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The Pleistocene and Holocene Mammalian assemblages from the Maasvlakte near Rotterdam (the Netherlands), with special reference to the Ovibovini *Soergelia minor* and *Praeovibos* cf. *priscus*

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The Maasvlakte is an artificially created area on the North Sea coast near Rotterdam. The suction-dredged sediments used to create the area, yielded a variety of mammalian remains. The late mr N.C. Kerkhoff and mrs A. Kerkhoff-van Grondelle have collected more than five thousand identifiable mammalian fossils on the Maasvlakte. Analyses of their collection showed that the Maasvlakte assemblage could be divided into at least four different faunas. Fauna 0, a small fauna with an Early Pleistocene age; Fauna I, late Early- to early Middle Pleistocene in age; Fauna II from the Late Pleistocene (Eemian? and Weichselian) and Fauna III with a Holocene age. Among the fossil remains there are remarkable specimens from species that are rare in the Pleistocene fossil record for example *Soergelia minor* and *Praeovibos* cf. *priscus*. Molars of these two species are described and figured in this paper.

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INTRODUCTION

In a country like The Netherlands there are not so many outcrops where one gets easily access to fossiliferous Pleistocene deposits with the possibility to collect mammalian remains. There are for example a few sand- and gravel pits in ice-pushed ridges in the central and eastern part of The Netherlands and in terraces along the river Maas in the south-eastern part of the country. The Pleistocene deposits in the western part of the

country are covered by up to about 20 metres of Holocene deposits. Dredging is one of the ways to get access to these deposits and the fossils in these layers. Many Pleistocene fossils are collected in this way in The Netherlands, in particular along the main rivers where commercial dredging of sand and gravels takes place. This also happened in the area west/south-west of Rotterdam (Fig. 1) where an artificial area on the North



Figure 1 Location of the Maasvlakte in the Netherlands.

Sea coast has been created in order to extend the Rotterdam harbour area. The sediments used were suction-dredged from a depth of up to 40 metres from areas south and east of the Maasvlakte. Non-professional paleontologists such as the late mr N.C. (Niek) Kerkhoff and mrs A. Kerkhoff-van Grondelle have collected thousands of mammalian fossils from these sediments during the past decades. They created one of the best collections with more than five thousand identified and registered specimens. The fossils were found along the coastline (Fig. 2), washed out of the sediments by waves and tides. The preservation of the material demonstrates that it originates from the suction-dredged Maasvlakte sediments and that it has not been washed ashore from some remote North Sea localities. The fossil remains in the Kerkhoff collection represent a variety of species, smaller as well as larger mammals and even marine mammals. The fossils differ in geological age and are subdivided into four different assemblages. An overview of the different assemblages is presented in this paper. Among the thousands of Maasvlakte fossils in the Kerkhoff collection there are several remarkable specimens from species

that are rare in the Pleistocene fossil record, for example the remains of *Soergelia minor* and *Praeovibos cf. priscus*. Both species are described in more detail in this paper.

THE FAUNAL ASSEMBLAGES FROM THE MAASVLAKTE

The Maasvlakte faunal collection consists of remains of reptiles, fishes, birds and small and large mammals. The material is very well preserved and indicates that hardly any re-working of the material took place before deposition on the Maasvlakte. Most of the material is fragmentary, caused by the way in which the fossiliferous sediments were obtained and transported to the Maasvlakte. The fossils show a large variation in the degree of mineralisation. Based on this and on the stratigraphical range and paleoecological indications of the species, the Maasvlakte mammalian assemblage can be subdivided into four groups which are presumed to represent at least four different faunas.

Fauna 0

The oldest fossil mammalian remains found on the Maasvlakte are from species referred to Fauna 0 and Fauna I (Tables 1 and 2). The material has been assigned to this assemblage because of its relatively high degree of mineralisation and/or based on the species identification. In previous papers on the Maasvlakte mammalian fauna (Van Kolfschoten & Van der Meulen 1986; Vervoort-Kerkhoff & Van Kolfschoten 1988) it has been assumed that the oldest remains represent a single fauna (Fauna I). However, further research indicated that we do not deal with a single late Early or early Middle Pleistocene assemblage but also with a few remains which must be much older, for instance the molars assigned to *Mimomys reidi* and to *Mimomys tigliensis*. A detailed study of the fossil deer remains by dr Adrian Lister also revealed indications of the presence of *Alces cf. gallicus*, *Eucladoceros* sp. and a small cervid in the size category of *Cervus thenanus*. Early Pleistocene species that are



Figure 2 Searching for fossils along the tide-line by Mr N.C. Kerkhoff and Mrs Y. Vervoort-Kerkhoff.
[Photo: Th. van Kolfshoten]

supposed to be older than Maasvlakte Fauna I with species such as *Alces latifrons* and early *Megaloceros* species (Lister & Van Kolfshoten in prep.).

