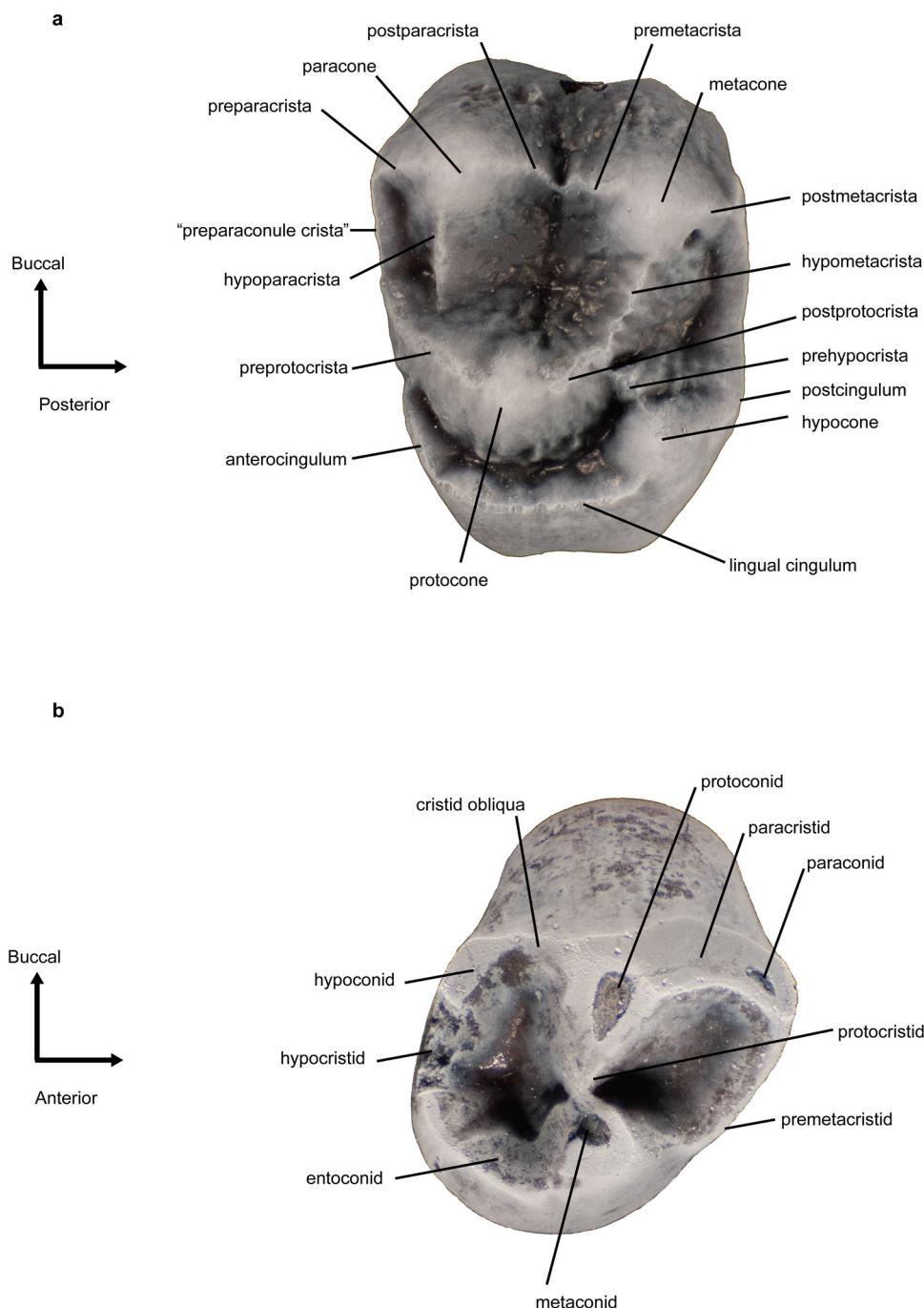
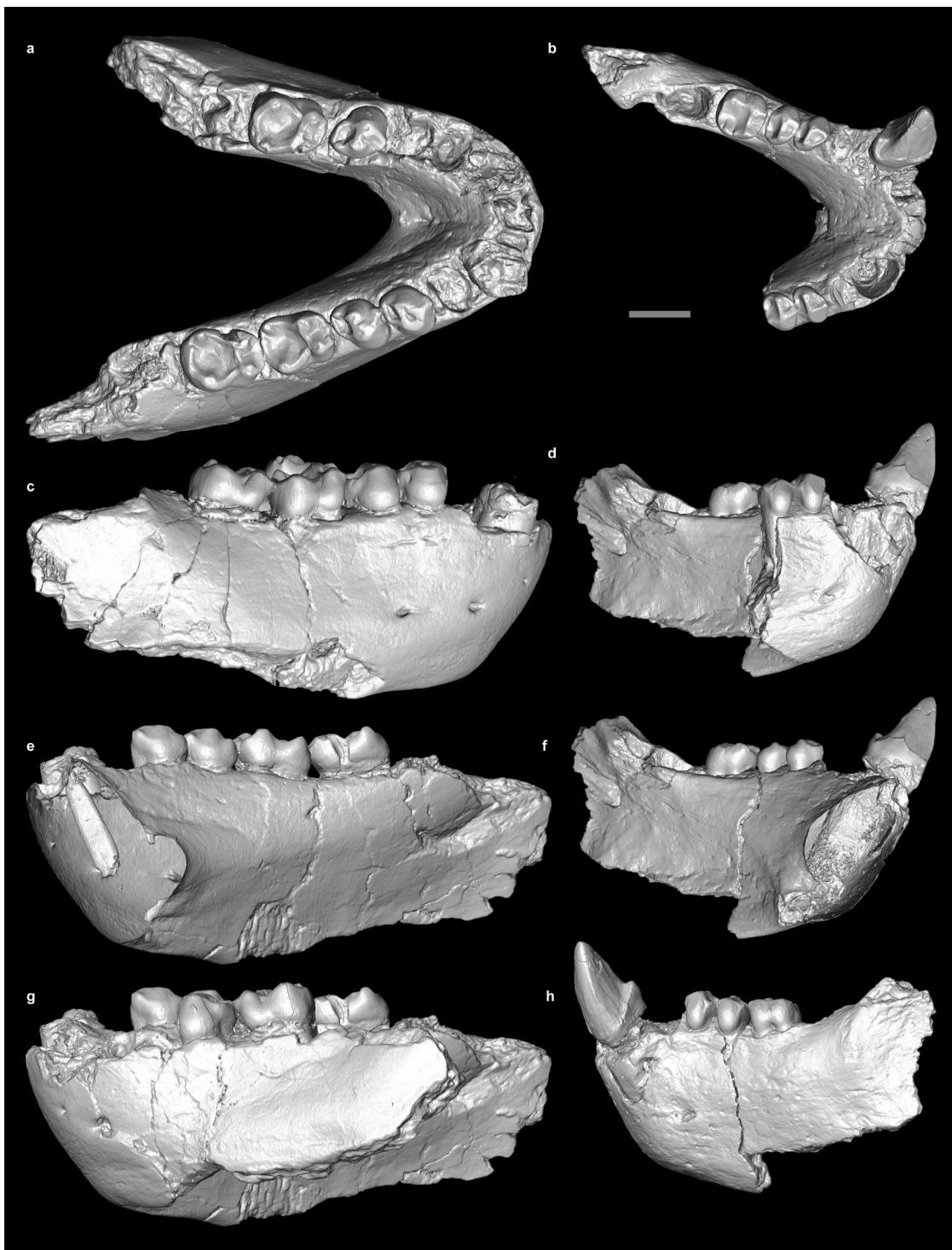


SUPPLEMENTARY INFORMATION

