**Supplementary file 2.**

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| # | Trait 1 | | Trait 2 | | Model | | Method | | | Commands | |
| 1 | Terrestrial  Lungs | | Site 1  Site 2  PY  Lungs | | Discrete:Independent | | ML1 | | | Res beta1 03 | |
| 2 | Terrestrial  Lungs | | Site 1  Site 2  PY  Lungs | | Discrete:Dependent | | ML | | | Res q24 q134  Res q31 q42 0 | |
| 3 | Site 1 | | Site 2 | | Discrete:Independent | | ML | | | Res alpha1 alpha25  Res beta1 beta2 | |
| 4 | Site 1 | | Site 2 | | Discrete:Dependent | | ML | | | Res q12 q136  Res q21 q31  Res q24 q34  Res q42 q43 | |
| 5 | Site 1 | | Site 2 | | Discrete:Dependent  *unrestricted ancestral nodes* | | MCMC2 | | | Commands from #4  Prior q34 exp 0.001  Prior q43 exp 0.001 | |
| 6 | Site 1 | | Site 2 | | Discrete:Dependent  *Trait 1 in ancestral nodes restricted to reflect divergent evolutionary model* | | MCMC | | | Commands from #7  AddTag TENaC Cow\_alpha Cow\_beta  Fossil ENaC TENaC 15  AddTag Tbg Cow\_beta Cow\_gamma  Fossil bg Tbg 15  AddTag Talpha Cow\_alpha SLamprey\_alpha  Fossil alpha Talpha 15  AddTag Tad Cow\_alpha Cow\_delta  Fossil ad Tad 15 | |
| 7 | Site 1 | | Site 2 | | Discrete:Dependent  *Trait 2 in ancestral nodes restricted to reflect divergent evolutionary model* | | MCMC | | | Commands from #7  AddTag TENaC Cow\_alpha Cow\_beta  Fossil ENaC TENaC 14  AddTag Tbg Cow\_beta Cow\_gamma  Fossil bg Tbg 14  AddTag Talpha Cow\_alpha SLamprey\_alpha  Fossil alpha Talpha 14  AddTag Tad Cow\_alpha Cow\_delta  Fossil ad Tad 14 | |
| 8 | | Site 1 | | Site 2 | | Discrete:Dependent  *Trait 1 in ancestral node 1 restricted to reflect convergent evolutionary model* | | MCMC | commands from #7  AddTag TENaC Cow\_alpha Cow\_beta  Fossil ENaC TENaC 10  AddTag Tbg Cow\_beta Cow\_gamma  AddMRCA bg Tbg  AddTag Talpha Cow\_alpha SLamprey\_alpha  AddMRCA alpha Talpha  AddTag Tad Cow\_alpha Cow\_delta  AddMRCA ad Tad | |
| 9 | | Site 1 | | Site 2 | | Discrete:Dependent  *Trait 2 in ancestral node 1 restricted to reflect convergent evolutionary model* | | MCMC | commands from #7  AddTag TENaC Cow\_alpha Cow\_beta  Fossil ENaC TENaC 11  AddTag Tbg Cow\_beta Cow\_gamma  AddMRCA bg Tbg  AddTag Talpha Cow\_alpha SLamprey\_alpha  AddMRCA alpha Talpha  AddTag Tad Cow\_alpha Cow\_delta  AddMRCA ad Tad | |
| 10 | | Terrestrial | | PY | | Discrete:Independent  *Unrestricted ancestral nodes* | | MCMC | Commands from #1  PriorAll exp 0.001 | |
| 11 | | Terrestrial | | PY | | Discrete:Independent  *Trait 2 in ancestral nodes restricted to reflect divergent evolutionary model* | | MCMC | Commands from #10  AddTag TENaC Cow\_alpha Cow\_beta  Fossil ENaC TENaC 14  AddTag Tbg Cow\_beta Cow\_gamma  Fossil bg Tbg 14  AddTag Talpha Cow\_alpha SLamprey\_alpha  Fossil alpha Talpha 14  AddTag Tad Cow\_alpha Cow\_delta  Fossil ad Tad 14 | |
| 12 | | Terrestrial | | PY | | Discrete:Independent  *Trait 2 in node 1 restricted to reflect convergent evolutionary model* | | MCMC | Commands from #10  AddTag TENaC Cow\_alpha Cow\_beta  Fossil ENaC TENaC 11 | |
| 13 | | Terrestrial | | PY | | Discrete:Independent  *Trait 2 in node 2 restricted to reflect convergent evolutionary model* | | MCMC | Commands from #10  AddTag Tbg Cow\_beta Cow\_gamma  Fossil bg Tbg 11 | |

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| 14 | Terrestrial | PY | Discrete:Independent  *Trait 2 in node 3 restricted to reflect convergent evolutionary model* | MCMC | Commands from #10  AddTag Talpha Cow\_alpha SLamprey\_alpha  Fossil alpha Talpha 11 |
| 15 | Terrestrial | PY | Discrete:Independent  *Trait 2 in node 4 restricted to reflect convergent evolutionary model* | MCMC | Commands from #10  AddTag Tad Cow\_alpha Cow\_delta  Fossil ad Tad 11 |