Fauna I

Fauna I consists of species that are restricted to the Early or early Middle Pleistocene. The extinct water vole *Mimomys savini* and the extinct beaver *Trogontherium cuvieri* dominate the Rodentia. The *Mimomys savini* molars are rooted, hypsodont and do not show primitive characters such as a *Mimomys*-islet and a *Mimomys*-ridge. Based on the dimensions of the *Trogontherium cuvieri* incisors and features of the upper M3 and the lower p4 it can be stated that the evolutionary stage of the *Trogontherium* from the Maasvlakte is intermediate between those of the *Trogontherium* from Tegelen and Mosbach (Vervoort-Kerkhoff & Van Kolfshoten 1988). The

same applies to the remains of the extinct bear *Ursus* aff. *deningeri*. Comparison of the bear molars from the Maasvlakte with those from Tegelen shows that those from the Maasvlakte are more complex than the ones from Tegelen, identified as *Ursus etruscus* by Newton (1913). The molars from Mosbach (main fauna), identified as *U. deningeri* have more accessory tubercles than those from the Maasvlakte. It is therefore concluded that the bear material from the Maasvlakte is of an intermediate age between that from Tegelen and that from the main fauna of Mosbach. Other remarkable carnivores are the clawless otter *Aonyx antiqua* (see Van Bree *et al.* this volume, also for a nomenclatural remark) and the lynx *Lynx lynx*. The *Aonyx antiqua* mandibula from the Maasvlakte is assigned to Fauna I on the basis of the state of preservation of the fossil. Willemsen (1992), however, questions the age since 'all the remains of

Table I The small mammal species of the Kerkhoff collection divided into the four faunal assemblages of the Maasvlakte as defined in this paper:

small mammals	Fauna			
	0	I	II	III
<i>Erinaeus europaeus</i>				+
<i>Sorex araneus</i>				+
<i>Sorex (Drepanosorex) spec.</i>	?	+		
<i>Neomys fodiens</i>				+
<i>Petenya hungarica</i>	?	+		
<i>Desmana thermalis</i>	?	+		
<i>Galemys spec.</i>	?	+		
<i>Talpa europaea</i>				+
<i>Lepus europaeus</i>				+
<i>Castor fiber</i>				+
<i>Trogontherium cuvieri</i>		+		
<i>Spermophilus cf. undulatus</i>			+	
<i>Clethrionomys glareolus</i>				+
<i>Arvicola terrestris</i>				+
<i>Mimomys reidi</i>	+			
<i>Mimomys tigliensis</i>	+			
<i>Mimomys savini</i>		+		
<i>Mimomys spec. (small species)</i>		+		
<i>Microtus oeconomus</i>				+
<i>Microtus arvalis</i>				+
<i>Microtus agrestis</i>				+
<i>Apodemus sylvaticus</i>				+
<i>Micromys minutus</i>				+

this species from other sites can be referred to an interval which includes the late Holsteinian to the Eemian or the early Weichselian'.

Dicero rhinus etruscus brachycephalus (the extinct rhinoceros) is well represented in the fauna. The dimensions of the molars, e.g. the hypsodonty, are comparable to those of the molars of *D. etruscus brachycephalus* described by Guérin (1980). The hippopotamus remains indicate that we are dealing with a large hippopotamus. Because of their dimensions the fossils are assigned to *Hippopotamus antiquus* and not to the younger *Hippopotamus incognitus* known from many Eemian localities in England. Some of the fossil molars from the Maasvlakte identified as belonging

to the Suidae have, compared to the modern *Sus scrofa*, a simple enamel pattern; they have less accessory tubercles. The molars are more advanced than the molars of *Sus strozzi* from Tegelen which have less accessory tubercles. Some molars from Mosbach have more accessory tubercles than the Suidae molars from the Maasvlakte. The Cervidae are well represented in Fauna I with at least four different species: early giant deer cf. *Megaloceros verticornis* and possible other *Megaloceros* species, fallow deer *Dama dama*, red deer *Cervus elaphus* and extinct elk *Alces latifrons* (Lister & Van Kolfschoten in prep.). *Soergelia minor* and *Praeovibos cf. priscus* are the two bovids assigned to Fauna I.

