



# Phylogeny of New Earliest Paleocene (Puercan) Peripitychid ‘Condylarths’ from the Great Divide Basin, WY

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## Abstract

An earliest Paleocene (Puercan) fauna discovered by the late James Honey and Malcolm McKenna in the lower China Butte Member of the Fort Union Formation in Wyoming’s Great Divide Basin contains a diverse mammalian faunal assemblage, including a number of ‘condylarth’ taxa. Preliminary studies by others have suggested that this faunal assemblage may be correlative with the early Puercan Littleton fauna in the Denver Formation, due to multiple shared taxa. The fauna from UCM locality 2011035 includes a new peripitychid ‘condylarth’ genus as well as a new species of *Conacodon*. The new genus, which is based on a left dentary containing p3-m3, is 10-12% larger than *Conacodon delphae*, the largest documented species of *Conacodon*, and appears similar in morphology to *Alticonus gazini*, but differs in having more inflated cusps, shorter molar talonids, and shallower basins. The new species of *Conacodon* is based on left and right dentaries that include the Lp3-m3 and Rp4-m3. This new species appears close in molar morphology to species of *Conacodon* and *Hemithlaeus kowalevskianus* (which occur at middle Puercan-aged localities elsewhere), differing primarily in its larger size and morphology of the p4. To examine the relationships between these two new taxa and other Puercan peripitychids from the Western Interior of North America, a phylogenetic analysis was performed using 18 ‘condylarth’ taxa and 53 dental characters. Characters were aggregated from previous phylogenetic analyses of ‘condylarth’ taxa, and they were scored based on comparative study with specimens and casts from several museum collections as well as descriptions of teeth from the literature. The preliminary phylogenetic analysis suggests that the new peripitychid genus from UCM locality 2011035 is closely related to *Ampliconus antoni*, while the new species of *Conacodon* appears closely related to *C. cophater* and *C. entoconus*, known from middle – late Puercan strata at several localities in the Western Interior. Additionally, the phylogenetic analysis suggests that the genus *Conacodon* may be paraphyletic. If prior estimates of an early Puercan age for UCM locality 2011035 are correct, then the occurrence of two new peripitychid taxa suggest that mammalian diversity is higher than previously thought for the earliest Paleocene.

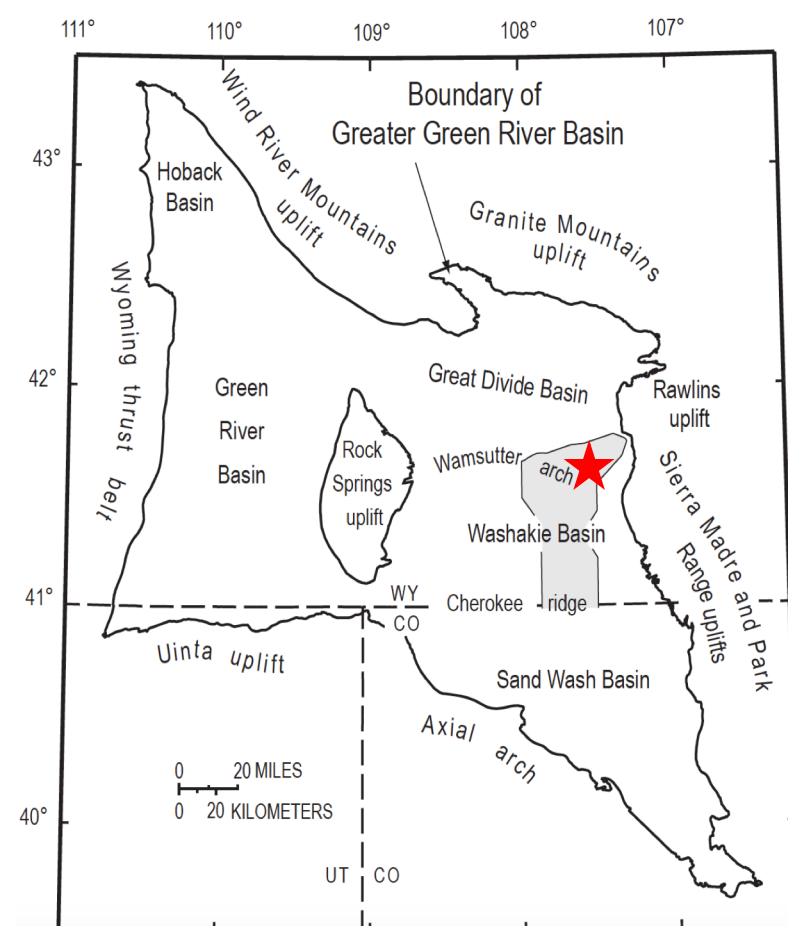


Figure 6. Map of the Greater Green River Basin showing the Great Divide Basin study locality, indicated by star (modified from Hettinger et al. 2008).

