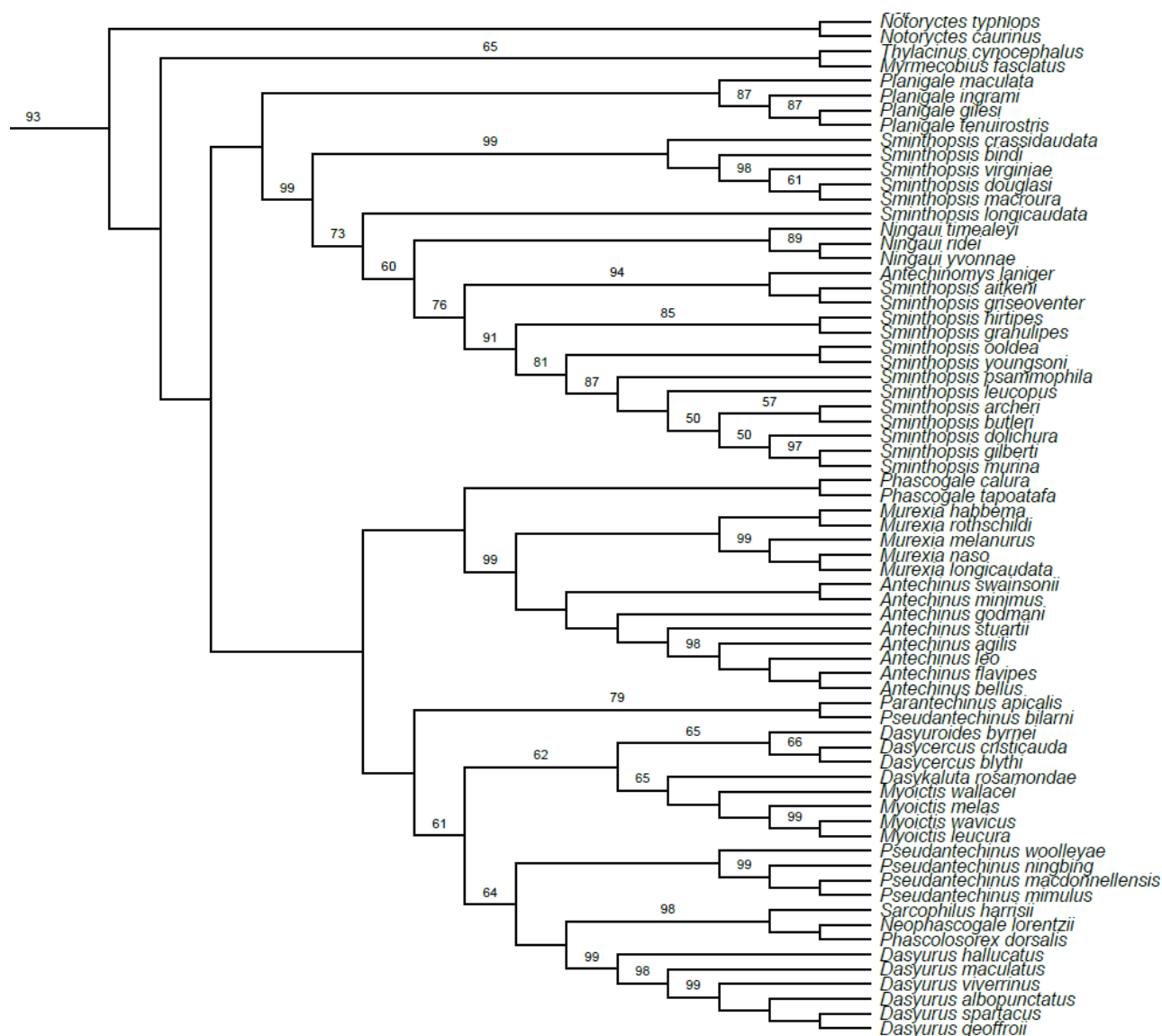


**Figure S1.** Mt<sub>192</sub> maximum likelihood phylogeny based on 12S/16S rRNA and *Cytb*. The analysis was performed in IQ-TREE without topological constraints and includes the complete, published *Chaeropus* sequences. Note that *Chaeropus* is not resolved as monophyletic. Ultrafast bootstrap support values are shown at nodes (when <100%).

Figure S1. Cont.



