Appendix 9. Results of Swofford-Olsen-Waddell-Hillis (SOWH) derived tests conducted to determine if alternative ML trees were significantly different when evaluated under the same model. Reciprocal tests were conducted between the most and least complex models selected for 60 data sets as well as between the K2P model and alternative best-fit models. An overview of the SOWH-derived test used in this analysis can be found in the text. Significant P-values ($\alpha = 0.05$) are given in bold type; highlighted text indicates cases where trees were found to be significantly different.

Data Set	1	2	6
TreeBASE ID	S1266/M2209	S685/M1075	S1067/M1819
Model 1	GTR+Γ	GTR+I+Γ	GTR
Model 2	HKY+Γ	TrN+Γ	HKY
Trees 1 & 2 Model 1	$P = 0.46$	$P = 0.57$	$P = 0.61$
Trees 1 & 2 Model 2	$P = 0.47$	$P = 0.42$	$P = 0.45$
Tree 1 & K2P tree Model 1	$P = 0.81$	$P = 0.90$	$P = 0.56$
Tree 1 & K2P tree K2P model	$P = 0.12$	$P = \mathbf{0.03}$	$P = 0.56$
Tree 2 & K2P tree Model 2	$P = 0.80$	$P = 0.86$	$P = 0.49$
Tree 2 & K2P tree K2P model	$P = 0.11$	$P = \mathbf{0.01}$	$P = 0.51$

Data Set	8	10	13
TreeBASE ID	S1038/M1767	S430/M630	S927/M1533
Model 1	TVMef+Γ	TrN+Γ	TIM+I+Γ
Model 2	K2P+Γ	K2P+Γ	TrN+I+Γ
Trees 1 & 2 Model 1	$P = 0.48$	$P = 0.86$	$P = 0.56$
Trees 1 & 2 Model 2	$P = 0.51$	$P = 0.51$	$P = 0.46$

Tree 1 & K2P tree Model 1	$P = 0.81$	$P > 0.99$	$P > 0.99$
Tree 1 & K2P tree K2P model	$P = 0.11$	$P = \mathbf{0.03}$	$P < \mathbf{0.01}$
Tree 2 & K2P tree Model 2	$P = 0.80$	$P = 0.89$	$P > 0.99$
Tree 2 & K2P tree K2P model	$P = 0.12$	$P = 0.08$	$P < \mathbf{0.01}$

Data Set	14	17	20
TreeBASE ID	S1120/M1917	S736/M1168	S1213/M2099
Model 1	GTR+Γ	TIM+I+Γ	GTR+I+Γ
Model 2	TVM+Γ	TrN+Γ	TIM+I+Γ
Trees 1 & 2 Model 1	$P = 0.52$	$P = 0.48$	$P = 0.47$
Trees 1 & 2 Model 2	$P = 0.43$	$P = 0.61$	$P = 0.47$
Tree 1 & K2P tree Model 1	$P = 0.84$	$P = 0.95$	$P = 0.79$
Tree 1 & K2P tree K2P model	$P = 0.12$	$P < \mathbf{0.01}$	$P = \mathbf{0.03}$
Tree 2 & K2P tree Model 2	$P = 0.77$	$P = 0.92$	$P = 0.78$
Tree 2 & K2P tree K2P model	$P = 0.10$	$P < \mathbf{0.01}$	$P = \mathbf{0.01}$

Data Set	23	25	28
TreeBASE ID	S1234/M2146	S1316/M2309	S1088/M1862
Model 1	GTR+I+Γ	TrN+I+Γ	TVM+Γ
Model 2	TrNef+I+Γ	HKY+I+Γ	HKY
Trees 1 & 2 Model 1	$P = 0.48$	$P = 0.49$	$P = 0.50$
Trees 1 & 2 Model 2	$P = 0.50$	$P = 0.52$	$P = 0.44$
Tree 1 & K2P tree Model 1	$P > 0.99$	$P > 0.99$	$P = 0.55$

