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Geo(Im)pulse

The oldest beaver from the Netherlands

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Abstract

A lower molar of *Castor fiber* from the sandpit of Langenboom (the Netherlands) represents, so far, the oldest occurrence of a beaver in the North Sea Basin. Its presence in the marine sand deposit of the Langenboom Formation indicates that *Castor fiber* inhabited areas in or near the river systems of Rhine and Meuse in the Early Pliocene.

Keywords: *Castor fiber*, Castoridae, Langenboom, North Sea Basin, Oosterhout Formation, Pliocene

Introduction

Large quantities of vertebrate remains were recovered from the sand depots of the sandpit 'de Kuilen' in the village of Langenboom (municipality Mill en Sint Hubert, Noord Brabant, the Netherlands) during the last 15 years. The sand originates from the nearby deposits of the Breda and Oosterhout Formations, excavated for industrial purposes. In 2008, a single tooth of the beaver *Castor* was collected by the third author. A remarkable find of a land mammal fossil, since the majority of the vertebrate fossils are from either marine mammals or sea birds.

The geology and the stratigraphic position of the Mill sediments are described in Wijnker et al. (2008), based on in situ collecting in 2005 of dinoflagellate cysts and macrofossils (molluscs, bivalves, gastropods, shark and ray teeth and otoliths). Four lithostratigraphic units were distinguished: early-middle Tortonian (Unit A, Breda Fm.), Zanclean-Early Piacenzian (Unit B; Oosterhout Fm.) and Piacenzian (Unit C; Oosterhout Fm.) and the Quaternary Unit D. Unit B is interpreted as a single depositional sequence, with a transgressive base containing many reworked Miocene and Early Pliocene fossils. The top of Unit B also contains many reworked fossils. The bottom layers of this unit are interpreted as deposited near the storm wave base, the top layers are a mix of storm wave base and storm and fair weather base (Wijnker et al., p. 177). In earlier years, vertebrate remains were collected in situ from the base of Unit B: shark and ray teeth, bird bones, and many remains of marine mammals (whales, porpoises, true seals, and walruses). A molar of a deer was recovered one metre above the base of Unit B (described in De Vos & Wijnker, 2006). The colour of the recovered vertebrate fossils is black (marine mammals) or brown (birds) and the specimens are well preserved. Land mammals recovered (ex-situ) so far from the Langenboom sediments are mastodon, bear, pig, cow, rhinoceros, deer, tapir, horse, and possibly panther and antelope (De Vos & Wijnker, 2008; Noud Peters pers. comm.; Mol et al., 2011).

The stratigraphic position of the ex-situ vertebrate remains is uncertain, although the colour of the vertebrate remains could be indicative: the fossil rich layer from the base of Unit B contains black and dark brown remains, whereas at the top of Unit B a light brown coloured vertebra of a mysticete is known. The colour of most vertebrates found ex-situ is brown, which could indicate that their provenance is the top of Unit B (Wijnker et al., 2008).

This single beaver molar collected ex-situ in 2008 is black-brown of colour and heavily worn and is interpreted as originating from the base of Unit B.

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The dental nomenclature is according to Hugueney (1999). The measurements were taken with a Leitz Ortholux microscope; the pictures were taken with a Leica multifocus microscope.

Taxonomy

Rodentia Bowdich, 1821
Castoridae Hemprich, 1820
Castorinae Hemprich, 1820
Castor Linnaeus, 1758
Castor fiber Linnaeus, 1758
Synonym: *Castor praefiber* Depéret, 1897

Locality
Langenboom ex-situ.

Age
Early Pliocene.

Material and measurements:
- 1 lower molar m2 (sin); Fig. 1; collection number MAB 4600.
- Minimum length: 6.9 mm; minimum with: 6.7 mm; maximum height: 21 mm.
- Striae free area on the lingual side: 10 mm.
- The material is stored in the geological museum 'Oertijdmuseum de Groene Poort' in Boxtel, the Netherlands.

Description

The molar is damaged, especially at the labial and lingual top. The enamel layer is on the lingual side thin and pitted, and covered with cement on a few small areas. The, slightly undulating, base of the enamel is present at the lowermost part of the molar. The roots are not preserved, but small remnants of the labial roots are still visible. Small wear facets on the anterior and posterior sides indicate the contact with an anterior and a posterior tooth. The anterior wear facet is almost as wide as the tooth, the posterior wear facet is half the width size and positioned on the lingual part of the molar.

The occlusal surface of the molar is slightly longer than wide, the labial and lingual edges are abraded, quite strongly on the lingual side. The hypoflexid is posteriorly directed, with a transversal orientation at its lingual part. It does not exceed the midline. The hypoflexid is strong on the topside of the tooth, downwards it diminishes in depth. It is filled with cement. The paraflexid is transverse and bended forwards at its labial part. The mesoflexid and metaflexid are transverse. The lingual side of the tooth is almost without striae, the mesoflexid and metaflexid are closed on their lingual part just below the occlusal surface, and thus the mesostriid and metastriid are only present at the top part of the tooth. The paraflexid descends into the parastriid, which is only 5 mm deep.

