

**Appendix 1.** Results of the comparison of molecular clock (MC) and free-rate (FR) models of rate change for each data set. The values of the second-order Akaike information criterion test (AICc) are shown. The favoured model is indicated, and a significant difference between the two models (taken to be  $\Delta AICc > 10$ ) is shown with an asterisk.

Data set	Gene	Sequence length, bp	No. species in tree	ln likelihood FR model	ln likelihood MC model	AICc FR model	AICc MC model	$\Delta$ AICc	Supported model
Species-level comparisons									
Lepidoptera	COI	1470	148	32028.66	32391.43	64805.50	65122.17	316.68	FR *
	COII	740	100	13303.57	13429.42	27163.85	27101.24	62.61	FR *
	ND5	783	69	11414.47	11498.35	23170.44	23157.93	12.52	MC *
Arachnida	16S	944	76	11309.09	11400.75	22986.69	22976.52	10.17	MC *
	COI	471	52	8456.71	8454.54	17187.73	17036.49	151.24	MC *
Cephalopoda	COI	684	105	22616.36	22759.56	45848.46	45778.90	69.56	MC *
	16S	457	94	5366.75	5505.20	11386.36	11260.59	125.77	MC *
Gastropoda	28S	1556	72	10585.75	10781.63	21493.96	21723.17	229.22	FR *
	COI	1209	44	15136.95	15256.41	30468.55	30612.88	144.34	FR *
Echinodermata	18S	1721	24	6125.68	6184.26	12354.41	12425.48	71.07	FR *
	28S	332	29	1615.64	1621.58	3378.30	3316.70	61.60	MC *
Platyhelminthes	18S	1709	28	8465.51	8532.63	17051.18	17130.51	79.33	FR *
	COI	810	25	7106.10	7147.53	14323.48	14355.28	31.80	FR *
Family-level comparisons									
Hymenoptera	28S	591	41	4242.88	4332.33	8681.98	8762.26	80.28	FR *
	COI	421	27	5134.23	5166.61	10398.00	10400.32	2.32	FR
Bivalvia	18S	1819	33	12349.78	12615.53	24840.91	25306.63	465.72	FR *
	28S	3509	35	15213.25	15440.33	30573.55	30959.56	386.01	FR *
	COI	1074	36	18732.27	18804.89	37623.66	37692.96	69.30	FR *
Annelida	18S	1624	57	19796.72	20209.29	39843.45	40545.43	701.98	FR *
	H3	1270	40	11672.05	11817.99	23519.56	23727.22	207.66	FR *
Monogenea	18S	1898	20	9765.94	9817.16	19617.84	19682.96	65.12	FR *
	28S	930	22	7128.10	7186.23	14353.10	14426.02	72.92	FR *