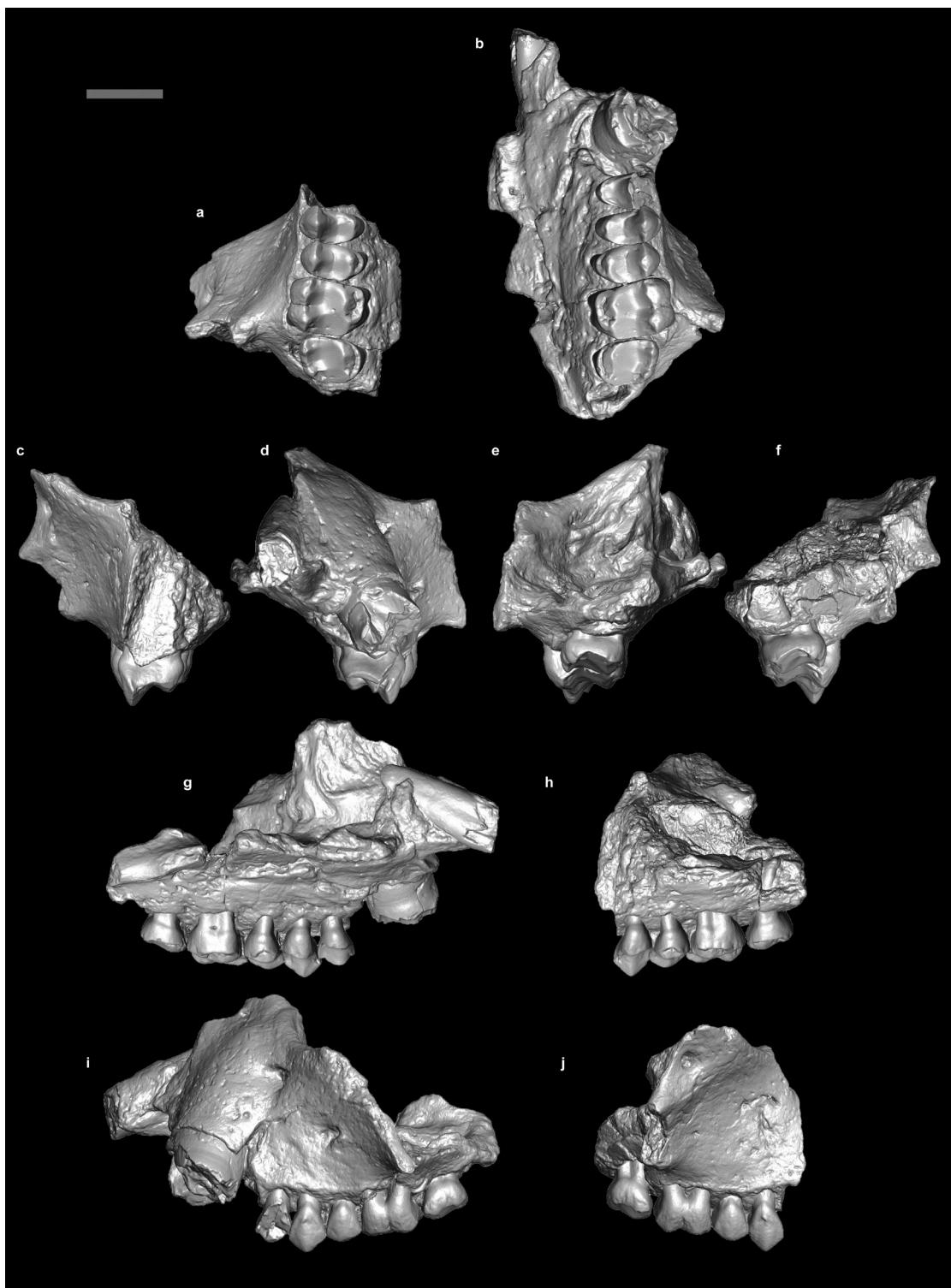
doi:10.1038/nature17415



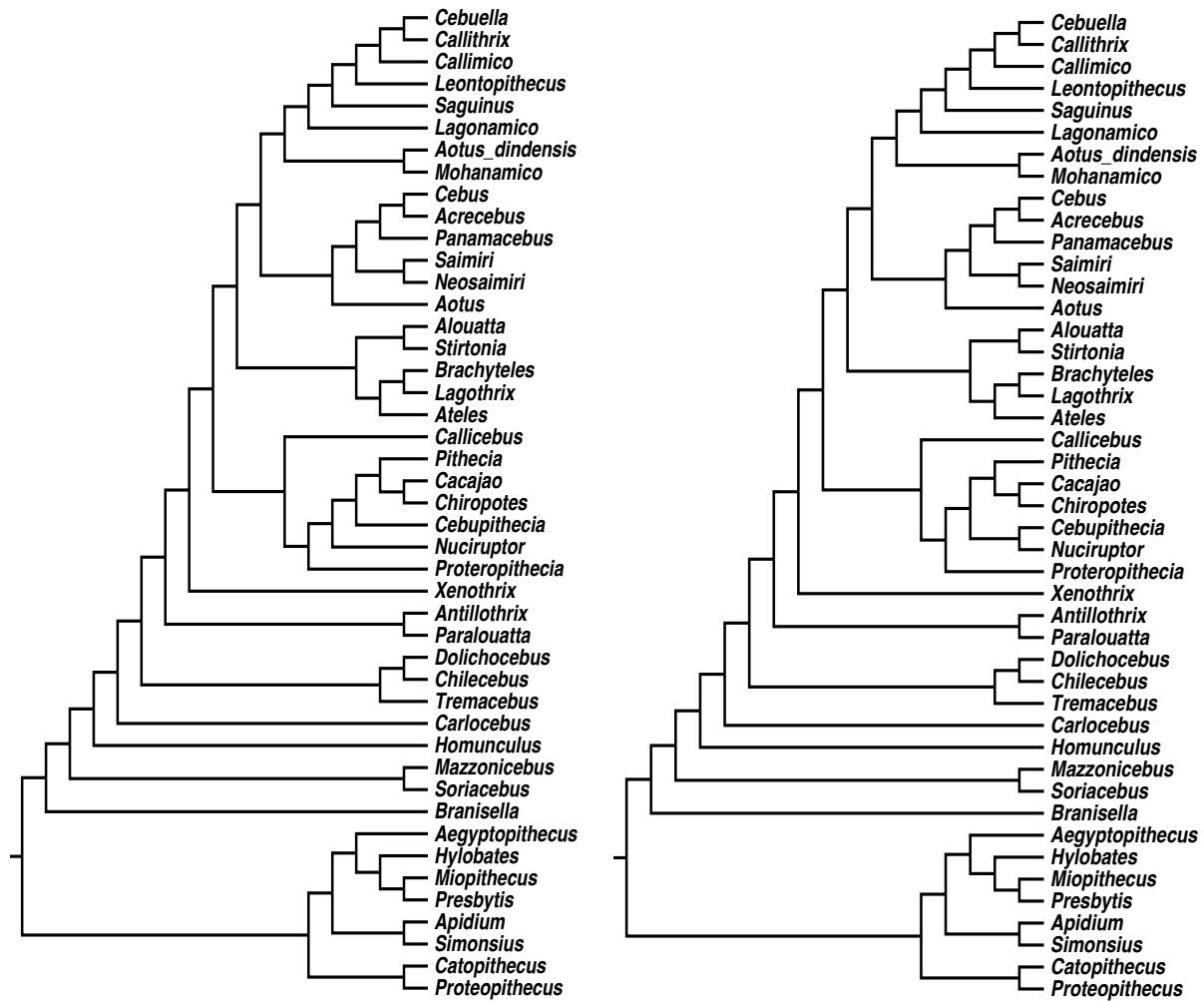
Supplementary Figure 1. Occlusal dental morphology of upper molar (a) and lower premolar (b) teeth of *Panamacebus* and related nomenclature used in the text.