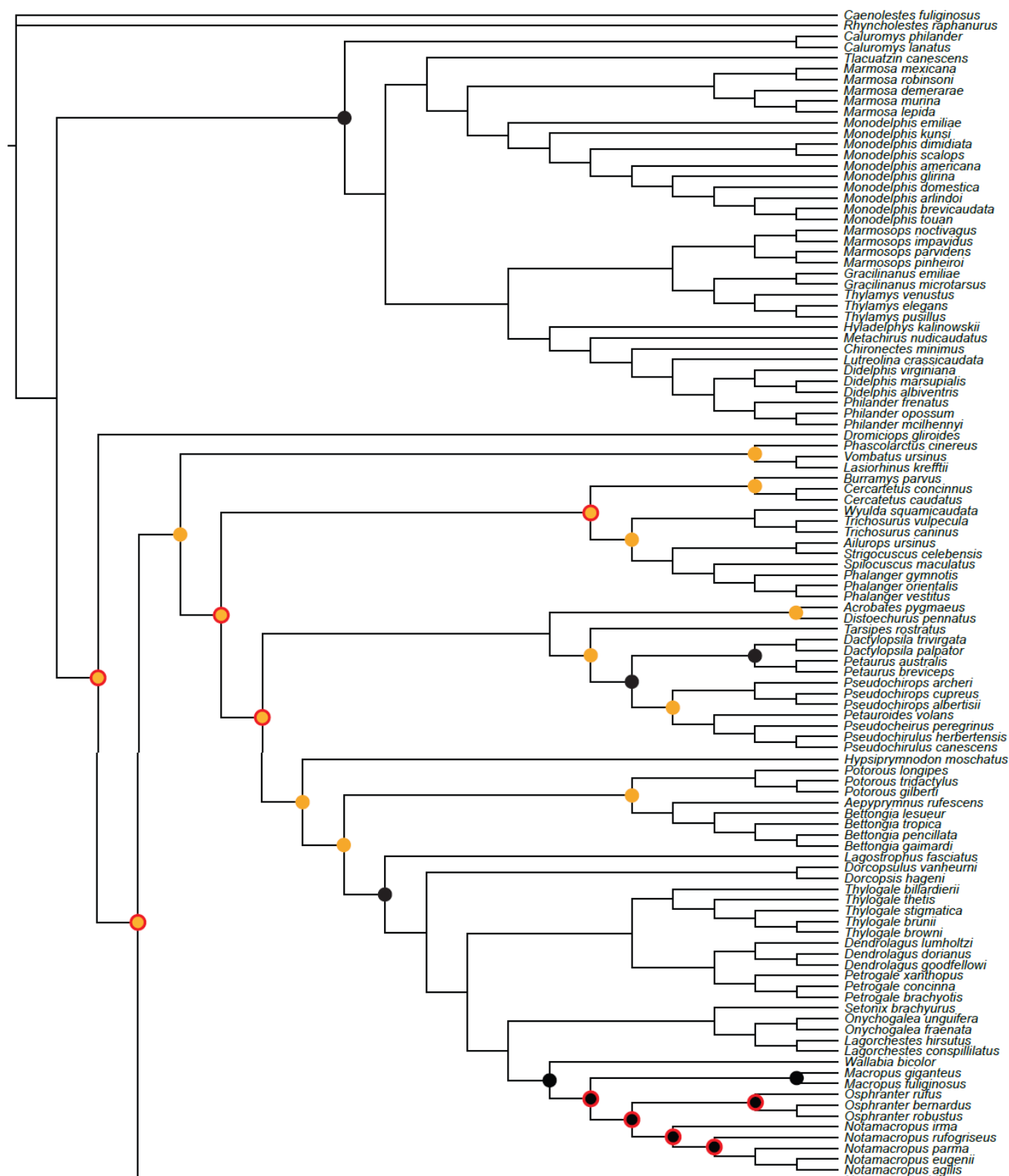
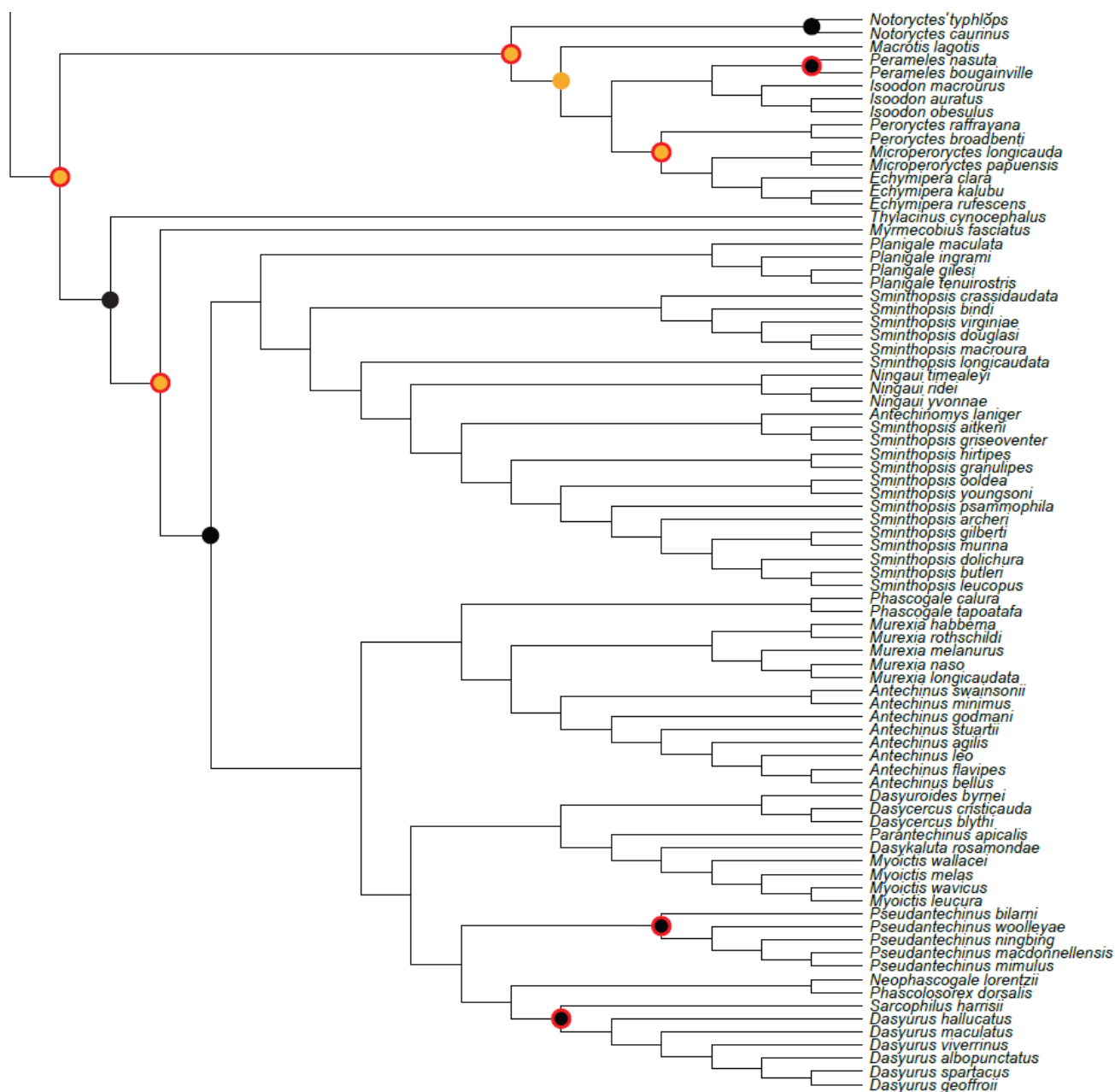
