One of the last wild brown bears (Ursus arctos) in the Netherlands (Noordwijk)

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One of the last wild brown bears (*Ursus arctos*) in the Netherlands (Noordwijk)

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Abstract: Early in 2016, bones of a left front leg of a brown bear (*Ursus arctos*) were found in the dunes between Noordwijk and Zandvoort (Amsterdamse Waterleidingduinen - Amsterdam Water Supply Dunes). The stratigraphical composition of the find horizon was identified as the old surface (palaeosoil) of the so-called 'Oude Duinen' (Old Dunes). The find horizon has yielded many shells and malacological research has indicated the former presence of a centuries-old, undisturbed, moist, deciduous forest. This forest was located at the border of Rijnland and Kennemerland, and remained unaffected by man for a long time. Shifting sand has since formed younger dunes on top of older ones. This process started around the year 1000 AD. The skeletal remains were ^{14}C dated to 1140 ± 30 BP, which calibrates to 880-970 calAD. This means that the remains are from the late Holocene age and belong to one of the last wild brown bears in the Netherlands, which was one of the largest mammals living in the Netherlands at this time. Zoological data and historical sources indicate that the last brown bear occurred in the Netherlands around the year 1000 AD. To contextualise the finding we also present an overview of all finds of the brown bear known from the Dutch Holocene.

Keywords: brown bear, *Ursus arctos*, Noordwijk, the Netherlands, Holocene.

Introduction

The brown bear (*Ursus arctos*) (figure 1) was one of the largest mammals found in the Netherlands during the Holocene but it disappeared around 1000 AD (Verhagen 1989). Since then, only occasionally individual brown bears have migrated from Germany to the eastern parts of the Netherlands, without forming a viable population. This paper reports on a find from the dunes north of Noordwijk (Province of Zuid-Holland), in the coastal area of the Netherlands. In addition we present an overview of all known Holocene brown bears finds in the Netherlands, as a follow-up to the publications of Verhagen (1989) and Ervynck (1993).

The site of the brown bear of Noordwijk

In the beginning of 2016 the skeletal remains of a brown bear were found in the dune area bordering the North Sea, north of Noordwijk, called the "Amsterdamse Waterleidingduinen" (Amsterdam Water Supply Dunes). A canal ("Van Limburg Stirumkanaal") was being infilled with sand from the surrounding area and this process uncovered soil profiles and old surface deposits from the Old Dunes, which dated back to medieval times and before. At several locations, geological and archaeological research was conducted

Figure 1. The brown bear (photo taken in Bayerischer Wald). *Photo: Paul van Hoof.*

(Vader 2007, Vossen 2007). After the construction work was completed, a bare stretch of sand, the "Van Limburg Stirumvallei" (figure 2) remained, with local exposures of palaeosoils.

The find horizon containing the brown bear remains was sampled for malacological purposes at 30 locations, distributed over an area of 2500 m². The total volume of the samples was 83.5 liters. The rich malacological fauna indicates that several hundred years this site was covered by a moist, deciduous forest. The soil would have been covered with a well-developed layer of leaf litter and decaying logs, and have contained a varied vegetation. The preserved remains of stubs of several birches (*Betula* sp.) and an alder (*Alnus* sp.) were found on the site (figure 2). Some water snails and plant seeds indicate local, wet conditions (Kuijper 2016). It is assumed that the sampled soil developed on the transition between a low (marshy) and a higher (moist) level.

In four samples, remains of mammals were present. One sample yielded some small bones and two molars of a wood mouse (*Apodemus sylvaticus*). The wood mouse lives in open country, wet pastures, woods, the edges of forests, dunes and heather fields and is common in the Netherlands (Pot 2016). In a second sample, a nearly complete skeleton of a root vole (*Microtus oeconomus*), containing dozens of small bones, nine molars and four incisor teeth was found. The root vole is a good swimmer and inhabits wet places (marsh, reed, wet forests, damp dune valleys) and dry grasslands. Its European population is mainly distributed throughout North-East Europe, although some relict populations persist in the Netherlands (Koelman & Bekker 2016). A third sample yielded seven ribs and a fragment of a pelvic bone. On the pelvic bone some gnawing marks, possibly of a fox, were present. These skeletal elements probably belong to a young deer, larger than a roe deer (*Capreolus capreolus*). On the surface of the old soil, a molar of a red deer (*Cervus elaphus*) was found. The find of several bones of a brown bear at one of the sampling locations was remarkable. All these skeletal remains were found in a natural setting and not, as with most other finds in the Netherlands,

Figure 2. The research area near Noordwijk, with stub remains (black) of birches (*Betula* sp.) and an alder (*Alnus* sp.). *Photo: Wim Kuijper.*

during archaeological excavations.

After the formation of the Older Dunes, shortly before the Roman era, there was a prolonged quiet phase in the formation of the dunes. Forests developed and the wet locations contained swamps and dune lakes. The pollen analysis of peat shows that between 175 BC and 900 AD the tree cover (birch, oak, alder, willow, beech) increased. Between the end of the 8th century and the end of the 9th century, the presence of beech increased remarkably (Jelgersma et al. 1970, Vossen 2007). At the same time, the water table rose and there was much open water present in the low-lying valleys. A virtually closed forest area formed in the whole dune area between Velsen and Noordwijk. Through archaeological research, we know that it contained large oaks and beeches. Part of this forest was the border of Rijnland and Kennemerland, and for that reason it remained unaffected by human influence for a long time. Around 1300 the area was still a ‘ wilderness ‘ and was (partly) known as Haarlemmerhout (van Til and Mourik 1999).

In the same area, near the site where the brown bear remains were recovered, skeletal remains of red deer, wild boar and roe deer have been found in recent years. These have not been dated, but probably originate from similar deposits. Thus it may be concluded, that the Old Dunes contained extensive deciduous forests that provide a suitable habitat for the brown bear.

