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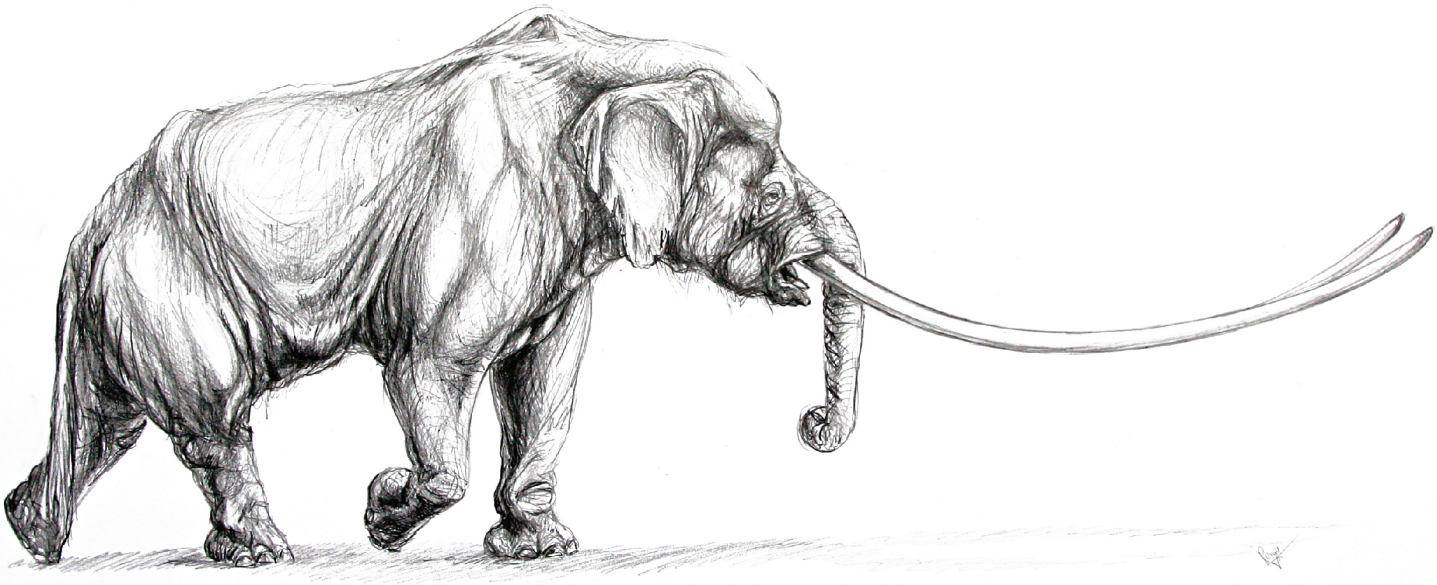

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ABSTRACT BOOK

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About the lower tusks of *Cuvieronius hyodon* (Gomphotheriidae, Proboscidea, Mammalia) from South America

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Proposed phylogenies of American gomphotheres are mainly based on adult characters (Shoshani, 1996; Prado & Alberdi, 2008; Ferretti, 2010; Mothé et al., 2013). However, juvenile features are known to be potentially useful in providing information on character polarity, by preserving plesiomorphic states, unknown in adult stages. Among New World proboscideans, the origin and evolution of South American Gomphotheriidae (SAG) are highly debated issues. Increase knowledge on morphology of SAG deciduous dentition may help to elucidate those issues. SAG are trilophodont, whose dentition consists of three deciduous premolars, three molars and a pair of upper tusks. Adult mandibles lack lower tusks. However, the presence of lower tushes (LT) was reported in juvenile mandibles of *Cuvieronius hyodon* from Tarija, Bolivia (Liendo, 1946; Ferretti, 2008). No detailed study of the LT and premolars of SAG have been made to date. We present the results of an analysis of the ontogenetic and evolutionary patterns of the deciduous dentition of *C. hyodon*, with special focus on LT. Despite *C. hyodon* occurs also in North America, we analyzed exclusively specimens from Tarija, Bolivia, because this is the only locality that provided statistically important and most complete juvenile jaws. We analyzed 34 mandibles, housed in various paleontological collections in the Americas and Europe. The age group of each individual was based on the deciduous tooth in use (dp2 to dp4) and its wear stage (Green & Hulbert, 2005). Each tooth wear class was then related to the age groups proposed for extant elephants (Laws, 1966). In order to recognize mandible development patterns, we compared relative change during growth of the mandibular depth measures in *C. hyodon* with that of the longirostrine gomphothere *Gomphotherium angustidens* and of the brevirostrine mammutid Mammut americanum (data from Tassy, 1996 and Green & Hulbert, 2005). The age classes recognized in our sample were from Juvenile 1 to 5 (J1-J5) of Green & Hulbert (2005), which includes individuals from 0.5 to 3.5 years.