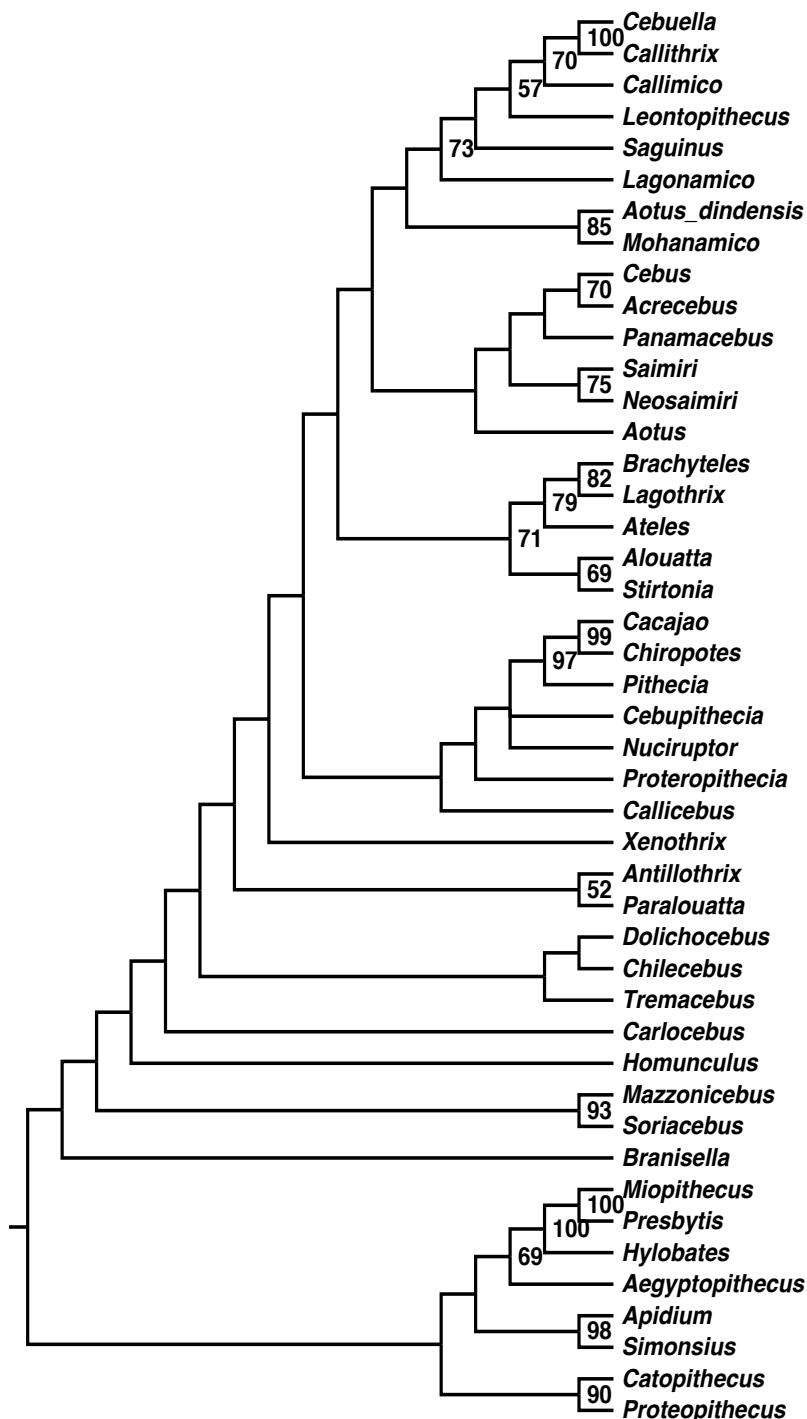
Supplementary Figure 2. Lower dentitions of *Stirtonia* and *Cebupithecia* from the middle Miocene (La Venta) of Colombia. Partial mandible of *Stirtonia tatacoensis* (UCMP 38989: [doi:10.17602/M2/M997](https://doi.org/10.17602/M2/M997)) in a) occlusal, c) right lateral, e) right lingual, and g) left lateral views, and the partial mandible of *Cebupithecia sarmientoi* (UCMP 38762: [doi:10.17602/M2/M2165](https://doi.org/10.17602/M2/M2165)) in b) occlusal, d) right lateral, f) left lingual, and h) left lateral views. Images generated from microCT scan data (see Methods and links associated with specimen numbers). Scale = 5mm.