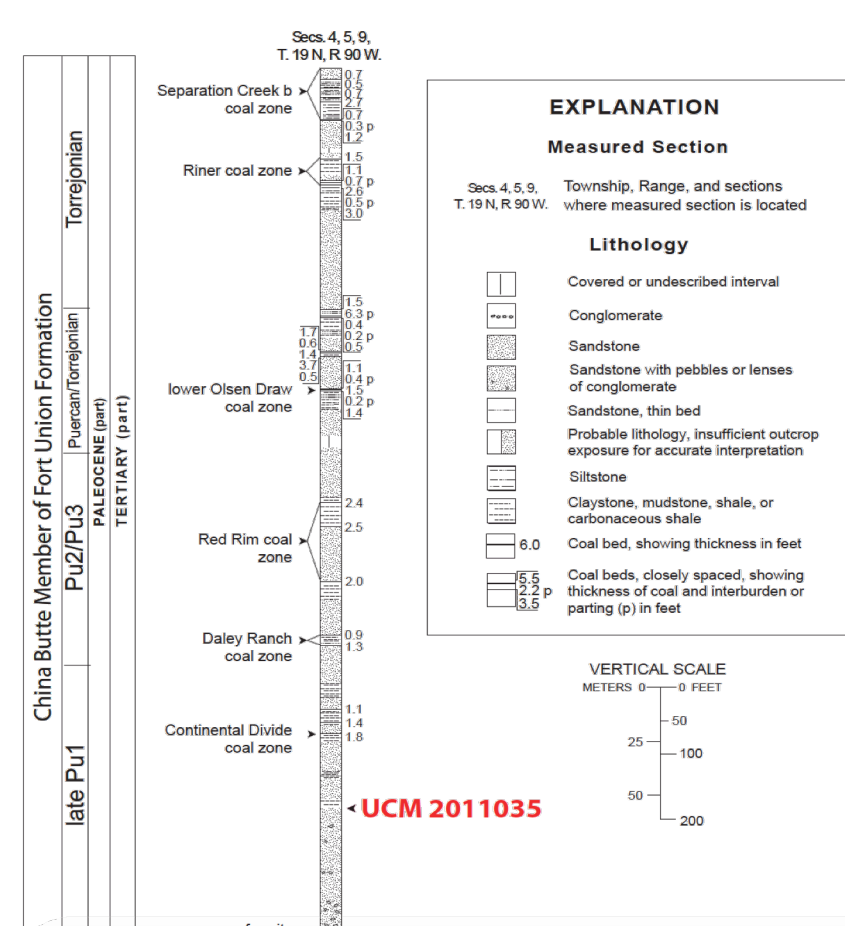


Figure 7. Stratigraphic section showing the position of UCM locality 2011035 (modified from Hettinger et al. 2008).

## Geologic Setting

Decades of paleontological fieldwork in the eastern Great Divide Basin (GDB) by James Honey and Malcolm McKenna produced a large and diverse assemblage of fossil mammals (3,200+ specimens) spanning latest Cretaceous (Lancian) through early Eocene (Wasatchian) time. Although it is separated today from the Hanna Basin (to the east) by the Rawlins Uplift, during earliest Paleocene time, the GDB was contiguous with the Hanna Basin, and both comprised part of the Greater Green River Basin (Lillegraven *et al.*, 2004).

The new peripitychid ‘condylarth’ taxa reported here are from Puercan-aged UCM loc. 2011035, which lies ~50 m (166 ft) above the base of the Fort Union Formation and is the stratigraphically lowest Cenozoic mammal-bearing locality yet found in the Great Divide Basin, shown in Figures 6-7 (McComas & Eberle, 2015). The quarry has produced more than 350 mammalian fossils, dominated by dentaries and a relatively small percentage of upper dentitions. This discrepancy may be due, in part, to quarrying techniques, or to the high-energy channel deposit in which the fossils were discovered. Based on the North American Land Mammal Ages (NALMA) as the biochronological framework, the fauna is hypothesized to represent the early Puercan Interval Zone (Pu1). This is based upon the presence of *Protungulatum donnae*, which marks the earliest Puercan boundary as well as the absence of *Ectoconus* which marks the middle Puercan boundary (Pu2) (McComas & Eberle, 2015).