Nine individuals securely bear lower tusk alveoli (LTA; Fig. 1) and only two had a portion of the LT preserved in situ. Differently from the upper permanent tusk, LT of *C. hyodon* are not twisted (Liendo, 1946). With exception of one fetal mandible, all studied *C. hyodon* mandibles from J1 on (0.5 year old) presented LTA. One-year-old individuals show

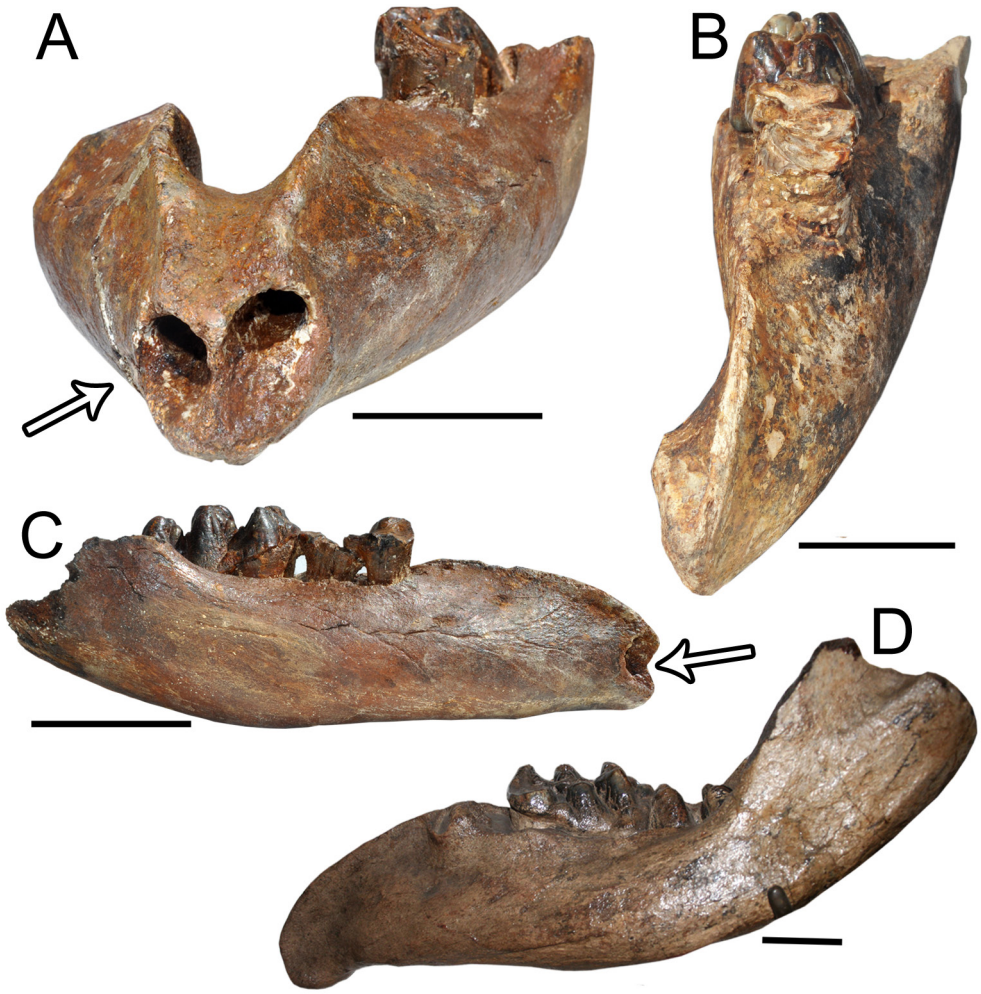

Fig. 1. *Cuvieronius hyodon* juvenile specimens from Tarija, Bolivia. **A**, Specimen MNPA-V 005888 with lower tusk alveoli; **B**, Specimen MNPA-V 92 without lower tusk alveoli; **C**, Same specimen of "A" in lateral view, with straight profile; **D**, Specimen TAR 806, with downturned profile. The arrows indicate the lower tusk alveoli. Scale bar = 5 cm.

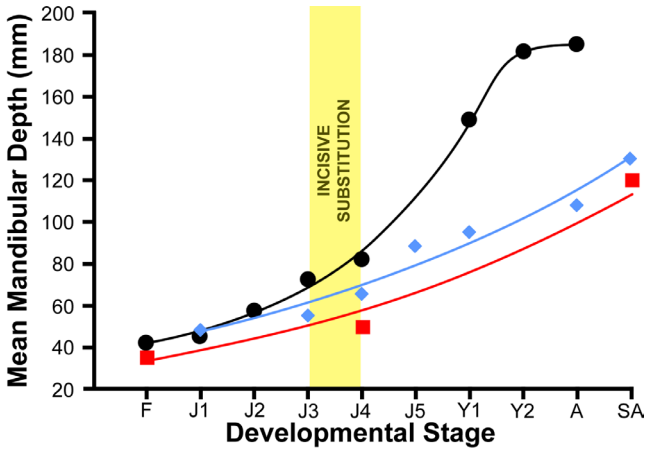

Fig. 2. Mean mandibular depth at posterior mental foramen for age classes of *Cuvieronius hyodon*, *Mammut americanum* (mean mandibular depth values from Green & Hulbert, 2005) and *Gomphotherium angustidens* (mean mandibular depth values from Tassy, 1996). *Cuvieronius hyodon* curve (blue line) and *G. angustidens* curve (red line) indicate a proportional growth from Juvenile to Adult classes, in contrast with *M. americanum* curve (black line), which presents an high increase between the Juvenile 4 and Adult classes. Graphic modified from Green & Hulbert (2005).

