.06	(Dorgan et al., 2011)
	11	Sediment	0.36	0.18	
Fossorial mammals					
<i>Cryptomys damarensis</i>	27	Dry	152.1	1967.5	(Lovegrove, 1989)
	27	Damp	152.1	6583.52	
<i>Heterocephalus glaber</i>	27	Dry	31.5	2319.82	(Lovegrove, 1989)
	27	Damp	32.3	4701.65	
<i>Georychus capensis</i>	22	Loose sand	113	1814.39	(Du Toit et al., 1985)
<i>Thomomys bottae</i>	23	Fine sand	150	3250	(Vleck, 1979)
	23	Clay	150	33100	
	23	Sand loam	150	6430	
	23	Gravel	150	3420	
<i>Thomomys talpoides</i>	N/A	Damp clay	75	3160	(Lovegrove, 1989)
<i>Scapanus townsendii</i>	N/A	Damp clay	148	3920	(Lovegrove, 1989)
<i>Scapanus orarius</i>	N/A	Damp clay	59	3380	(Lovegrove, 1989)
<i>Eremitalpa namibensis</i>	23 – 28.5	Loose sand	20.62	78.96	(Seymour et al., 1998)
<i>Fukomys mechowii</i>	25	Hard soil	320	33800	(Zelová et al., 2010)
	25	Soft soil	320	5500	
<i>Heliosciurus argenteocinereus</i>	25	Hard soil	232	19300	(Zelová et al., 2010)
	25	Soft soil	232	3500	
<i>Ctenomys talarum</i>	15	Soft soil	131.6	1162.87	(Luna and Antinuchi, 2007)
	25	Soft soil	126.4	647	
	35	Soft soil	142.4	1532	
<i>Ctenomys talarum</i>	24	Soft soil (sandy loam)	125	643.29	(Luna and Antinuchi, 2006)
<i>Ctenomys talarum</i>	24	Hard soil (gravely sand)	130	1604.62	
Semi-fossorial mammal					
<i>Notomys alexis</i>	26.8	sand-loam	33	7100	(White et al., 2006)
Marsupial					
<i>Notoryctes caurinus</i>	15 – 30	Loose dry soil	34	81	(Withers et al., 2000)
Amphibian					
<i>Scaphiopus hammondii</i>		soil	11.75	278.22	(Seymour, 1973)
Reptiles					
<i>Liopholis striata</i>			27.9	296.03	this study
<i>Liopholis inornata</i>			13	204.68	this study

Table S4. Additional data of burrow cross-sectional area and body mass from a range of animals not listed from White (2005).

Species	Common name	Mass (g)	A_b (cm ²)	References
Mammals				
<i>Dasyurus novemcinctus</i>	Nine-banded armadillos	6350	397.76	(Sawyer et al., 2012)
<i>Lemmus lemmus</i>	Norwegian lemming	100	25.13	(Eriksson, 2011)
<i>Mus musculus</i>	House mouse	30	25.13	(Eriksson, 2011)
<i>Orycteropus afer</i>	Aardvark	60000	1431.68	(Whittington-Jones, 2007)
<i>Otomys sloggetti robertsi</i>	African ice rat	130	48	(Hinze et al., 2006)
<i>Spermophilus brunneus</i>	Idaho ground squirrel	120	17.3	(Yensen et al., 1991)
Birds				
<i>Alcedo spp.</i>	Kingfishers	45	45	(Heneberg, 2012)
<i>Apteryx australis mantelli</i>	North Island brown kiwi	2500	415.47	(Potter, 1989) (Ramos et al., 1997; Rodríguez et al., 2013)
<i>Bulweria bulwerii</i>	Bulwer's petrel	100	213.63	(Zino, 1971; Ramos et al., 1997)
<i>Calonectris diomedea</i>	Cory's shearwater	877	647.97	(Merops apiaster
<i>Merops apiaster</i>	European Bee-eater	56	60	(Heneberg, 2012)
<i>Oceanodroma castro</i>	Band-rump storm petrel	49	112.31	(Ramos et al., 1997)
<i>Pseudopodoces humilis</i>	Tibetan ground tit	40	36.31	(Ke and Lu, 2009)
<i>Puffinus assimilis</i>	Little shear water	223	188.5	(Ramos et al., 1997; Booth et al., 2000)
<i>Riparia riparia</i>	Sand Martin	14	24	(Heneberg, 2012)
Reptiles				
<i>Liopholis inornata</i>	Desert skink	12.92	3.37	this study
<i>Liopholis slateri</i>	Slater's skink	35	7.96	(Fenner et al., 2012)
<i>Liopholis striata</i>	Night skink	27.82	6.72	this study
<i>Sphenodon guntheri</i>	Brother's island tuatara	500	50	(Cree et al., 1991)
Invertebrate				
<i>Upogebia pugettensis</i>	Blue mud shrimp	5.3	2.84	(Thompson and Pritchard, 1969)
<i>Callianassa subterranea</i>		2.45	1.130972	(James et al., 1990; Astall et al., 1997)
<i>Callianassa tyrrhena</i>		4.3017	4.908734	(Dworschak, 1998; Dworschak, 2001)
<i>Calocaris macandreae</i>		1.55	2.010618	(Nash et al., 1984; Astall et al., 1997)
<i>Jaxea nocturna</i>		0.95	1.227184	(Nickell and Atkinson, 1995; Astall et al., 1997)
<i>Solenopsis invicta</i>	Fire ant	0.004	0.107521	(Gravish et al., 2013; Tschinkel, 2013)
<i>Upogebia deltaura</i>		6.75	4.154753	(Astall et al., 1997; Hall-Spencer and Atkinson, 1999)
<i>Upogebia pusilla</i>		1.505	2.010618	(Dworschak, 1983; Astall et al., 1997)
<i>Upogebia stellata</i>		1.8	1.130972	(Nickell and Atkinson, 1995; Astall et al., 1997)
<i>Anguilla japonica</i>	Japanese eel	1800	49.02	(Okamura et al., 2002; Aoyama et al., 2005)