## New Peripitychids

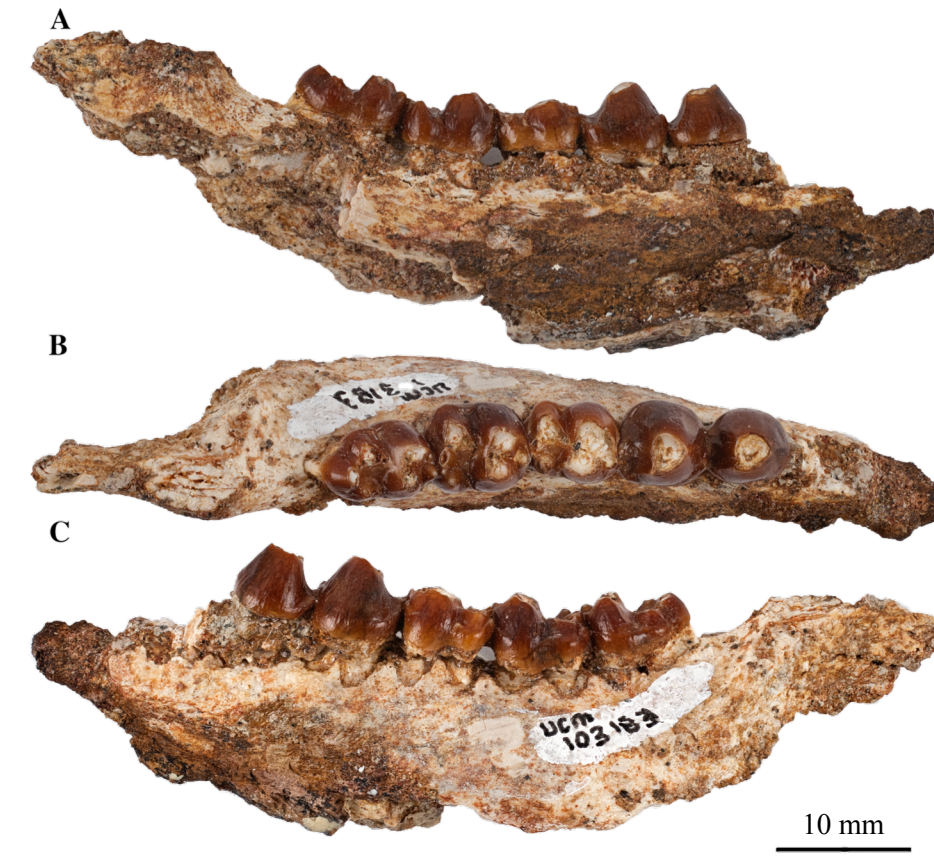


Figure 1. Gen. et sp. nov. A from UCM loc. 2011035. UCM 103183 left mandible with p3 – m3, in A, lingual; B, occlusal; and C, labial views. Inset images provide detailed views of diagnostic and descriptive features, as labeled.

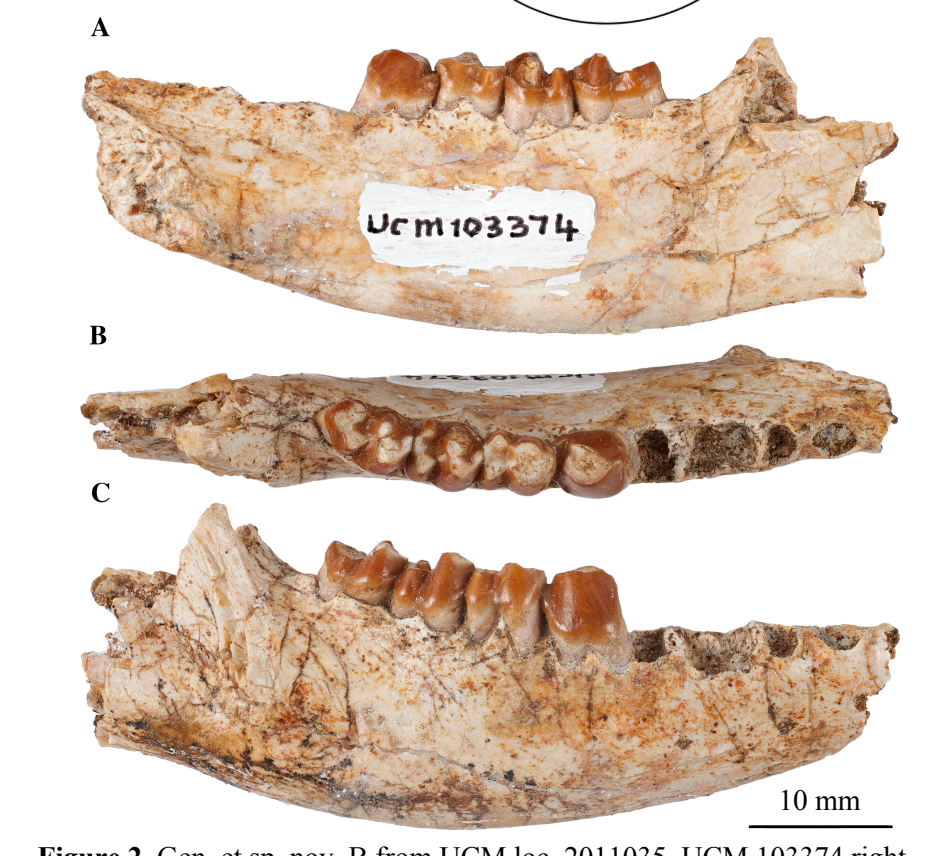
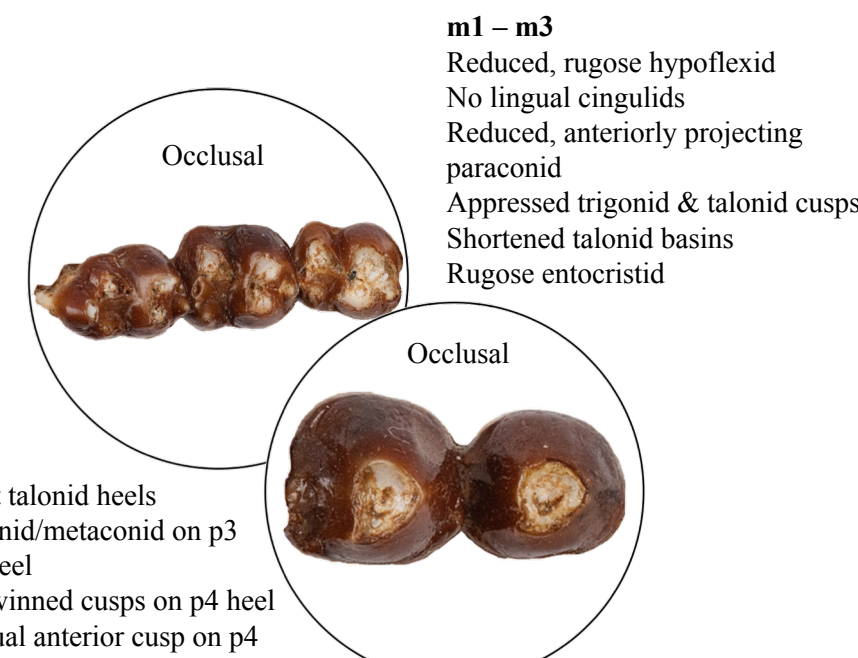