Table 2 The large mammal species of the Kerkhoff collection divided into the four faunal assemblages of the Maasvlakte as defined in this paper

large mammals	Fauna			
	0	I	II	III
<i>Homo sapiens</i>				+
<i>Canis lupus familiaris</i>				+
<i>Ursus</i> aff. <i>deningeri</i>		+		
<i>Putorius putorius</i>				+
<i>Martes martes</i>				+
<i>Lutra lutra</i>				+
<i>Acynx antiqua</i>		+		
<i>Crocuta crocuta spelaea</i>			+	
<i>Felis sylvestris</i>				+
<i>Panthera leo spelaea</i>			+	
<i>Lynx lynx</i>		+		
<i>Mammuthus primigenius</i>			+	
<i>Archidiskodon meridionalis</i>		+		
<i>Palaeoloxodon antiquus</i>			+	
<i>Equus</i> sp.		+	+	+
<i>Dicerorhinus euriscus brachycephalus</i>		+		
<i>Coelodonta antiquitatis</i>			+	
<i>Sus scrofa</i>				+
<i>Sus scrofa</i> cf. <i>mosbachensis</i>		+		
<i>Hippopotamus antiquus</i>		+		
<i>Eucladoceros</i> sp.	+			
cf. <i>Megaloceros verticorais</i>		+		
<i>Megaloceros</i> sp.		+		
<i>Megaloceros giganteus</i>			+	
<i>Dama dama</i>		+	+	
<i>Cervus elaphus</i>		+	+	+
<i>Cervus</i> sp.	+			
<i>Alces</i> cf. <i>gallicus</i>	+			
<i>Alces latifrons</i>		+		
<i>Alces alces</i>			+	+
<i>Rangifer tarandus</i>			+	
<i>Capreolus capreolus</i>				+
<i>Sorpegia minor</i>		+		
<i>Bos taurus</i>				+
<i>Bos primigenius</i>			+	+
<i>Bison priscus</i>			+	
<i>Praecvibos</i> cf. <i>priscus</i>		+		
<i>Capra hircus</i>				+
<i>Ovis aries</i>				+

STRATIGRAPHICAL POSITION OF THE MAASVLAKTE FAUNAS 0 AND I

It is not easy to detect the stratigraphical age of the Maasvlakte faunal assemblages because the fossils are not found *in situ*, but in mixed suction-dredged sediments. Analysis of the geological setting of the area where the Maasvlakte sediments have been dredged led to useful indications of the age of the fossil remains. Important information has been obtained from the Zuurland boreholes close to that area; boreholes with a depth of up to 107 metres. Mr L.W. Hordijk, who made these boreholes (Hordijk 1988; Reumer & Hordijk this volume), found several fossiliferous layers with an Early Pleistocene to Holocene age (Van Kolfschoten 1988; Hordijk 1988). The lowermost layer (Fig. 3) yielded a fauna with *Mimomys praepliocaenicus*; the fauna is tentatively correlated with the early Tiglian (Fig. 3). The level between –63 to –66 metres has yielded a rich fauna with different species of the genus *Mimomys*: *M. pliocaenicus*, *M. reidi*, *M. tigliensis*, *M. hordijki* and *M. pitymyoides* (Van Kolfschoten & Tesakov 1998). The height of the dentine tracts of the *M. pliocaenicus* molars hardly differs from that of the specimens from the Tegelen stratotype suggesting that both faunas are almost similar in age (Tesakov 1998). The deposits between –52 to –56 metres and between –42 to –46 metres are also rich in mammalian remains; both faunas, which probably hardly differ in age (Van Kolfschoten 1998) are characterised by the primitive *Allophaiomys deucalion*, the predecessor of *Allophaiomys pliocaenicus*, a species which is known from many Early Pleistocene localities. The *Allophaiomys deucalion* faunas are supposed to be only slightly younger than the fauna from Tegelen with a late Tiglian (TC-5) age (Van Kolfschoten 1998).

The complete absence of *Allophaiomys* in the Maasvlakte fauna indicates that the Maasvlakte sediments have been dredged up from levels above –42 metres, the uppermost

boundary of the *Allophaiomys* faunas. The smaller mammals assigned to Maasvlakte Fauna I correspond in many aspects with the fauna from Zuurland level –28 to –36 with a late Early Pleistocene (Bavelian) or early Middle Pleistocene (early Cromerian) age (Vervoort-Kerkhoff & Van Kolfschoten 1988). In both faunas a small *Mimomys*-species and the advanced larger *Mimomys savini* are present and *Allophaiomys* is absent. Most of the large mammals of Fauna I have an evolutionary stage in between the Early Pleistocene (Tiglian) mammals from Tegelen and the Middle Pleistocene (Late Cromerian) ones from Mosbach. The presence of e.g. *Hippopotamus antiquus* indicates that Fauna I dates from an interglacial phase just before or after the transition of the Early to the Middle Pleistocene. Fauna I has an age which is most probably comparable to that of faunas such as Untermaßfeld (Germany) (Kahlke 1997). The remains assigned to Maasvlakte Fauna 0 most probably are derived from the stratigraphical hiatus between the late Tiglian/early Eburonian *Allophaiomys* level and the Bavelian/early Cromerian.