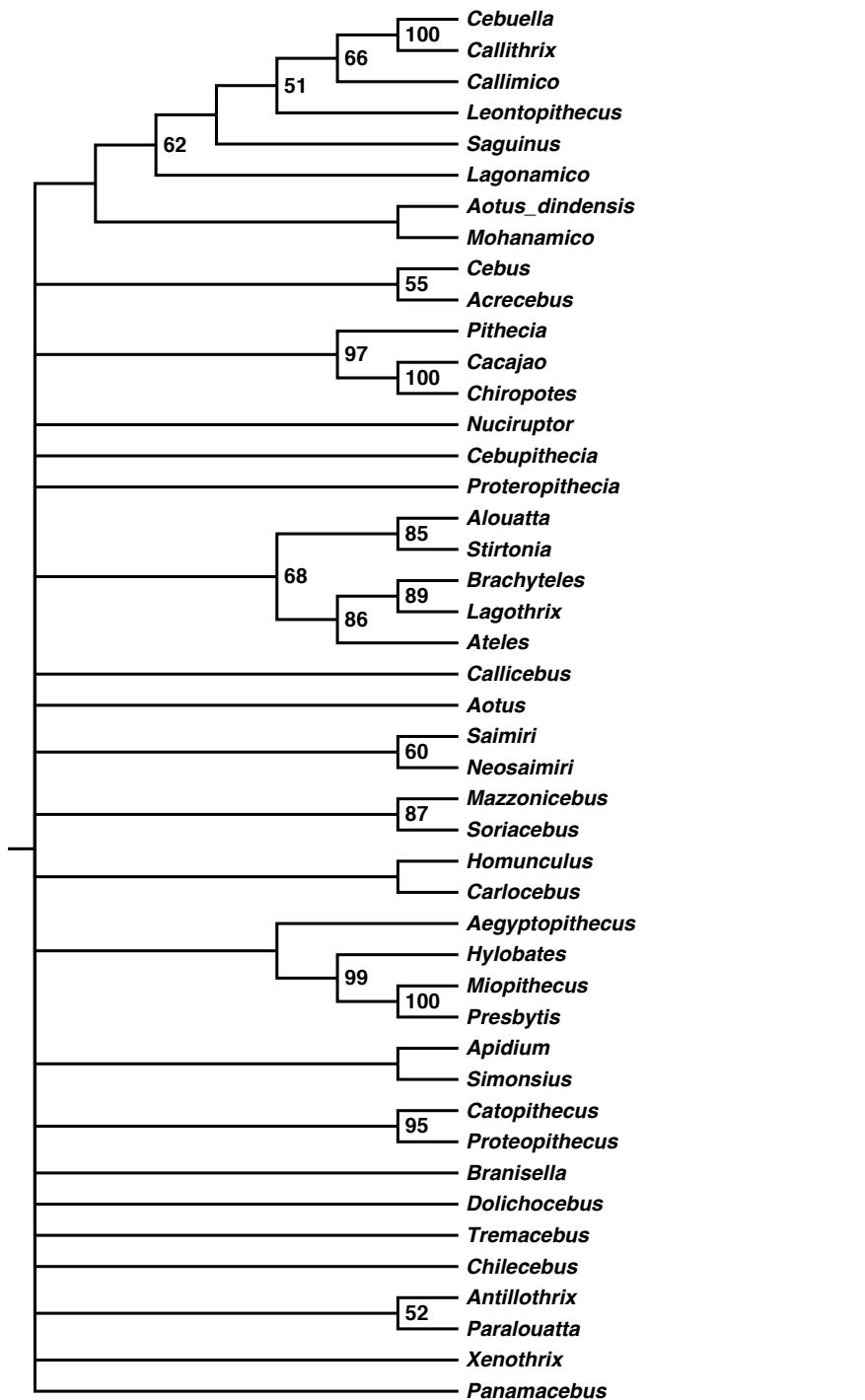
Supplementary Figure 3. Upper dentition of *Cebupithecia* from the middle Miocene (La Venta) of Colombia. Maxillae of *Cebupithecia sarmientoi* (UCMP 38762: [doi:10.17602/M2/M2164](https://doi.org/10.17602/M2/M2164), [doi:10.17602/M2/M2163](https://doi.org/10.17602/M2/M2163)): right maxilla in a) occlusal, c) rostral, f) caudal, h) lingual, and j) buccal view, and left maxilla in b) occlusal, d) rostral, e) caudal, g) lingual, and i) buccal views. Images generated from microCT scan data (see Methods and links associated with specimen numbers). Scale= 5 mm.



