Eucyon sp. (Mammalia, Carnivora, Canidae, Caninae), an early dog from Mill-Langenboom, The Netherlands

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Fossil remains of terrestrial mammals were frequently collected in sandpit 'De Kuilen' in Mill-Langenboom (The Netherlands) during the past decades. Recently a carnassial of a fossil canid was discovered in the collection of one of the many private collectors that used to visit the sandpit. Provisionally the tooth was identified as a 'wolf-like' canid, but in a more elaborate and comparative study it turned out to be a more primitive dog belonging to the yet rather poorly known genus *Eucyon*. This carnassial from Mill-Langenboom documents for the first time a representative of this genus in the Netherlands and NW Europe. It also might be one of the latest occurrences anticipating the extinction of early dogs of this genus in the Late Pliocene.

Key words: extinct dogs, *Eucyon,* Canini, Pliocene, De Kuilen

Introduction

Although scanty and sometimes problematic, remains of early dogs (Tribe Canini, family Canidae, subfamily Caninae) in the Late Miocene and Pliocene Old World fossil record are important evidence of a diverse taxonomy within the tribe in the Mio-Pliocene of Eurasia and Africa (Tedford & Qiu, 1996; Rook, 2009; Werdelin & Peigné, 2010). On the other hand, the occurrence of the Tribe Canini in the Hemphillian (Mio-Pliocene) of North America has been long known (Tedford *et al*., 2009).
The *Eucyon* Old World fossil documentation allows the recognition of different *Eucyon* species, although deeper analyses are still needed to understand the full pattern of *Eucyon* relationships and its evolutionary history across North America and the Old World (Rook, 2009).
Here we report on a lower carnassial of a dog that was collected in a sandpit at Mill-Langenboom in the southern part of the Netherlands. Over the last ten years sandpit 'De Kuilen' has yielded abundant fossil remains of terrestrial mammals. Many of these were described in several contributions in Cainozoic Research as well as in Netherlands Journal of Geosciences (de Vos & Wijnker, 2006; Mol *et al*., 2011; Peters & de Vos, 2012, 2013; Wessels *et al*., 2012).
But since many collectors were involved in the year-long search for fossils in 'De Kuilen' from time to time new discoveries turn up in existing collections. Recently in one of these as yet unexplored 'stockpiles', owned by François van Wessel (Tegelen, The Netherlands) a dog's molar was discovered and brought to our attention.
Supposed to represent a Villafranchian *Canis* species it was presented for a comparison with the rich Italian canid fossil record in the collections of the Museo di Storia Naturale (Sezione di Geología e Paleontología) of the University of Firenze (Italy).
Detailed morphological comparison revealed, however, that the specimen represents the first occurrence of the primitive dog genus *Eucyon* in the Netherlands. The specimen might represent one of the youngest records of *Eucyon* in Eurasia, and the northernmost occurrence of the genus in Europe. At present we cannot rule out the possibility that the specimen belongs to the older (Late Miocene) faunal complex represented in the Mill-Langenboom sediments as well (Wijnker *et al*. 2008).

Systematic paleontology

Order Carnivora Bowdich, 1821
Suborder Caniformia Kretzoi, 1943
Family Canidae Fischer von Waldheim, 1817
Subfamily Caninae Fischer von Waldheim, 1817
Tribe Canini Fischer von Waldheim, 1817
Genus *Eucyon* Tedford & Qiu, 1996

***Eucyon* sp.**
Figure 1a-c

Material examined – A single, well-preserved, right low-

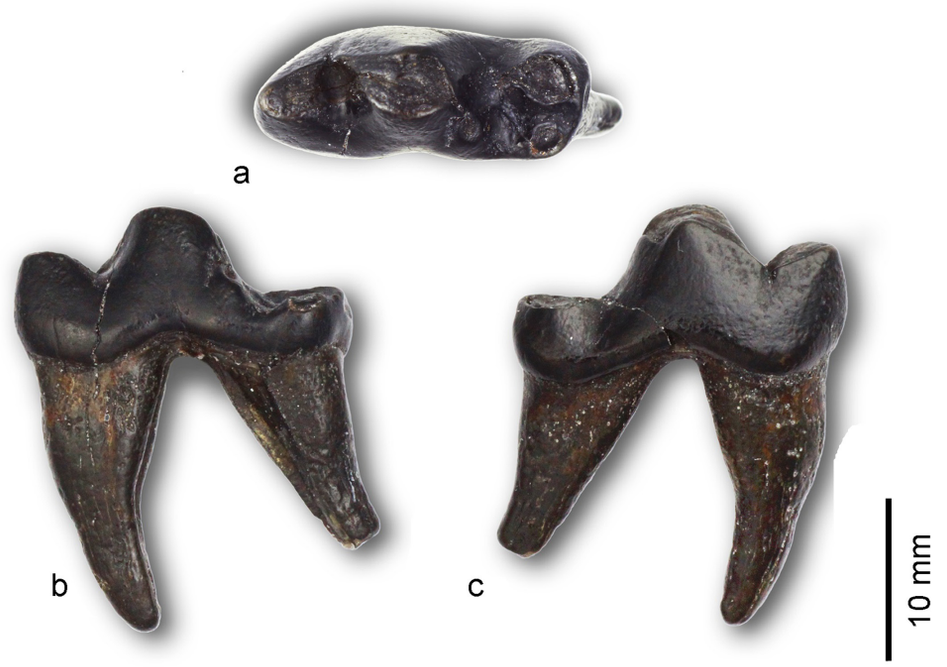

Figure 1. *Eucyon* sp.; right lower m1 (MAB 004703) from Mill-Langenboom; a: occlusal view, b: lingual, c: labial views. Photo Barry van Bakel.