well-developed LTA (figure 1A), while all J3 and most of J4 but one, the oldest, lack LTA. Individuals from J5 on, with preserved symphysis, also lack LTA (Fig. 1B). Concluding, in *C. hyodon* the LT is reabsorbed, and LTA closes, at approximately one year of age (J4). A similar pattern was documented for *M. americanum* (Green & Hulbert, 2005).

A change in the lateral profile of the symphysis of *C. hyodon* is recognized during growth; It is straight in J1-4 (Fig. 1C), and the downturned profile, typical of most adults, appears from J5 on (Fig. 1D). An exception is specimen MNPA-V 005869, which groups with J4, but has a downturned symphysis profile, probably because of a delayed dental substitution.

Lack of LT is a derived feature among Gomphotheriidae (Shoshani, 1996) and it is commonly associated with brevirostry. In order to document the structural rearrangements related to the evolution of brevirostry among SAG, we compared the growth pattern of the mandible of *C. hyodon*, the only brevirostrine Gomphotheriidae possessing LT and lacking lower permanent tusks (LPT), with that of the longirostrine *G. angustidens* and the brevirostrine *M. americanum*. The three taxa show similar growth pattern at early developmental stages, from Fetus to J4 (Fig. 2). Since this latter stage on, the rate of growth of the mandibular depth in *M. americanum* markedly increases, producing a very deep mandible at adult stages. Conversely, the growth rate remains substantially constant in the two gomphothere taxa, untill adult size is reached. Interestingly, the time of more rapid mandibular growth observed in the American mastodon coincides with the LT substitution (Fig. 2), occurring around J4. This is possibly a result of a selective pressure caused by the presence of LPT associated with the brevirostrine (derived) condition in *M. americanum*, in which the roots of both LPT and permanent molariforms possibly compete for space in the mandible. On the contrary, in the longirostrine *G. angustidens*, the lower teeth roots do not compete for space (plesiomorphy). Although *M. americanum* and *C. hyodon* share brevirostry, they responded in a different way to this issue. *C. hyodon* responded in a distinct way to the same selective pressure, by repressing the development of LPT and the maintenance of a relatively shallow mandible. Thus, *C. hyodon* represents an important (intermediate) stage in Gomphotheriidae evolution in the Americas, and may provide clues about how the fully brevirostrine condition in *Notiomastodon* and *Stegomastodon* evolved from such longirostrine taxa as *Gomphotherium* and *Rhynchotherium*.

References

Ferretti, M.P., 2008. Enamel structure of *Cuvieronius hyodon* (Proboscidea, Gomphotheriidae) with a discussion on enamel evolution in elephantoids. Journal of Mammalian Evolution 15(1): 37-58.

Ferretti, M.P., 2010. Anatomy of *Haplomastodon chimborazi* (Mammalia, Proboscidea) from the late Pleistocene of Ecuador and its bearing on the phylogeny and systematics of South American gomphotheres. Geodiversitas 32(4): 663-721.

Green, J.L., Hulbert, Jr., R.C., 2005. The deciduous premolars of *Mammut americanum* (Mammalia, Proboscidea). Journal of Vertebrate Paleontology 25(3):702–715.

Laws, R.M., 1966. Age criteria for the African elephant, *Loxodonta africana*. African Journal of Ecology 4: 1–37.

Liendo Lazarte M. 1946. Algunas consideraciones sobre los mastodontes de Tarija. Editorial del Estado, La Paz.

Mothé, D., Avilla, L.S., Cozzuol, M., 2013. The South American Gomphotheres (Mammalia: Proboscidea): Taxonomy, Phylogeny, and Biogeography. Journal of Mammalian Evolution 20: 23-32.

Prado, J.L., Alberdi, M.T., 2008. A cladistic analysis among trilophodont gomphotheres (Mammalia, Proboscidea), with special attention to the South American genera. Palaeontology 51(4): 903–915

Shoshani, J., 1996. Para- or monophyly of the gomphotheres and their position within the Proboscidea. In: Shoshani, J.; Tassy, P. (Eds.) The Proboscidea: Evolution and Palaeoecology of Elephants and their Relatives. Oxford University Press, Oxford. 1996.

Tassy, P., 1996. Growth and sexual dimorphism among Miocene elephantoids: the example of *Gomphotherium angustidens*. In: Shoshani, J.; Tassy, P. (Eds.) The Proboscidea: Evolution and Palaeoecology of Elephants and their Relatives. Oxford University Press, Oxford. 1996.

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