Figure 2. Gen. et sp. nov. B from UCM loc. 2011035. UCM 103374 right mandible with p4 – m3, in A, lingual; B, occlusal; and C, labial views. Inset images provide detailed views of diagnostic and descriptive features, as labeled.

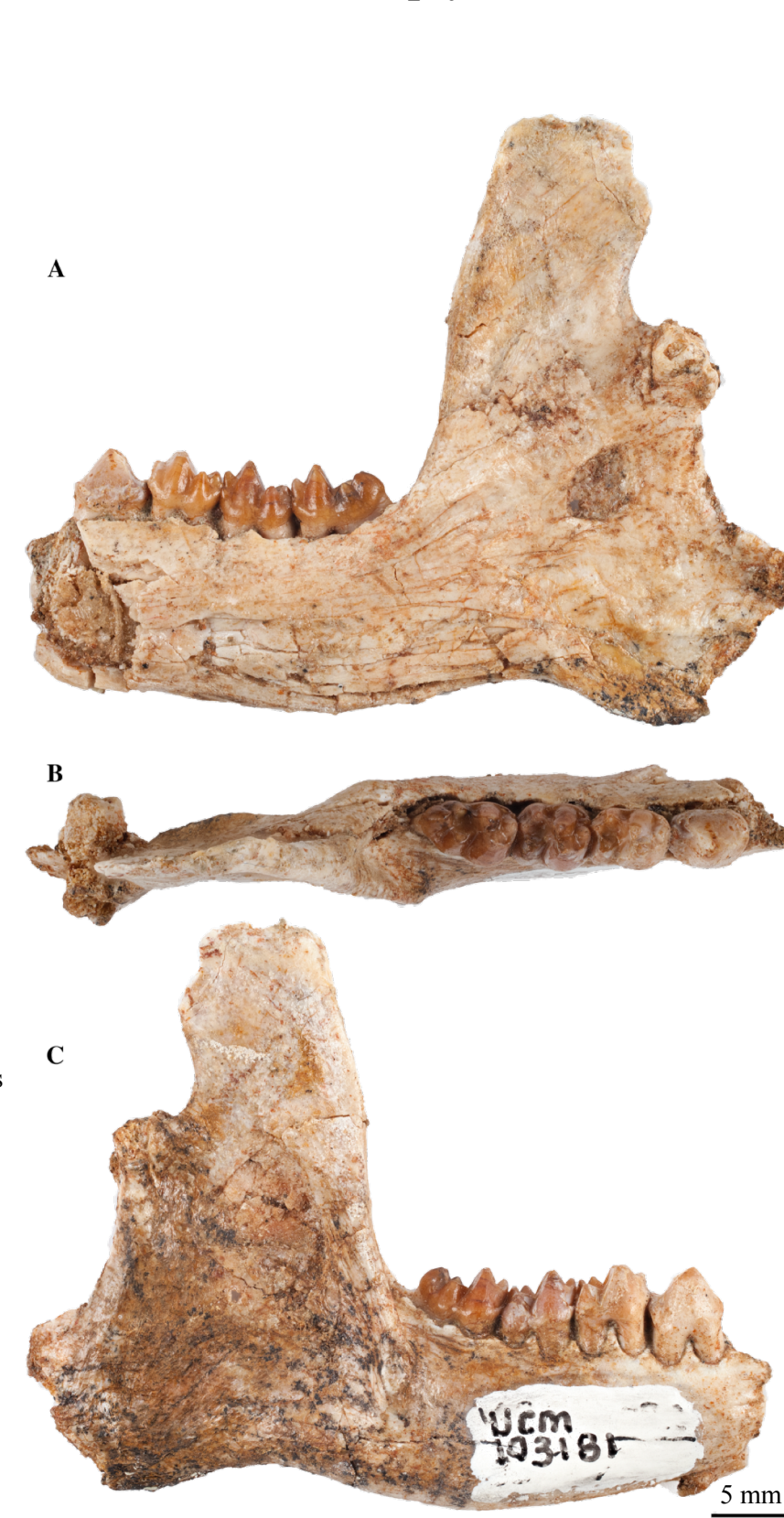
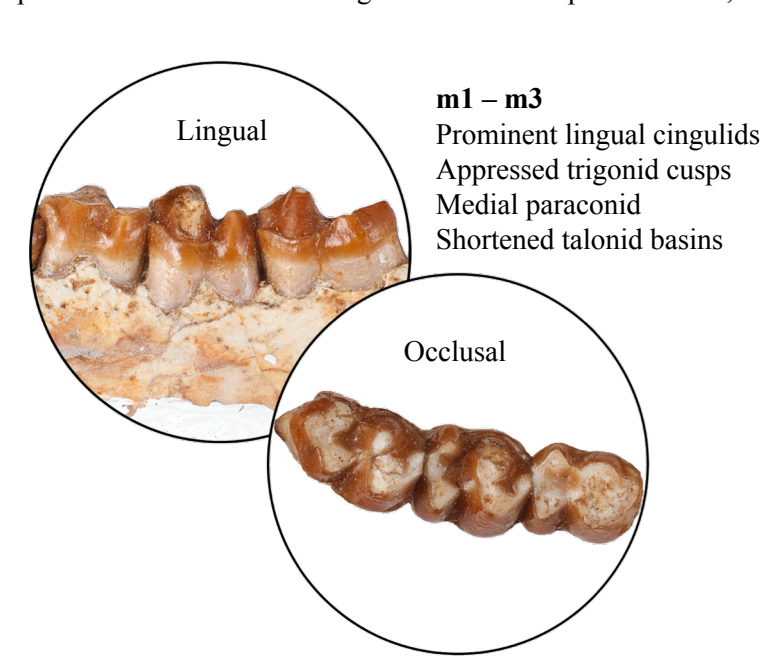