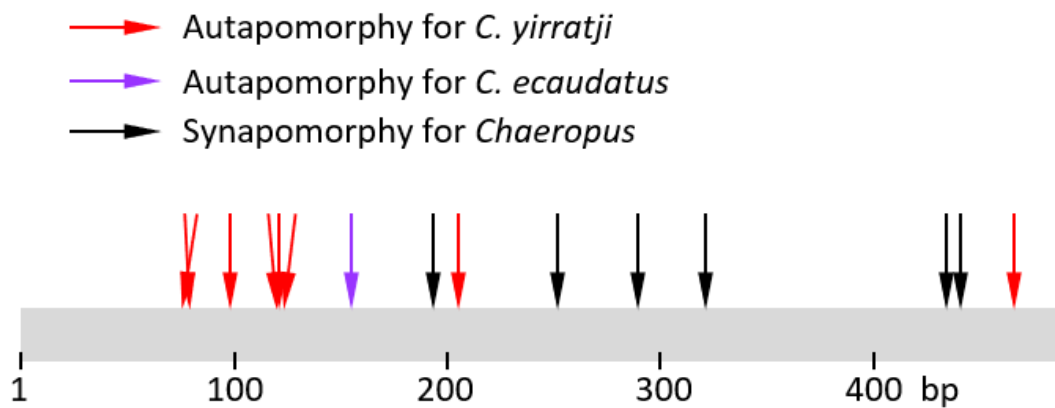