Fig. 1. Castor fiber from Langenboom, m2 sin: a. Occlusal view; b. Labial view; c. Lingual view (coll. nr. MAB 4600).

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Discussion and conclusions

Identification as an m2 is based on the size and position of the wear facets on the anterior and posterior side of the molar. These are interpreted as the contact areas with the m1 on the anterior side and with the narrower m3 on its posterior side respectively. The morphology of the occlusal surface is as in *Castor fiber* specimens; however the lack of striae on the lingual side of the tooth is considered to be atypical for *Castor*.

Variability in size of beaver molars is largely due to differences in stage of wear, in stage of ontogeny, and due to influence of climate (Schreuder, 1929; Mayhew, 1978a; Stefen, 1997; Stefen & Mörs, 2008). In *Castor fiber* the growth of the molars is constant during the first 4 years, after that only a little size increase occurs. The presence of roots is indicative of an individual at least older than about 4 years (Stefen, 2009). The amount of cement on the lowermost part of the molar increases in age strongly and age determination of the individual can be made by the counting of annual cement layers (Klevezal, 1996). Variation in the length of the striae is known to occur in *Castor* molars (e.a. Stirton, 1935; Kretzoi, 1977; Mayhew, 1978a; Van de Weerd, 1978; Heinrich, 1991; Stefen, 2005). Kretzoi (1977), and later Heinrich (1989), argue that the distance between the base of the molar and the base of the striae changes through time (especially in the p4), and could be used to indicate relative age (Maul 2009). However, the absence or length of these striae and absence or presence of roots is also dependent on stage of ontogeny (Stefen, 2009). Moreover, it cannot be excluded that size and morphology are influenced by climate and/or location. Such variations are known in recent and Pleistocene mammals and are known to occur in the living Eurasian and North American beavers (Mayhew & et al., 2008).

Depéret (1897) described *Castor praefiber* from a Pliocene fauna from Roussillon (France). Schreuder (1928) argues that the bones and skull assigned to this new species represent at least two species: the bones a small *Trogontherium* species and the skull *Castor fiber*. Also Van de Weerd (1978) doubts the validity of *C. praefiber* since the variation in *C. fiber* teeth is large and morphological criteria are absent to distinguish these two species.

Dahlmann (2001) allocates a small collection of castor molars from Wölfersheim (Germany) to *C. praefiber* based on the smaller sizes, the flat occlusal surfaces and the roughened enamel in comparison to *C. fiber*. Barisone et al. (2006) use the presence of pronounced roots and the absence of striae on the lowermost part of the molar as argument to place the Wölfersheim specimens in *Castor praefiber* and not in *Castor fiber*. Although the means of the length and width are lower than in extant ones, the measurements do fall within the range of extant *Castor fiber* molars (Stefen, 2009), and as is discussed above, also in *Castor fiber* molars striae free areas are common. Concluding, the variation in size and in morphology does not support a differentiation into two species. Therefore we consider *Castor praefiber* as a junior synonym of *Castor fiber*, and only one fossil *Castor* species was present in Europe from the Late Miocene upwards.

The damage seen on this *Castor fiber* molar is not due to mastication and is probably caused by transport. Either the molar is transported by river or it is from older (Miocene) deposits, which were reworked during the sea level fluctuations at the latest Miocene. In both cases, the area of origin of the beaver is upriver; either Meuse or Rhine. The drainage area of these rivers is large and covers southwestern Germany, northern Switzerland, the northeastern tip of France and eastern Belgium.

Late Miocene beaver remains are unknown from this area, Early Pliocene beaver remains are only known from Wölfersheim (Germany; *Castor fiber* and two *Trogontherium* species; Dahlmann, 2001). Geologically younger beaver remains are described from Hambach 11 (Germany, Late Pliocene with *C. fiber* and *T. minus*; Mörs, 2002) and Tegelen (the Netherlands, Early Pleistocene with *C. fiber* and *T. minus* Schreuder, 1929, Mayhew 1978b). Late Pleistocene and Holocene beavers are known from many localities.

Both *Castor* and *Trogontherium* lived in riparian environments, but *Trogontherium* inhabited areas with very slow flowing rivers or still waters, whereas *Castor* prefers the more dynamic riverine environment. At the end of the Miocene and in the Pliocene the climate was warm and humid, with suitable areas in or near the river systems of Rhine and Meuse for *Castor* and *Trogontherium* to inhabit. In contrast to *Castor*, *Trogontherium* did not fell trees; it fed probably on herbaceous vegetation and therefore was more depended on a stable and warm climate (Frieling in prep.). The generation of a stronger continental climate in the Pliocene, with arid conditions and lower annual mean temperatures (Fortelius et al., 2002), probably reduced the number of rivers and lakes and thus diminished the habitats of *Trogontherium*. The last occurrences of *Trogontherium* are reported from the Late Middle Pleistocene of Europe (Mayhew et al., 2008). In the future, we expect *Trogontherium* remains to be uncovered in Langenboom sediments.

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