Figure 3. Gen. et sp. nov. C from UCM loc. 2011035. UCM 103181 right mandible with p4 – m3, in A, lingual; B, occlusal; and C, labial views. Inset images provide detailed views of diagnostic and descriptive features, as labeled, of all three specimens.

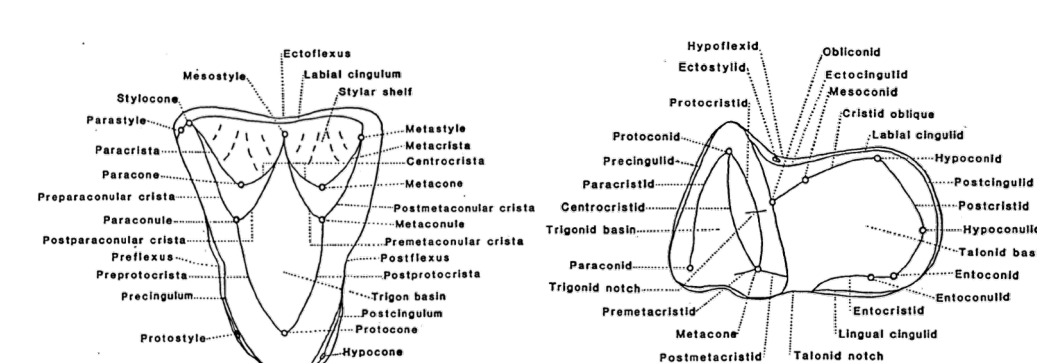
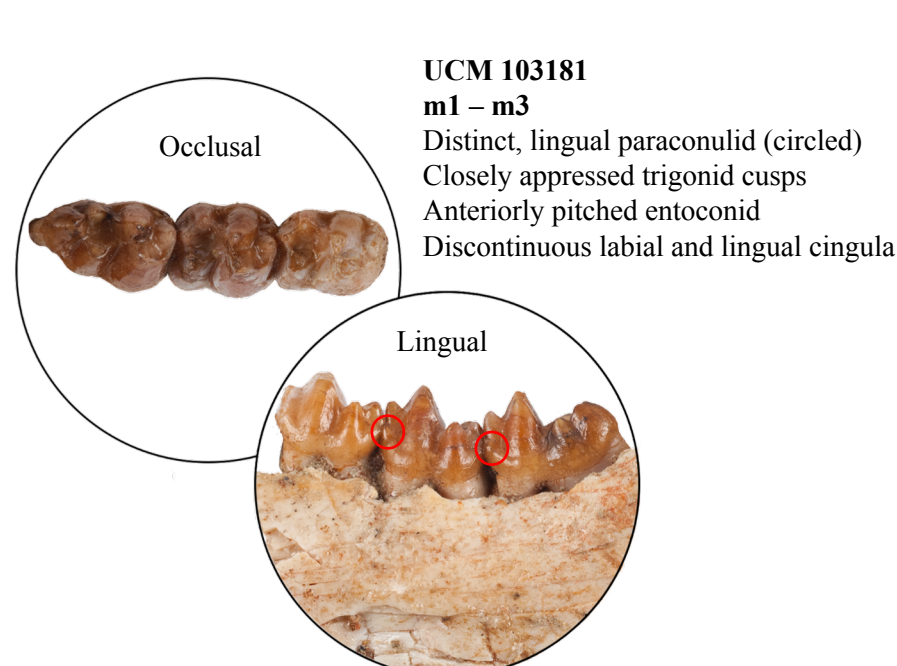


Figure 6. Nomenclature for mammalian molars. (Upper molar in left diagram and lower molar in right diagram). Labial perspective is top. Adapted from Taylor, 1984.