Tree 1 & K2P tree K2P model	*P* < **0.01**	*P* < **0.01**	*P* = 0.51
Tree 2 & K2P tree Model 2	*P* > 0.99	*P* > 0.99	*P* = 0.55
Tree 2 & K2P tree K2P model	*P* < **0.01**	*P* < **0.01**	*P* = 0.44

Data Set	31	34	36
TreeBASE ID	S1315/M2308	S1069/M1823	S771/M1220
Model 1	TIM+I+Γ	TrN+I	TVM+Γ
Model 2	TrN+I+Γ	TrNef+Γ	K3Puf+Γ
Trees 1 & 2 Model 1	*P* = 0.54	*P* = 0.41	*P* = 0.50
Trees 1 & 2 Model 2	*P* = 0.51	*P* = 0.46	*P* = 0.52
Tree 1 & K2P tree Model 1	*P* > 0.99	*P* = 0.50	*P* = 0.52
Tree 1 & K2P tree K2P model	*P* < **0.01**	*P* = 0.32	*P* = 0.50
Tree 2 & K2P tree Model 2	*P* > 0.99	*P* = 0.66	*P* = 0.61
Tree 2 & K2P tree K2P model	*P* < **0.01**	*P* = 0.34	*P* = 0.43

Data Set	37	45	48
TreeBASE ID	S428/M626	S693/M1102	S1304/M2284
Model 1	HKY+Γ	SYM+Γ	TVM+I
Model 2	HKY+I	TrNef+Γ	HKY+Γ
Trees 1 & 2 Model 1	*P* = 0.53	*P* = 0.43	*P* = 0.42
Trees 1 & 2 Model 2	*P* = 0.42	*P* = 0.44	*P* = 0.45
Tree 1 & K2P tree Model 1	*P* > 0.99	*P* > 0.99	*P* = 0.59
Tree 1 & K2P tree K2P model	*P* < **0.01**	*P* < **0.01**	*P* = 0.31

Tree 2 & K2P tree Model 2	$P > 0.99$	$P = 0.96$	$P = 0.56$
Tree 2 & K2P tree K2P model	$P < 0.01$	$P < 0.01$	$P = 0.32$

Data Set	49	58	59
TreeBASE ID	S3x10x98c09c42c47/ M184c3x2x98c11c12c31	S367/M502	S322/M401
Model 1	TVM+Γ	K3Puf+Γ	TVM+Γ
Model 2	HKY+Γ	JC+Γ	TVMef+Γ
Trees 1 & 2 Model 1	$P = 0.06$	$P = 0.52$	$P = 0.46$
Trees 1 & 2 Model 2	$P = 0.94$	$P = 0.45$	$P = 0.46$
Tree 1 & K2P tree Model 1	$P > 0.99$	$P = 0.84$	$P = 0.95$
Tree 1 & K2P tree K2P model	$P < 0.01$	$P = 0.01$	$P < 0.01$
Tree 2 & K2P tree Model 2	$P > 0.99$	$P = 0.72$	$P = 0.95$
Tree 2 & K2P tree K2P model	$P < 0.01$	$P < 0.01$	$P < 0.01$

Data Set	61	63	66
TreeBASE ID	S529/M777	S400/M568	S522/M760
Model 1	GTR+I+Γ	GTR+I+Γ	TrN+I+Γ
Model 2	TIM+Γ	TrNef+I+Γ	TrNef+I+Γ
Trees 1 & 2 Model 1	$P = 0.51$	$P = 0.44$	$P = 0.48$
Trees 1 & 2 Model 2	$P = 0.46$	$P = 0.59$	$P = 0.41$
Tree 1 & K2P tree Model 1	$P = 0.97$	$P = 0.88$	$P = 0.88$
Tree 1 & K2P tree K2P model	$P = 0.04$	$P = 0.04$	$P < 0.01$
Tree 2 & K2P tree Model 2	$P = 0.76$	$P = 0.88$	$P = 0.92$