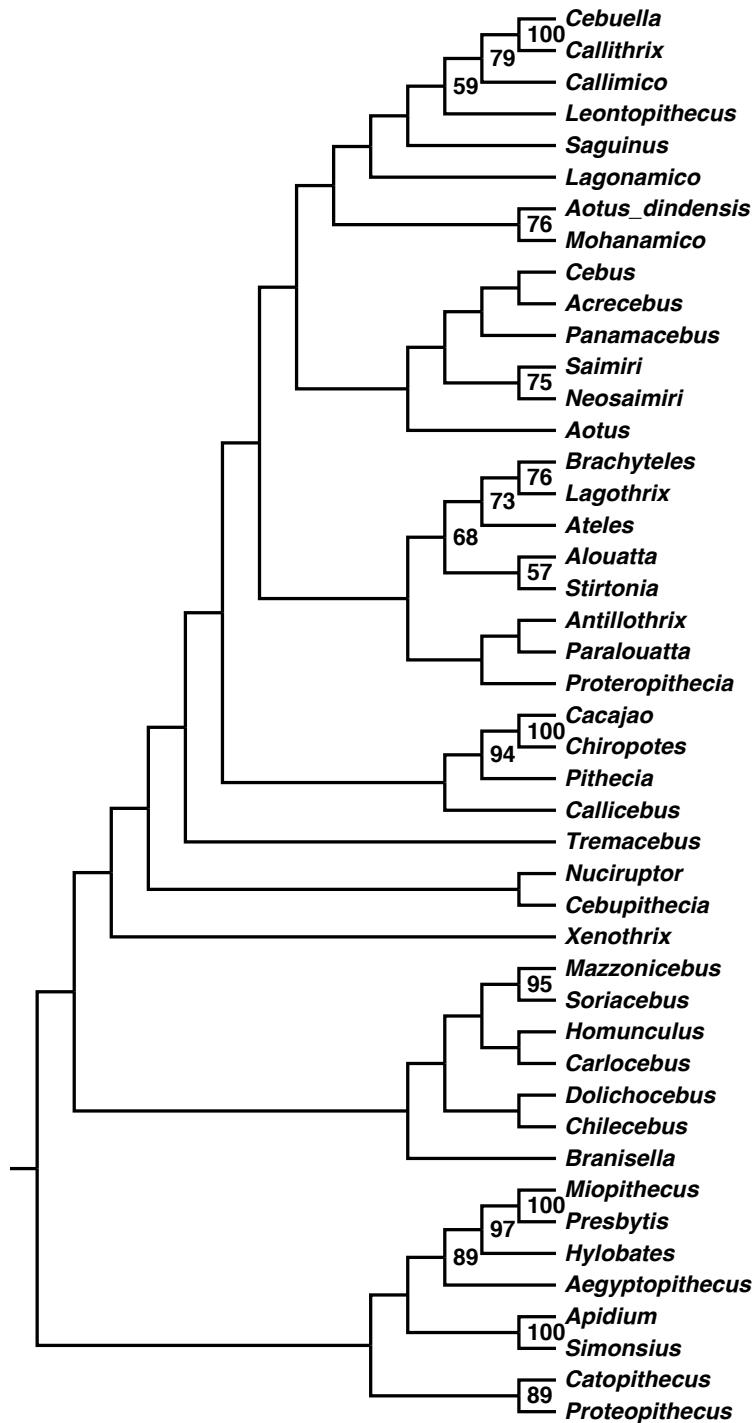
Supplementary Figure 4. Most parsimonious trees from the phylogenetic analysis of *Panamacebus*. Two MP trees resulting from a maximum parsimony analysis of primates including *Panamacebus* based on morphological data (Kay 2015)¹. This analysis was conducted the characters ordered and weighted following Kay (2015)¹. Length: 126733 steps, CI: 0.424, RI: 0.513, HI: 0.737. Bootstrap support shown in Supplementary Fig. 4.



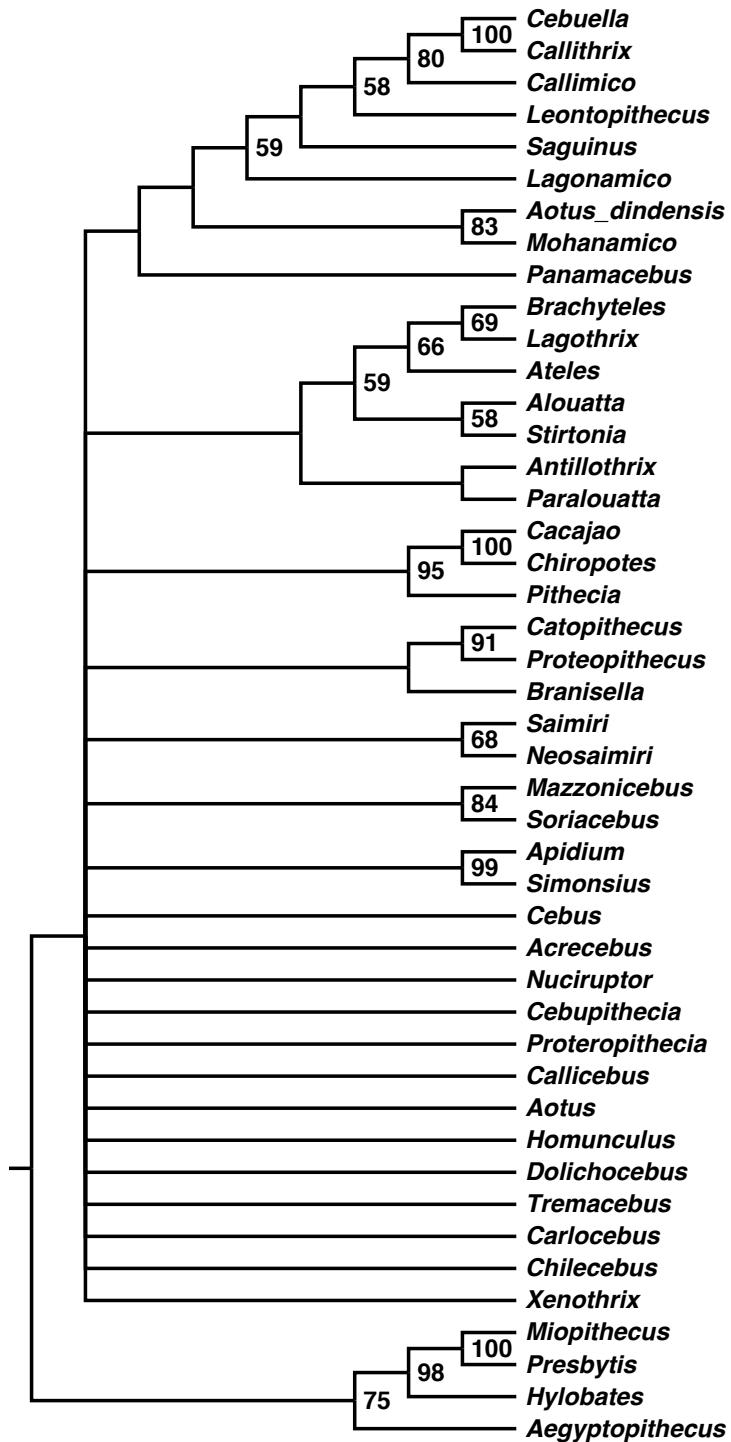
Supplementary Figure 5 . Strict consensus of 2 MP trees from an analysis of ordered and weighted characters. This analysis was performed enforcing the constraint topology and the character ordering and weighting scheme from Kay (2015)¹. Tree length: 126,733 steps, CI: 0.424, RI: 0.513, HII: 0.737. Bootstrap values greater than 50% are indicated at the nodes, but nodes with less than 50% bootstrap support are not annotated.