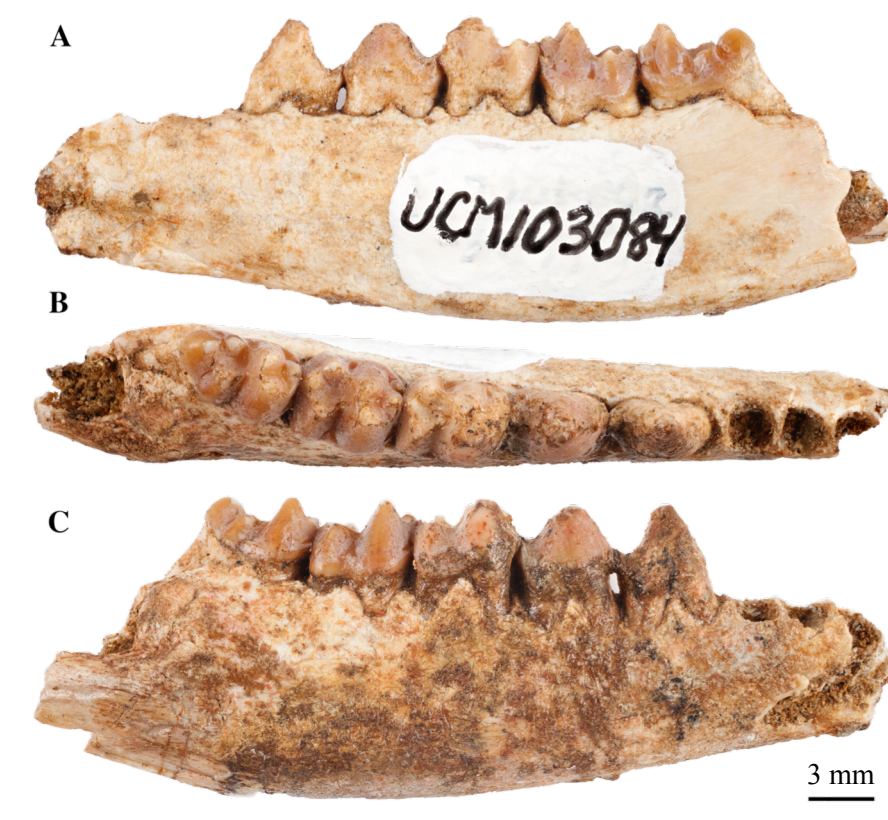


Figure 4. Gen. et sp. nov. C from UCM loc. 2011035. UCM 103084 right mandible with p3 – m3, in A, lingual; B, occlusal; and C, labial views. Inset images provide detailed views of diagnostic and descriptive features, as labeled.