Tree 2 & K2P tree K2P model	$P = 0.07$	$P = \mathbf{0.01}$	$P < \mathbf{0.01}$

Data Set	67	69	70
TreeBASE ID	S967/M1604	S385/M537	S6x22x97c14c38c41/ M170c6x22x97c14c48c20
Model 1	K3Puf	TrN+I+Γ	GTR+I+Γ
Model 2	HKY	HKY+Γ	TIM+Γ
Trees 1 & 2 Model 1	$P = 0.46$	$P = 0.55$	$P = 0.50$
Trees 1 & 2 Model 2	$P = 0.49$	$P = 0.37$	$P = 0.40$
Tree 1 & K2P tree Model 1	$P = 0.51$	$P = 0.97$	$P = 0.91$
Tree 1 & K2P tree K2P model	$P = 0.53$	$P < \mathbf{0.01}$	$P < \mathbf{0.01}$
Tree 2 & K2P tree Model 2	$P = 0.52$	$P > 0.99$	$P = 0.92$
Tree 2 & K2P tree K2P model	$P = 0.51$	$P < \mathbf{0.01}$	$P = \mathbf{0.02}$

Data Set	75	76	78
TreeBASE ID	S463/M676	S990/M1650	S560/M847
Model 1	GTR+I+Γ	TrN+I+Γ	GTR+I+Γ
Model 2	TrN+I+Γ	TrNef+Γ	HKY+I+Γ
Trees 1 & 2 Model 1	$P = 0.62$	$P = 0.51$	$P = 0.98$
Trees 1 & 2 Model 2	$P = 0.43$	$P = 0.45$	$P = \mathbf{0.04}$
Tree 1 & K2P tree Model 1	$P = 0.95$	$P = 0.89$	$P > 0.99$
Tree 1 & K2P tree K2P model	$P < \mathbf{0.01}$	$P < \mathbf{0.01}$	$P < \mathbf{0.01}$
Tree 2 & K2P tree Model 2	$P = 0.92$	$P = 0.85$	$P > 0.99$
Tree 2 & K2P tree K2P model	$P < \mathbf{0.01}$	$P = \mathbf{0.01}$	$P < \mathbf{0.01}$

Data Set	79	86	88
TreeBASE ID	S1053/M1794	S436/M641	S413/M603
Model 1	GTR+I+Γ	TrN+I+Γ	TIM+I+Γ
Model 2	TrNef+I+Γ	TrNef+I	TrN+Γ
Trees 1 & 2 Model 1	$P = 0.55$	$P = 0.59$	$P = 0.54$
Trees 1 & 2 Model 2	$P = 0.58$	$P = 0.45$	$P = 0.36$
Tree 1 & K2P tree Model 1	$P = 0.90$	$P = 0.80$	$P = 0.99$
Tree 1 & K2P tree K2P model	$P = 0.08$	$P < \mathbf{0.01}$	$P < \mathbf{0.01}$
Tree 2 & K2P tree Model 2	$P = 0.89$	$P = 0.83$	$P = 0.96$
Tree 2 & K2P tree K2P model	$P = \mathbf{0.02}$	$P = \mathbf{0.05}$	$P < \mathbf{0.01}$

Data Set	98	100	101
TreeBASE ID	S568/M861	S11x6x95c10c11c33/ M58c11x6x95c10c13c27	S1094/M1869
Model 1	GTR+Γ	SYM+Γ	GTR+I+Γ
Model 2	HKY+Γ	K2P+Γ	TrN+I+Γ
Trees 1 & 2 Model 1	$P = 0.42$	$P = 0.58$	$P = 0.55$
Trees 1 & 2 Model 2	$P = 0.55$	$P = 0.40$	$P = 0.37$
Tree 1 & K2P tree Model 1	$P > 0.99$	$P = 0.85$	$P = 0.50$
Tree 1 & K2P tree K2P model	$P < \mathbf{0.01}$	$P = \mathbf{0.01}$	$P = 0.55$
Tree 2 & K2P tree Model 2	$P > 0.99$	$P = 0.68$	$P = 0.49$
Tree 2 & K2P tree K2P model	$P < \mathbf{0.01}$	$P = \mathbf{0.03}$	$P = 0.57$