Fauna II

The faunal assemblage assigned to Maasvlakte Fauna II (Tables 1 and 2) is based on fossil remains that are generally speaking less mineralised than those referred to Maasvlakte Fauna I. The assemblage is composed of species (e.g. *Mammuthus primigenius*, *Coelodonta antiquitatis*, *Megaloceros giganteus*, *Rangifer tarandus*) that indicate 'glacial' conditions and a 'Mammoth Steppe' environment. The species are known to have occurred in north-western Europe during the late Middle and Late Pleistocene; remains of these species are frequently found in the Netherlands. They can be collected from the Pleistocene sands and gravels dredged up along the main rivers (Rhine, IJssel, Waal and Maas). The species are also known from the Brown Bank area in the North Sea, about 50 miles north-west of the Maasvlakte, where Late Pleistocene de-

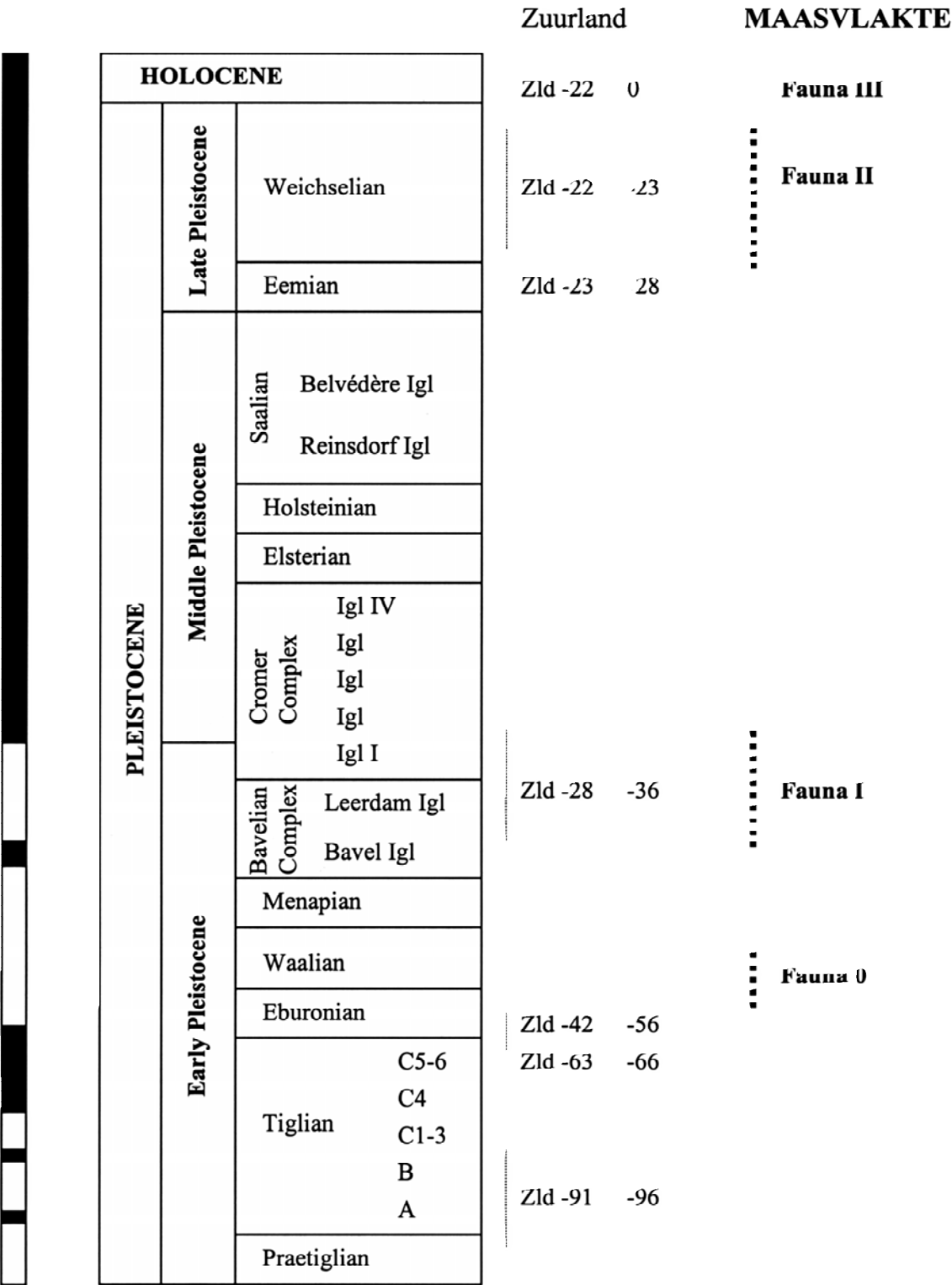


Figure 3 Stratigraphical position of the Maasvlakte faunas related to the Dutch chronostratigraphic subdivision of the Quaternary and the paleomagnetic scale.

posits come to the surface of the bottom of the North Sea (Van Kolfschoten & Laban 1995). Apart from the 'cold stage' elements of the Maasvlakte Fauna II there are also remains of the straight-tusked elephant *Palaeoloxodon antiquus* and the fallow deer *Dama dama* that are assigned to the same assemblage. These remains might date from a warmer episode in the time range covered by the Maasvlakte Fauna II assemblage.

Fauna III

Most of the specimens collected on the Maasvlakte are from species assigned to Fauna III. The material is only slightly mineralised; most of the bones have a light brown colour. The smaller mammal fauna is mainly composed of species that also occur in the Netherlands nowadays. Beavers have recently been re-introduced in the Netherlands. The species is, however, just as for instance the otter, well represented in early Holocene faunas like the late Mesolithic – early Neolithic fauna from Hardinxveld/Polderweg. Domesticated animals are well represented in the fauna, in particular cattle. Many bones show cut-marks or are fragmented. Various types of bone-artefacts have been collected such as a fishhook, more than 20 harpoons, a comb made out of bone, and a flute.

Marine mammals

The fossil mammalian assemblage from the Maasvlakte also contains remains of different