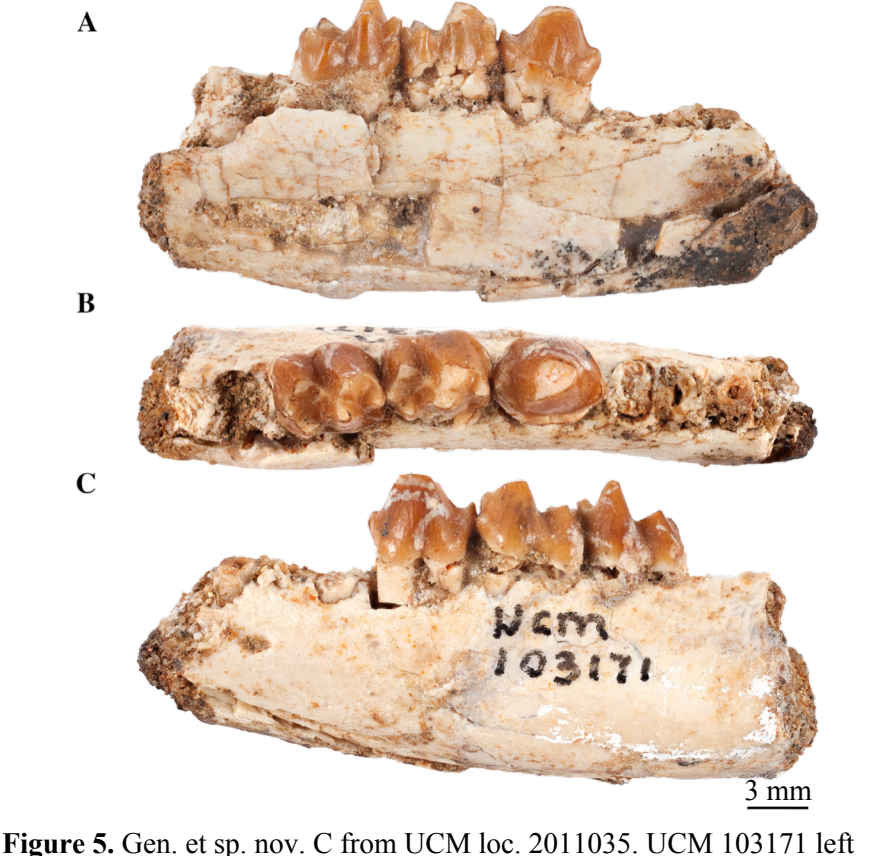
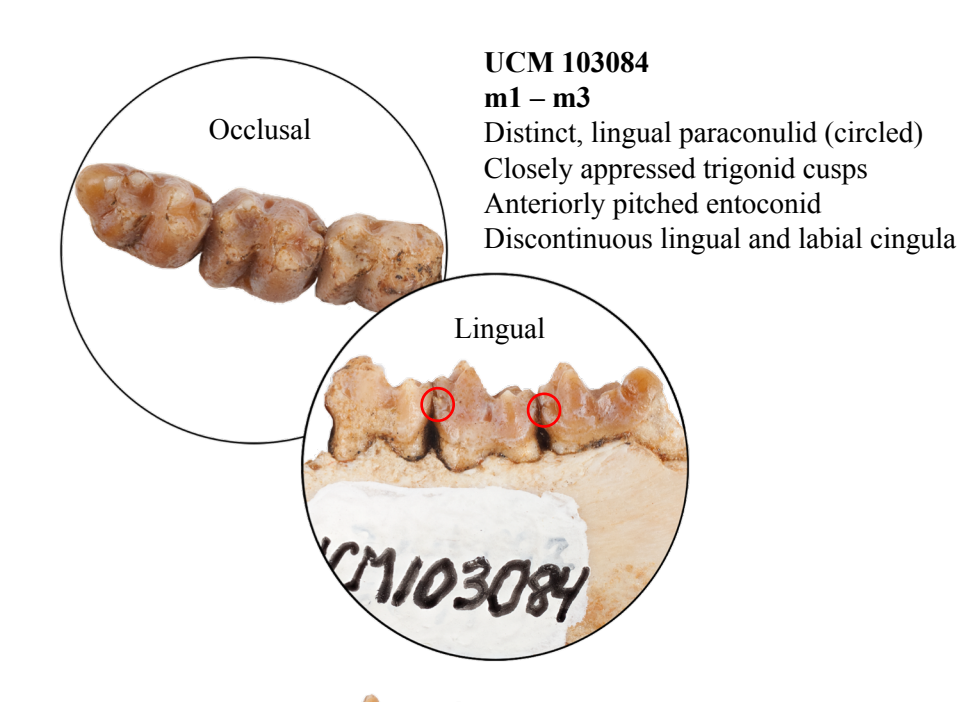


Figure 5. Gen. et sp. nov. C from UCM loc. 2011035. UCM 103171 left mandible with p4 – m2, in A, lingual; B, occlusal; and C, labial views. Inset images provide detailed views of diagnostic and descriptive features, as labeled.