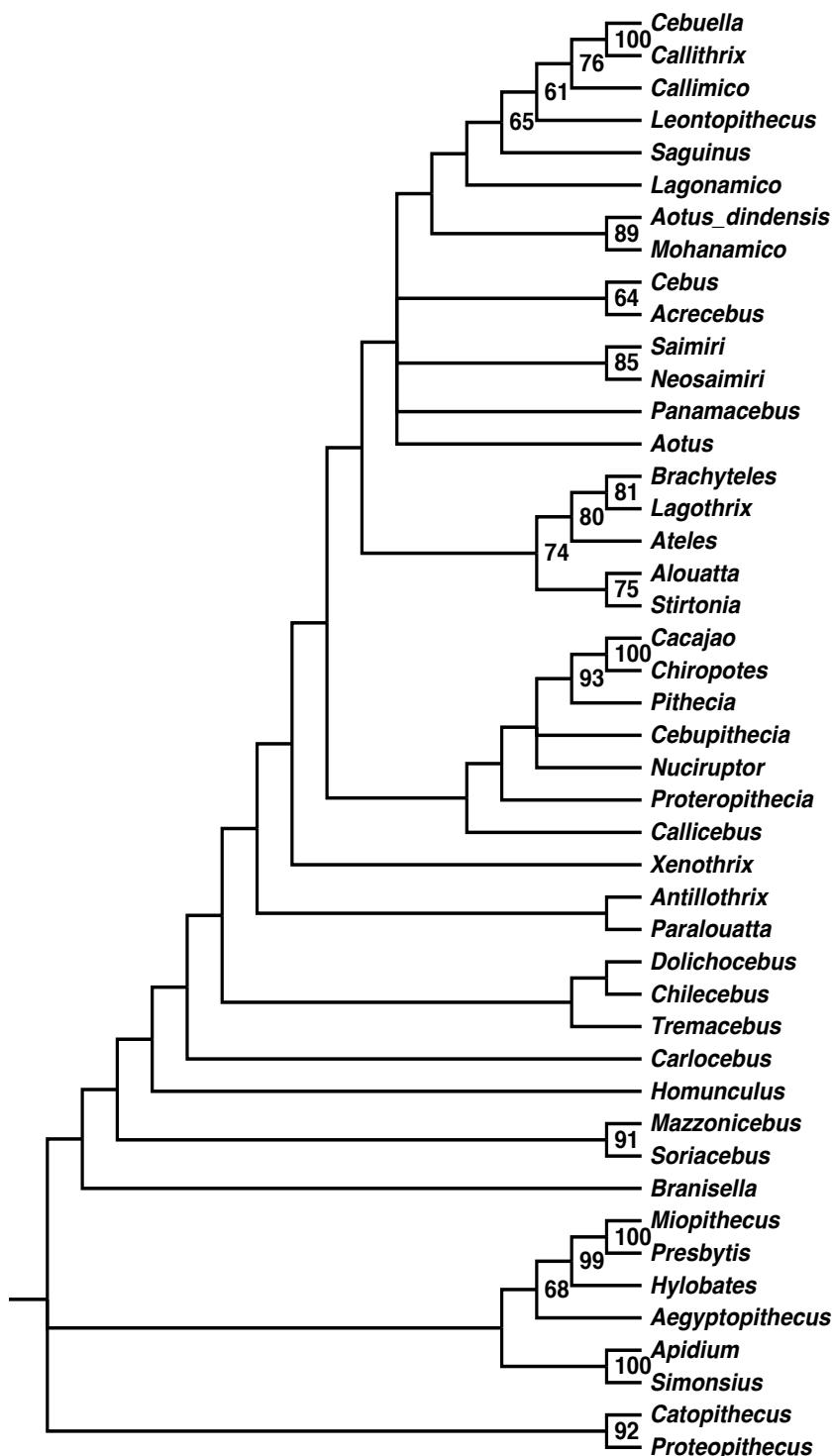
Supplementary Figure 6. Strict consensus of 11 MP trees from an analysis conducted with characters ordered but equally weighted. The constraint topology from Kay (2015)¹ was also enforced in this analysis. Tree length: 2083 steps, CI: 0.428, RI: 0.496, HI: 0.756. Bootstrap values greater than 50% are indicated on nodes, all other un-annotated nodes have bootstrap values less than 50%.