marine mammal species (Table 3). Most of the remains probably date from the Holocene; their degree of mineralisation is comparable to that of the remains assigned to Fauna III. Only the fossils of the narwhal *Monodon monoceros* show a rather advanced degree of mineralisation and are, according to Van Bree & Bosscha Erdbrink (1987), possibly of late Eemian age.

SOERGELIA MINOR AND PRAEOVIBOS CF. PRISCUS

Among the thousands of Maasvlakte fossils in the Kerkhoff collection there are several remarkable specimens from species that are rare in the Pleistocene fossil record, for example the remains of the extinct bear *Ursus* aff. *deningeri* and the *Aonyx antiqua* mandibula. In addition there are, among the bovidae remains, at least two molars with a different morphology: one molar is assigned to *Soergelia minor*, the other to *Praeovibos* cf. *priscus*. Both species belong to the tribe Ovibovini, musk oxen in a broad sense with high-horned members (*alticornis*) and low-horned members (*depressicornis*; McDonald *et al.* 1991). The 'depressicornis' subtribe contains three genera: *Ovibos* and *Praeovibos* with a Palearctic distribution and *Bootherium*, which is restricted to North America. The Musk Ox s.s. *Ovibos moschatus* is well known and is found in several Middle and Late Pleistocene faunas including Maasvlakte Fauna II (Kerkhoff &

Table 3 The marine mammal species of the Kerkhoff collection all assigned to Fauna III as defined in this paper.

marine mammals	Fauna			
	0	I	II	III
<i>Monodon monoceros</i>				+
<i>Delphinus delphis</i>				+
<i>Tursiops truncatus</i>				+
<i>Phocoena phocoena</i>				+
<i>Phoca (Pusa) hispida</i>				+
<i>Phoca vitulina</i>				+
<i>Halichoerus grypus</i>				+

Mol 1991). The genus *Praeovibos* with three species (*Praeovibos priscus*, *P. recticornis* and *P. beringiensis*) is less well-known. Most of the *Praeovibos* remains in the European fossil record date from the Middle Pleistocene (Crégut-Bonnoure 1984; McDonald *et al.* 1991) and are assigned to the ‘Giant Musk Ox’ *Praeovibos priscus* that was larger in size than the modern species and had longer and less massive limb bones (Kurtén 1968, see also Mol *et al.* this volume).

The high-horned ‘*alticornis*’ subtribe, to which the genus *Soergelia* belongs, is very rare, particularly in the European fossil record. From Middle Pleistocene deposits at a few localities in Central and Eastern Europe we know the species *Soergelia elisabethae* and so far from only one locality in Spain (Venta Micena), and from the Maasvlakte we know the species *Soergelia minor*.