er m1, F. van Wessel collection, Tegelen, The Netherlands (Fig. 1); a cast is in Oertijdmuseum De Groene Poort, Boxtel, registration number MAB 004703.

Locality and biochronologic position – The fossil tooth was found in sediment excavated at the Mill-Langenboom sandpit 'De Kuilen' (province of Noord-Brabant, The Netherlands) in 2006. Most of the terrestrial fossils from this sandpit indicate a mammal fauna of middle Villafranchian age. The presence of some taxa (such as chalicothere and *Hipparion*) makes it plausible that also elements of Late Miocene age are documented in de Mill-Langenboom sediments.

Description – The lower carnassial specified above is relatively large in absolute dimensions: length 19,0 mm, breadth 7,7 mm and maximum crown height 6,0 mm. It shows a quite advanced stage of wear, with dentine exposed on all cusps (Fig. 1). The specimen shows a considerably slanting anterior edge of the paraconid.
The metaconid, albeit relatively small, is well-developed. The talonid is short and narrow, characterised by a simple morphology. The main cuspids of the talonid (the hypoconid and the entoconid) are well-preserved, not connected by transverse cristids. The hypoconid is large and dominant, its ridge is positioned mesio-frontally from the tip. The entoconid is much smaller, positioned on the lingual periphery of the talonid and its ridges are somewhat oblique with respect to the tooth axial direction. There is no occurrence of an hypoconulid cuspid at the distal border of the talonid. (Fig. 2).

Comparisons – The present specimen matches closely

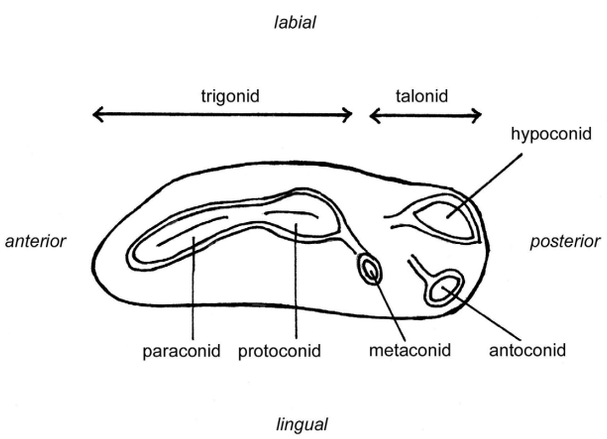

Figure 2. Diagnostic features of the occlusal surface of carnassial MAB 004703.

the accumulated data on the zoogeography and morphology of the Late Miocene and Early Pliocene representatives of the Tribe Canini, and specifically with the genus *Eucyon*, erected by Tedford & Qiu (1996) for some primitive *Canis*-like forms.
The generic identification of this tooth is based on the m1 diagnostic feature that allows to include it within the genus *Eucyon*: the lack of the transversal cristids connecting the hypoconid and entoconid. This feature is rather evident, and allows a reliable separation of early and relatively small *Canis* from *Eucyon*. The slanting of the anterior edge of the paraconid in canids may show some individual variation, but generally it is a significant feature with taxonomic value at the specific and even generic levels (in *Canis* the slanting of the edge is an apo-

morphy of derived forms).

Compared with other representatives of the genus the present specimen is among the larger of the genus, close to the higher limits of the 95% confidence ellipse in the plotted data of the *Eucyon* sample (lumping the latest Miocene-Pliocene species of the genus) in Fig. 3. It is still considerably smaller than the classical Late Villafranchian species such as *Canis arnensis* Forsyth Major 1877, *Canis etruscus* Del Campana 1913 and *Xenocyon* (=*Lycaon* for some authors) *falconeri* Forsyth Major 1877. Dimensions are no chronological discriminants among Late Miocene and Pliocene species. Among the largest individuals of our comparative *Eucyon*-sample are specimens from Brisighella (latest Messinian, Italy) as well as specimens from Beregovaia (Middle Villafranchian, Mongolia).