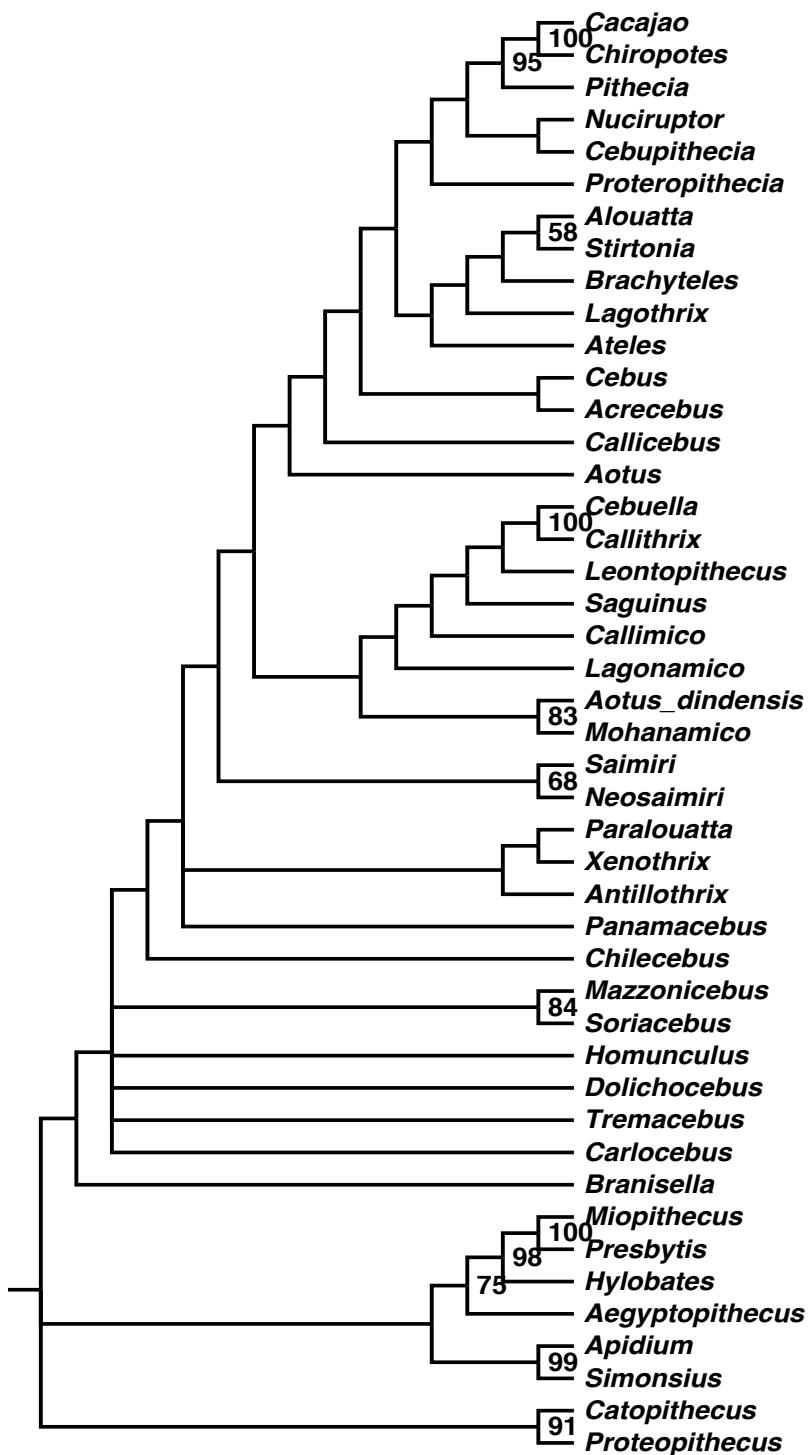
Supplementary Figure 7. The single MP tree from an analysis performed with characters weighted but un-ordered. The constraint topology from Kay (2015)¹ was also used in this analysis. Tree length: 119479 steps, CI: 0.446, RI: 0.503, HI: 0.723. Bootstrap values greater than 50% are shown on the tree but all other un-annotated nodes have bootstrap values less than 50%.



Supplementary Figure 8. Strict consensus of 66 MP trees from an analysis performed with equally weighted and un-ordered characters constrained by the same topology used in Kay (2015)¹. Tree length: 1935 steps, CI: 0.456, RI: 0.481, HI: 0.740. Bootstrap values greater than 50% are shown on the tree but all other un-annotated nodes have bootstrap values less than 50%.



Supplementary Figure 9. Strict consensus of 4 MP trees from an analysis using a constraint tree derived from Springer et al. (2012)²¹. Tree length: 127183, CI: 0.423, RI: 0.510, HI: 0.738. Bootstrap values greater than 50% are shown on the tree but all other un-annotated nodes have bootstrap values less than 50%.



Supplementary Figure 10. Strict consensus of 5 MP trees from an unconstrained analysis with characters ordered and weighted following Kay (2015)¹. Tree length: 124010 steps, CI: 0.433, RI: 0.531, HI: 0.731. Bootstrap values greater than 50% are shown on the tree but all other un-annotated nodes have bootstrap values less than 50%.