Fam. Bovidae GRAY, 1821

Subfam. Caprinae GILL, 1872

Tribe Ovibovini SIMPSON, 1945

Genus *Soergelia* SCHAUB, 1951

***Soergelia minor* MOYÀ-SOLÀ, 1987**

Material: m3 dext. (RM 4491) (Fig. 4)

Measurements: length 35.20 mm; width (max.) 13.76 mm

Description and remarks: The molar is little worn and almost complete, only the anterior base of the crown and the lingual upper part of the anterior lobe are broken off. The lingual side of the molar is, compared to lower molars of bovids, rather flat due to the fact that metaconid and entoconid are less pronounced and parastylid and metastylid in particular less well-developed. In the development of metaconid and entoconid the Maasvlakte molar resembles the lower molars of a sheep or a goat (both well represented in the Maasvlakte assemblage). The molar is,

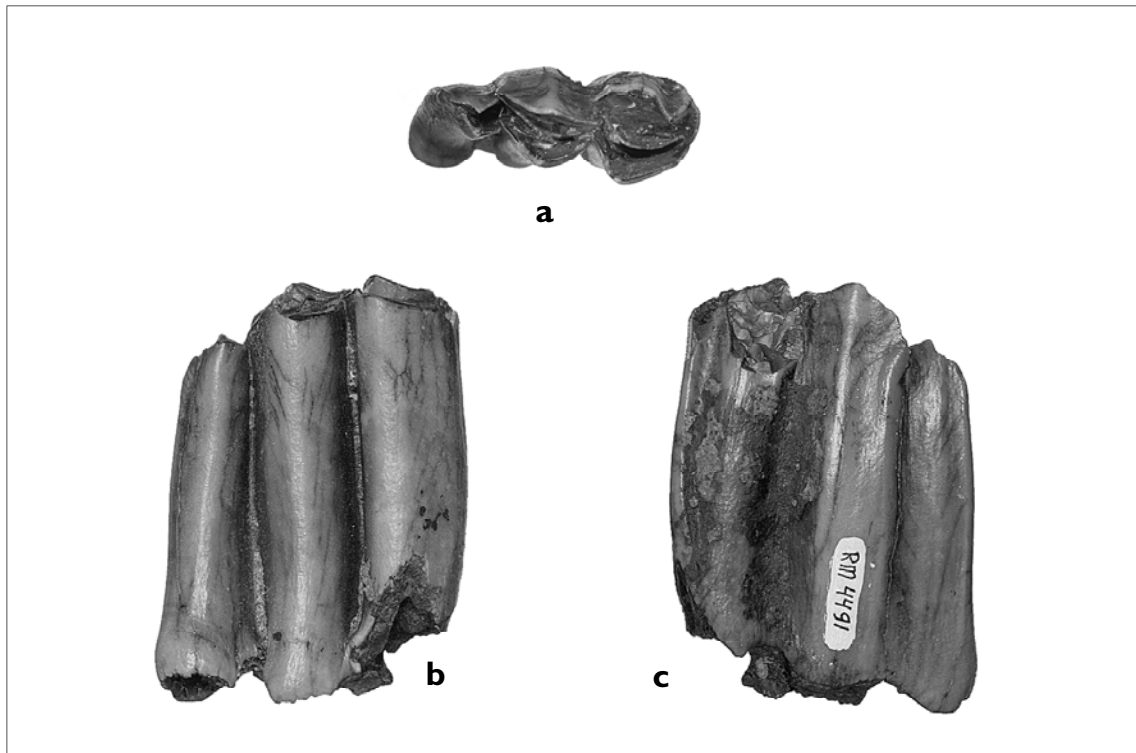


Figure 4 *Soergelia minor* m3 dext. (RM 4491): **a:** occlusal view; **b:** labial view; **c:** lingual view (Collection: Kerkhoff, Schiedam). [Photo: J. Pauptit]

however, too big to be assigned to a sheep or a goat. It is also too small for a m3 of the Musk Ox *Ovibos moschatus*. The molar looks morphologically like the molars of Soergel's Goat, *Soergelia elisabethae*, a goat of the size of a cow, with short, thick, lateral horns which bend downward and forward (Schaub 1951). The type-locality of the species is Süssenborn (Germany) where it was found in early Middle Pleistocene deposits. Since its recovery the species or genus could be identified in a number of localities in Eastern, Central and Western Europe. The number of specimens is, however, still limited. The Maasvlakte molar is too small to be assigned to *Soergelia elisabethae* (Fig. 5); the size of the molar corresponds better to the m3 of *Soergelia minor*, a smaller form recovered at the site Venta Micena-2 (Orce, Spain), described by Moyà-Solà (1987).