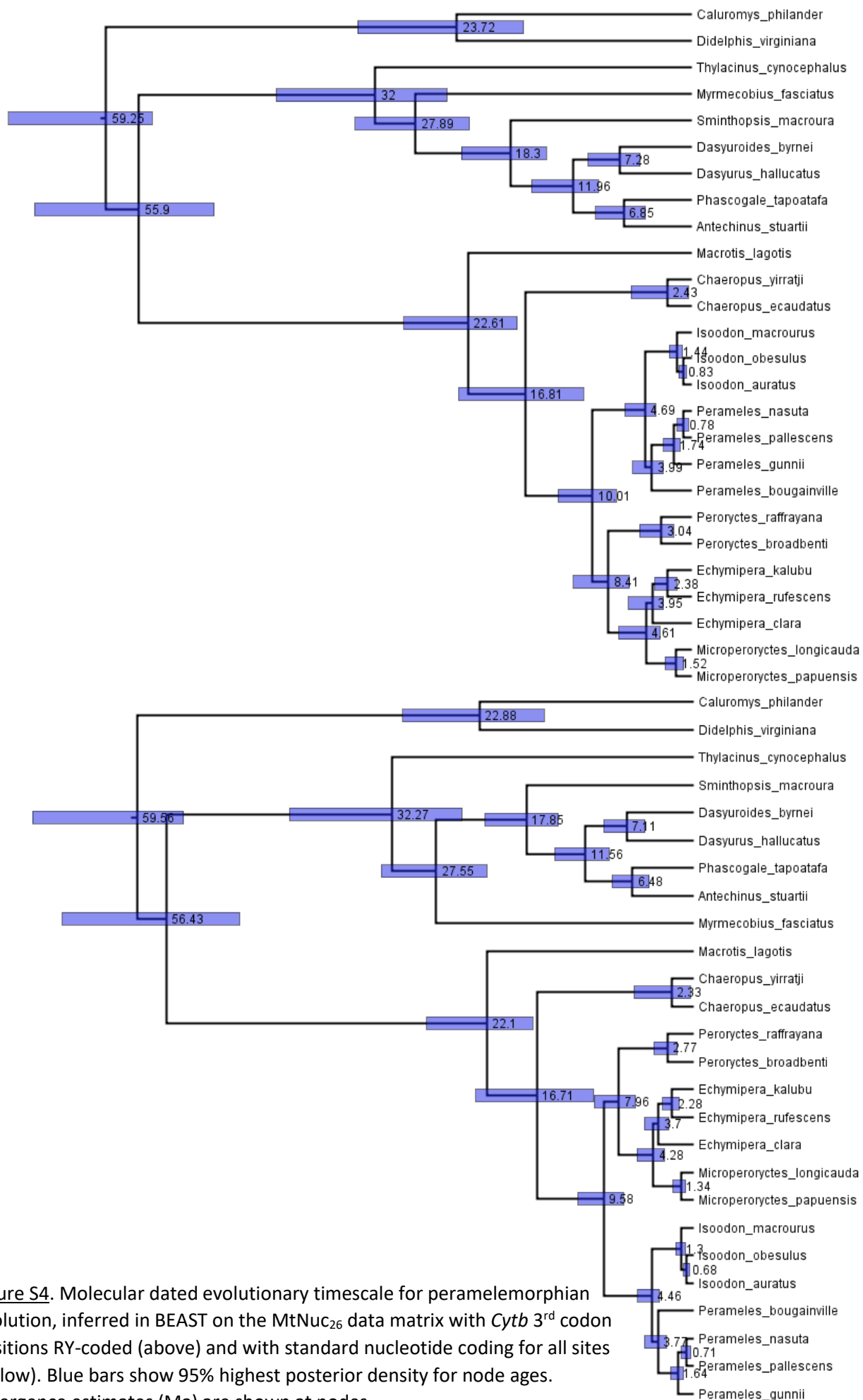
Figure S2. Constraint tree employed for sliding window MP bootstrap analyses. *Chaeropus* is excluded, so that those sequences can float freely in the sliding window analyses. The topology is based on maximum likelihood analysis of the Mt<sub>192</sub> (12S/16S rRNA and *Cytb*) dataset, performed in IQ-TREE with topological constraints enforced in agreement with Duchêne et al (2018), noted as orange-filled node circles and with other nodes (as black-filled circles) that are often incorrectly resolved with only short mtDNA sequences (constrained in agreement with mito-nuclear phylogenies (see main text)). Only nodes with red circle margins were actually corrected by these constraints, in that the other nodes were resolved in agreement with constraints in the unconstrained Mt<sub>192</sub> tree.

Figure S2. Cont.





**Figure S3.** Maximum parsimony inferred apomorphy distribution along the aligned 490bp segment of 16S rRNA that is shared between the *C. yirratji* and *C. ecaudatus* published sequences. *Chaeropus* was constrained to be monophyletic and placed as sister to Peramelidae (the favoured placement on the overall data, Mt<sub>192</sub>) on the backbone marsupial tree (Figure S2).



**Figure S4.** Molecular dated evolutionary timescale for peramelemorphian evolution, inferred in BEAST on the MtNuc<sub>26</sub> data matrix with *Cytb* 3<sup>rd</sup> codon positions RY-coded (above) and with standard nucleotide coding for all sites (below). Blue bars show 95% highest posterior density for node ages. Divergence estimates (Ma) are shown at nodes.