Data Set	106	112	113
TreeBASE ID	S1140/M1958	S1197/M2066	S884/M1435
Model 1	TrN+I+Γ	HKY+Γ	TVM+Γ
Model 2	HKY+I+Γ	HKY	HKY+Γ
Trees 1 & 2 Model 1	$P = 0.53$	$P = 0.57$	$P = 0.49$
Trees 1 & 2 Model 2	$P = 0.60$	$P = 0.42$	$P = 0.53$
Tree 1 & K2P tree Model 1	$P = 0.78$	$P = 0.60$	$P = 0.81$
Tree 1 & K2P tree K2P model	$P = 0.17$	$P = 0.39$	$P = 0.08$
Tree 2 & K2P tree Model 2	$P = 0.78$	$P = 0.51$	$P = 0.80$
Tree 2 & K2P tree K2P model	$P = 0.13$	$P = 0.39$	$P = \mathbf{0.05}$

Data Set	123	124	127
TreeBASE ID	S619/M955	S902/M1482	S700/M1118
Model 1	GTR+I+Γ	HKY+I+Γ	GTR+I+Γ
Model 2	SYM+I+Γ	K2P+I+Γ	TrN+I+Γ
Trees 1 & 2 Model 1	$P = 0.60$	$P = 0.41$	$P = 0.30$
Trees 1 & 2 Model 2	$P = 0.40$	$P = 0.57$	$P = 0.74$
Tree 1 & K2P tree Model 1	$P = 0.96$	$P = 0.66$	$P > 0.99$
Tree 1 & K2P tree K2P model	$P < \mathbf{0.01}$	$P = 0.10$	$P < \mathbf{0.01}$
Tree 2 & K2P tree Model 2	$P = 0.89$	$P = 0.74$	$P > 0.99$
Tree 2 & K2P tree K2P model	$P < \mathbf{0.01}$	$P = 0.06$	$P < \mathbf{0.01}$

Data Set	130	151	153

TreeBASE ID	S1307/M2290	S726/M1157	S971/M1612
Model 1	TVM+I	TVM+Γ	TIM
Model 2	K3Puf+I	HKY+Γ	F81
Trees 1 & 2 Model 1	$P = 0.42$	$P = 0.57$	$P = 0.43$
Trees 1 & 2 Model 2	$P = 0.55$	$P = 0.43$	$P = 0.44$
Tree 1 & K2P tree Model 1	$P = 0.56$	$P = 0.98$	$P = 0.45$
Tree 1 & K2P tree K2P model	$P = 0.66$	$P < \mathbf{0.01}$	$P = 0.52$
Tree 2 & K2P tree Model 2	$P = 0.61$	$P = 0.92$	$P = 0.49$
Tree 2 & K2P tree K2P model	$P = 0.29$	$P < \mathbf{0.01}$	$P = 0.49$

Data Set	**171**	**175**	**183**

TreeBASE ID	S1125/M1928	S701/M1119	S331/M433
Model 1	TrN+Γ	TVM+Γ	HKY+I
Model 2	TrNef+Γ	K3Puf+I	JC+Γ
Trees 1 & 2 Model 1	$P = 0.55$	$P = 0.41$	$P = 0.51$
Trees 1 & 2 Model 2	$P = 0.53$	$P = 0.62$	$P = 0.52$
Tree 1 & K2P tree Model 1	$P > 0.99$	$P = 0.84$	$P = 0.65$
Tree 1 & K2P tree K2P model	$P < \mathbf{0.01}$	$P = \mathbf{0.01}$	$P = 0.40$
Tree 2 & K2P tree Model 2	$P = 0.99$	$P = 0.95$	$P = 0.60$
Tree 2 & K2P tree K2P model	$P < \mathbf{0.01}$	$P < \mathbf{0.01}$	$P = 0.35$