Genus *Praeovibos* STAUDINGER, 1908

Species *Praeovibos* cf. *priscus* STAUDINGER, 1908

Material: m3 sin. (RM 4936) (Fig. 6)

Measurements: length 48.85 mm; width (max.) 19.41 mm

Description: The molar is high-crowned with a weakly pronounced metaconid and entoconid and a metastylid that is only visible in the upper half of the crown; there is no ectostylid and the buccal valley between protoconid and hypoconid is deep. The crown of the lower m3 flares out towards its base, a feature which, according to Crégut & Guérin (1979), is characteristic for *Praeovibos priscus*. The morphology of the molar resembles that of the molar from the early Middle Pleistocene deposits (Kä E) at Kärlich (Germany) assigned to *Praeovibos priscus* (Van Kolfschoten & Turner 1996); the molar is large and falls just outside the range of the *Praeovibos priscus* molars from Arago, France (Fig. 5). Therefore, we prefer to assign the molar to *Praeovibos* cf. *priscus*.

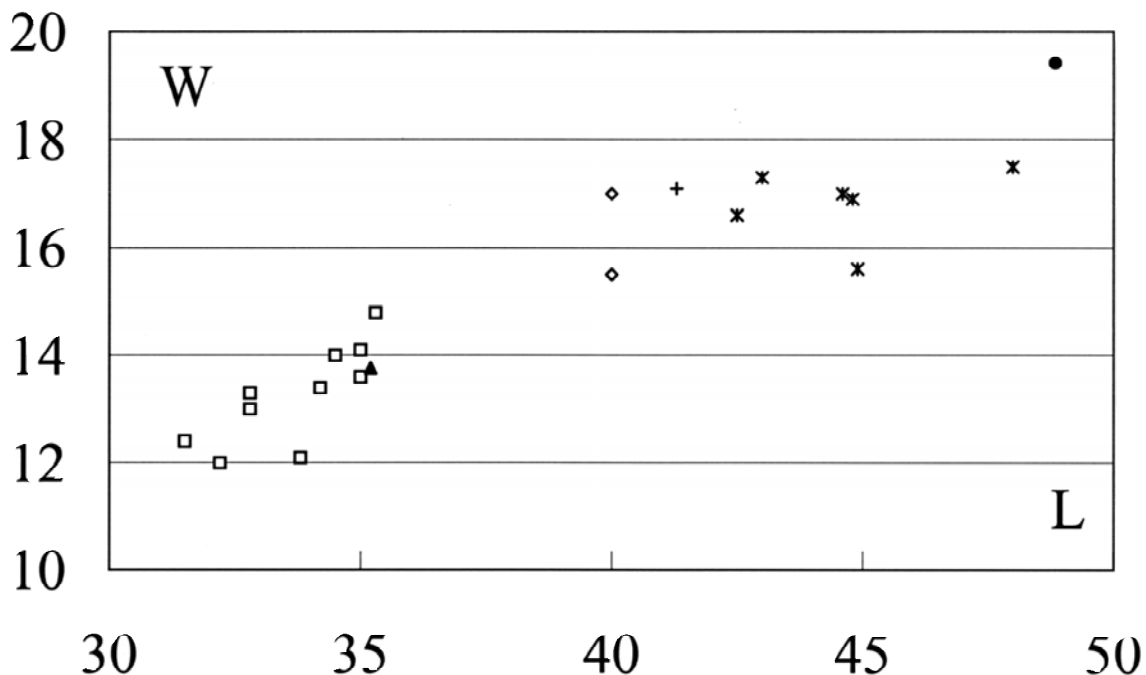


Figure 5 Scatter diagram showing the relation between length and width (in mm) of the third lower molars (m3) of *Soergelia elisabethae* from Süssenborn (open circle), *Soergelia minor* from Venta Micena-2 (Orce, Spain) (open square) and from the Maasvlakte (black triangle), *Praeovibos priscus* from B. Frankenhausen (cross) and Arago (star) and *Praeovibos* cf. *priscus* from the Maasvlakte (black dot). (Data from Moyà-Solà 1987)