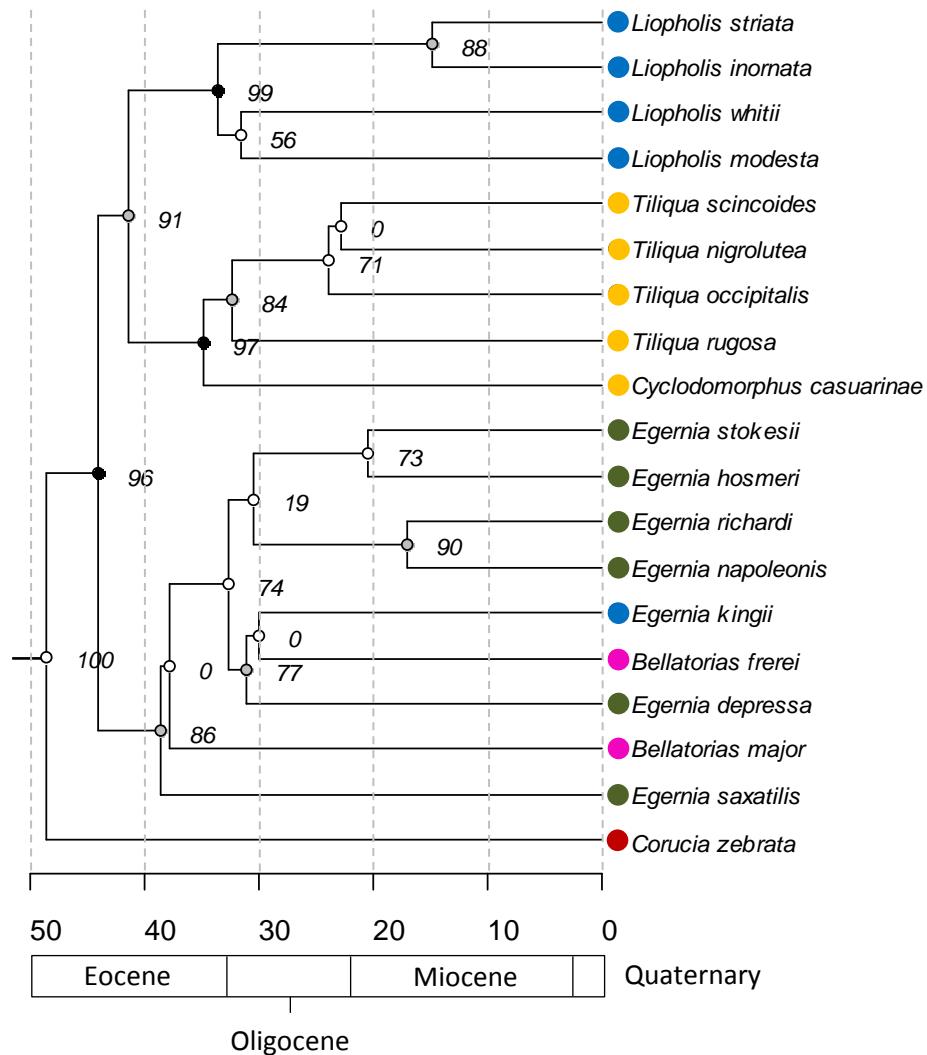


Figure S1. Phylogeny for 19 species of *Egernia* group skinks used for this study based on time calibrated Maximum Likelihood estimates of squamate phylogeny by Pyron and Burbrink (2014). Strength of ancestral state nodes were represented by shaded circles (> 95 = black, 75 – 95 = grey, < 75 = white). Time scale in millions of years before the present (mya). Retreat preferences represented by the following coloured circles: Burrow retreats (blue), Vegetation retreats (yellow), Hollow logs/rock crevices (green), Hollow logs/burrow retreats (pink) and trees (red).

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