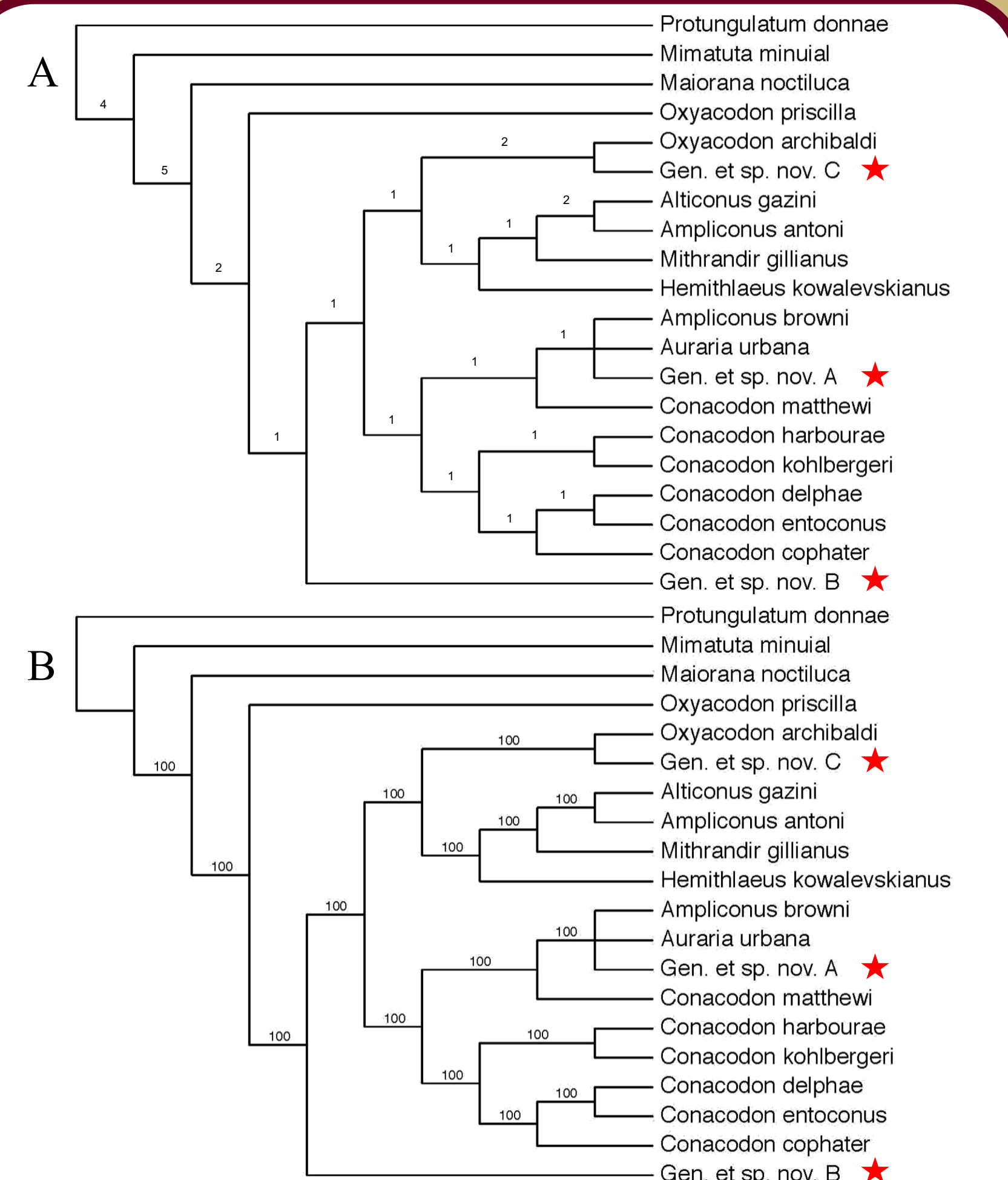
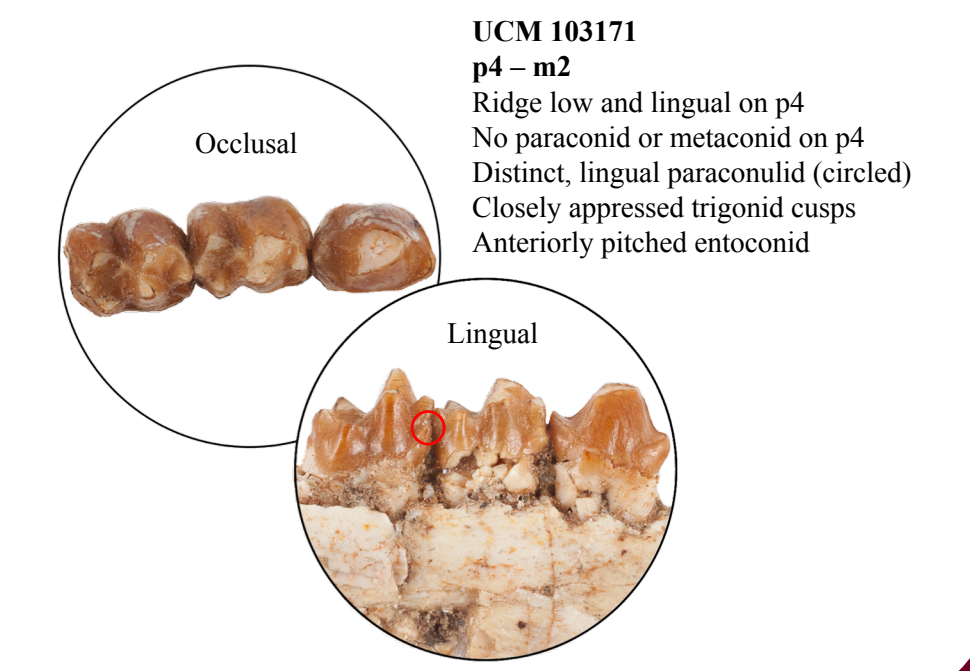


Figure 8. Preliminary phylogenetic relationships obtained using PAUP\* v.4.0 beta 10 Win (Swofford 1998), based on 56 dental characters and performed on 20 ‘condylarth’ taxa, with *P. donnae* as the outgroup, and new taxa indicated by stars. A, strict consensus of 2 most parsimonious trees (162 steps, Consistency Index = 0.42, Retention Index = 0.53), with Bremer decay indices above the branches. B, 50% majority rule tree, in which percentage values at 50% or higher are shown above the branches.

## Conclusions

The new taxa from the GDB increase the known diversity of early Puercan peripitychid ‘condylarths’. Gen. et sp. nov. A appears to form a polytomy with *Auraria urbana* and *Ampliconus browni*. Gen. et sp. B appears to be a sister group to the Conacodontines. Gen. et sp. nov. C forms a moderately well supported clade with *Oxyacodon archibaldi*. Our phylogenetic analysis suggests that Puercan conacodontines are paraphyletic, and future discovery in the Great Divide Basin may continue to resolve the diversity of this family. This hypothesis will continue to be tested through the incorporation of additional ‘condylarth’ taxa.

Acknowledgements  
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Figure 9. Photo of UCM field crew (from left to right): Nicole Neu-Yagle, Maddy Atteberry, Bob Hettinger, Wendy Hettinger, and Jeannine Honey. Taken by Jaelyn Eberle, 2017.