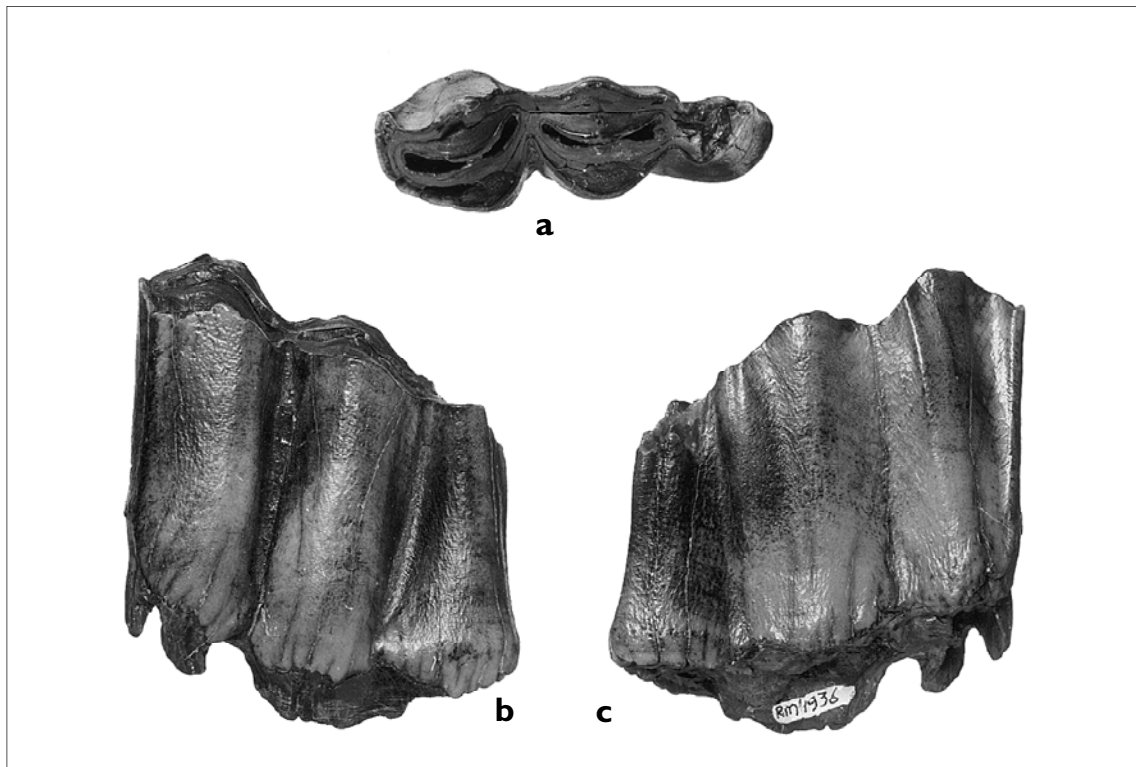


Figure 6 *Praeovibos* cf. *priscus* m3 sin. (RM 4936): **a**: occlusal view; **b**: labial view; **c**: lingual view (Collection: Kerkhoff, Schiedam). [Photo: J. Pauptit]

DISCUSSION

To unravel the Pleistocene mammalian history paleontologists need extensive, well preserved and well stratified fossil collections. Collections such as the one from the Maasvlakte, however, do not fulfil all these requirements. The Maasvlakte collection is, thanks to the dedication of non-professional palaeontologists such as the late mr Kerkhoff and Mrs Kerkhoff-van Grondelle and many others, very extensive. The material is rather well preserved; however, we deal with isolated bones and teeth and many pieces are incomplete and fragmentary. The biggest problem, however, is that different faunal assemblages are mixed. Bones of domesticated Holocene species are mixed with remains of species dating from different Pleistocene episodes. The fossil assemblage consists of species which never co-occur in well stratified faunas. Various criteria can be used to unravel the mixed assemblage and

divide it up in 'natural' assemblages using for instance the degree of mineralisation and our common knowledge about the Pleistocene faunal history. If we combine the results with the knowledge about the geological setting of the area where the sediments have been dredged, it is, as in the case of the Maasvlakte collection, even possible to get an idea about the age of the different faunal assemblages. The dates might be less accurate than one would prefer, but despite this deficiency these faunas give valuable information. Information about the species but, for instance, also about the geographical range of species such as *Soergelia minor*, a species which is almost unknown from the Pleistocene fossil record in Europe. Its presence in the Maasvlakte collection shows that it occurred not only in southern Europe - so far the species is only known from the localities Venta Micena, Spain (Moyà-Solà 1987) and Apollonia, Greece (Koufos & Kostopoulos 1997) - but

also at northern latitudes. Faunal remains, although from a disturbed context, can contribute in this way to solve the Pleistocene mammalian puzzle.

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