Data Set	**190**	**194**	**195**

TreeBASE ID	S1018/M1725	S935/M1550	S1101/M1883
Model 1	GTR+I+Γ	GTR+I	GTR+I+Γ
Model 2	TrN+I+Γ	TrNef+Γ	TIMef+Γ
Trees 1 & 2 Model 1	$P = 0.40$	$P = 0.49$	$P = 0.80$
Trees 1 & 2 Model 2	$P = 0.54$	$P = 0.56$	$P = 0.17$
Tree 1 & K2P tree Model 1	$P > 0.99$	$P = 0.83$	$P > 0.99$
Tree 1 & K2P tree K2P model	$P < 0.01$	$P = 0.06$	$P < 0.01$
Tree 2 & K2P tree Model 2	$P > 0.99$	$P = 0.83$	$P = 0.98$
Tree 2 & K2P tree K2P model	$P < 0.01$	$P = 0.01$	$P < 0.01$
Data Set	**196**	**198**	**201**
TreeBASE ID	S1008/M1704	S621/M959	S1312/M2300
Model 1	K3Puf+I+Γ	TIMef+Γ	GTR+I+Γ
Model 2	HKY+Γ	JC+Γ	HKY+I+Γ
Trees 1 & 2 Model 1	$P = 0.56$	$P = 0.56$	$P = 0.14$
Trees 1 & 2 Model 2	$P = 0.44$	$P = 0.41$	$P = 0.81$
Tree 1 & K2P tree Model 1	$P = 0.86$	$P = 0.70$	$P > 0.99$
Tree 1 & K2P tree K2P model	$P = 0.02$	$P = 0.29$	$P < 0.01$
Tree 2 & K2P tree Model 2	$P = 0.70$	$P > 0.99$	$P > 0.99$
Tree 2 & K2P tree K2P model	$P = 0.05$	$P = 0.27$	$P < 0.01$
Data Set	**208**	**217**	**219**
TreeBASE ID	S1253/M2191	S1072/M1828	S1122/M1919

Model 1	TVM+Γ	GTR+I+Γ	TIM+I+Γ
Model 2	K2P+Γ	TIM+I+Γ	TrNef+I+Γ
Trees 1 & 2 Model 1	$P = 0.48$	$P = 0.49$	$P = 0.57$
Trees 1 & 2 Model 2	$P = 0.50$	$P = 0.46$	$P = 0.40$
Tree 1 & K2P tree Model 1	$P = 0.67$	$P > 0.99$	$P = 0.89$
Tree 1 & K2P tree K2P model	$P = 0.22$	$P < \mathbf{0.01}$	$P < \mathbf{0.01}$
Tree 2 & K2P tree Model 2	$P = 0.66$	$P > 0.99$	$P = 0.89$
Tree 2 & K2P tree K2P model	$P = 0.28$	$P < \mathbf{0.01}$	$P < \mathbf{0.01}$

Data Set	**221**	**222**	**228**
TreeBASE ID	S983/M1636	S773/M1224	S382/M529
Model 1	GTR+I+Γ	GTR+I+Γ	TrN+I
Model 2	K2P+I	TrN+I+Γ	K2P+I
Trees 1 & 2 Model 1	$P = 0.63$	$P = 0.30$	$P = 0.39$
Trees 1 & 2 Model 2	$P = 0.45$	$P = 0.78$	$P = 0.62$
Tree 1 & K2P tree Model 1	$P = 0.99$	$P > 0.99$	$P = 0.95$
Tree 1 & K2P tree K2P model	$P < \mathbf{0.01}$	$P < \mathbf{0.01}$	$P = \mathbf{0.01}$
Tree 2 & K2P tree Model 2	$P = 0.93$	$P > 0.99$	$P = 0.98$
Tree 2 & K2P tree K2P model	$P < \mathbf{0.01}$	$P < \mathbf{0.01}$	$P < \mathbf{0.01}$