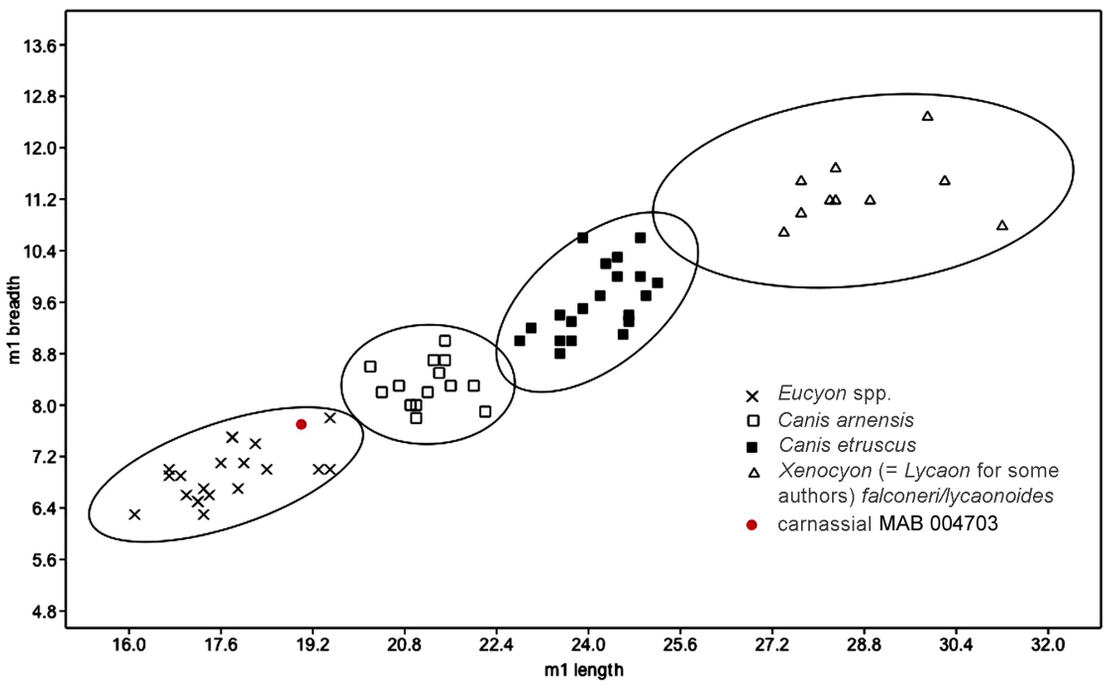

Figure 3. Bivariate plot (mm) of lower m1 length versus breadth (95% confidence ellipse) in several species of Late Miocene to Pleistocene Canidae.

Statistics (including plot) have been performed using Past (version 3.04), a free software for scientific data analysis developed by Øyvind Hammer (University of Oslo) and available for download at http://folk.uio.no/ohammer/past.

Discussion – The genus *Eucyon* Tedford & Qiu, 1996 is the earliest advanced member of the Tribe Canini - first occurring in the Clarendonian (Late Miocene; 12-9 Ma) of North America (Tedford & Qiu, 1996; Wang & Tedford, 2008). Having a jackal-like size, *Eucyon* is clearly distinguished from the Tribe Vulpini (Tedford & Qiu, 1996).

An analysis of the taxonomy and distribution of the Mio–Pliocene and Pleistocene *Eucyon*-like and *Canis*-like canids of the Tribe Canini of Eurasia was performed by Sotnikova & Rook (2010) , with a description of several fossils from the Late Miocene and Early Pliocene of Asia. The changes in the assemblages of the Canini generally coincided with the most significant Eurasian faunal turnovers, but the European and Asian diversities of the Canini peaked asynchronously. In the Late Miocene, an expansion of the genus *Eucyon* to the Old World took place, indicated as the '*Eucyon* event'. This event is part of the event that in the Late Miocene let a number of taxa disperse from North America towards Asia and the Old World and vice versa (Tedford *et al*., 1991; Qiu, 2003; Wang & Tedford, 2008).

While *Eucyon* did not survive the late Hemphillian in North America (5-6 Ma) where it gave rise to the first representative of *Canis* (Wang & Tedford, 2007, 2008) the genus reached a relatively high diversity during the Pliocene in Eurasia, surviving until the very Late Pliocene in China, Tadzhikistan, Kazakhstan, and southeastern Mediterranean regions (Spassov & Rook, 2006; Sotnikova & Rook, 2010). The wolf-sized species of the *Canis* group made their first appearance in Eurasia during the Late Pliocene (Wang & Tedford, 2007, 2008). The peak of their diversity occurred in Europe at the beginning of the early Pleistocene (the so-called '*Canis* event' Rook & Torre, 1996; Rook & Martínez-Navarro, 2010). For the timing of the '*Canis*-event' see also Lacombat *et al*. (2008) and van der Made *et al*. (2014). At the end of the Pliocene, *Eucyon* and *Eucyon*-like canids went extinct in Eurasia.

The *Eucyon*-specimen from Mill-Langenboom presented herein completes this scenario by extending the geographic range of the genus during the Late Pliocene (Middle Villafranchian) in northern Europe, albeit that at present we cannot rule out the possibility that the specimen belongs to the older (Late Miocene) faunal complex docu-

mented in the Mill-Langenboom sediments as well. In that scenario the Mill-Langenboom specimen would represent evidence for a very early dispersal of *Eucyon* to northern Europe.

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