About 1000 AD, a new phase of aeolian deposition started in the dunes: from the west and the Young Dunes developed. Swamps were filled-in, and forests were buried by sand. The sand drifts would not have taken part simultaneously all across the area: their extent would

have differed and the vegetation would have changed in response to this. Sand drift in the Young Dunes continued throughout the Middle Ages up to early modern times. There were probably not enough quiet phases during this period to allow for forests to become re-established. To help age our finds it is important to know the original altitude of the soils from where the samples were taken. They are estimated to have been deposited several metres above sea level (NAP). Some studies, including Blokzijl & Pruissers (1989), Jelgersma et al. (1970) and Vossen (2007), provide geological information on the immediate vicinity of the site of the brown bear find. Based on these studies we conclude that our materials (bones, molluscs, seeds) originated from the surface of the Old Dunes. The forest that grew here was overblown by the Young Dunes and its fauna and flora became covered. This is confirmed by the result of the ^{14}C date 880-970 calAD.

Description of the skeletal remains

The skeletal material is a large portion of a left front leg. All the skeletal elements are present except for one second phalanx, two third phalanges and most of the sesamoid bones (figures 3 and 4). Overall the bones are well-preserved: most of the skeletal elements are complete and they only show slight cracking due to dehydration. The proximal end of the humerus is fragmented and the ulna partly fragmented, but all the parts are still present. Two of the three third phalanges are fragmented distally. The good preservation is indicated by the high collagen yields, taken before dating the sample. The good preservation, the representation of skeletal elements and the location of the find supports the possibility that originally, a large part, possibly a complete skeleton was preserved. Unfortunately, it was not possible to study the overlying sediments as they were removed during the restructuring of the landscape.

Figure 3. Left front leg of the brown bear from Noordwijk. *Photo: Ivo Verheijen.*

Figure 4. Left hand of the brown bear from Noordwijk (detail of figure 3). In the bottom left corner of the picture the grey fragments show the skeleton elements (distal phalanges) of which the position is uncertain. *Photo: Ivo Verheijen.*

The material was checked by A. Verbaas for macroscopic traces such as cut marks and traces of gnawing that could possibly provide insights into the taphonomic history of the find. No traces were found and this suggests an undisturbed deposition with little or no access by carnivore scavengers.

In order to compare the skeletal remains to other Holocene and Pleistocene brown bear remains from north-western Europe, measurements were taken using the standards provided by Von den Driesch (1976). Apart from providing a framework for comparison, these measurements can also give us an idea about the body size of one of the last brown bears in the Netherlands. All the measurements taken are shown in table 1. For measurements of less than 15 cm, a digital caliper was used. These measurements were rounded to a tenth of a millimetre. For larger measurements, a larger, analogue caliper was used, accurate to one millimetre. Skeletal elements with damage on the specific areas of the bone used for measuring, were excluded and recorded in the table with a dash (-). For the phalanges, the numbering by phalanx type (middle and end) was not done anatomically, since it is very hard to distinguish the exact position of each phalanx within the hand. The numbering was done in accordance with the position of the phalanges in figure 4, sequentially from left to right.

We could only find good references for comparing the size of the longbones and metacarpals. The largest radius from the Noordwijk fossils was 273 millimeters, which is in the top range of modern day brown bears that have dimensions of between 240 and 270 millimeters (Couturier 1954: 52). For European brown bear fossils from the Pleistocene, larger measurements have been found including a 334 mm radius from Maspino (Tuscany) (Koby 1945). The largest length of the ulna from our find is 309 millimeter. This is in accordance with modern-day specimens, where males measure between 315 and 321 millimeter and a female specimen has been recorded as having a length of 288 millimeter (Couturier 1954: 52). The ulna of the brown bear fossil from Masipino (Koby 1945) was 375 mm. The proximal end of the humerus from the Noordwijk fossils was damaged and no measurements could be taken. The distal epiphysis was complete; the maximal width of the epicondyles is 83.1 mm. In the bear remains from the North Sea, described by Bosscha Erdbrink (1982, 1983) these were generally larger. He concluded that the North Sea specimen belonged to a large and robust bear, but it is possible that it was of another species or subspecies. Finds from Jaurens (France) with an average metacarpal I length of 84 mm (Ballesio 1983) confirm that Pleis-

tocene bears might have been larger than the Holocene one from Noordwijk.

Dating and stable isotope composition

A sample of the humerus was radiocarbon (^{14}C) dated to 1140 ± 30 BP (before present) (laboratory number GrA-66477). The organic fraction of bone is best dated by collagen. This is extracted from the bone using a procedure originally developed by Longin (1971). The collagen is then combusted in an Elemental Analyser, which is coupled to an Isotope Ratio Mass Spectrometer (EA-IRMS). The IRMS determines the isotope ratios $^{13}C/^{12}C$ (for CO_2) and $^{15}N/^{14}N$ (for N_2) for the combustion products. Part of the CO_2 gas is reduced to graphite by a reaction with H_2 (Aerts et al. 2001). For this graphite, the isotope ratio $^{14}C/^{12}C$ is measured by Accelerator Mass Spectrometry (AMS) based on a 2.5 MV particle accelerator (van der Plicht et al. 2000).

The radiocarbon date is reported according to an internationally agreed convention (Mook & Streurman 1983, Mook & van der Plicht 1999). This convention takes complications, such as variations in the natural ^{14}C content, into account. This defines the ^{14}C timescale, which is relative. It differs from the calendar timescale, but the two timescales are related. They can be connected by calibration, which converts ^{14}C dates (in BP) into calendar ages. Only then does the ^{14}C timescale become absolute. Calibration curves are obtained by dating samples by both ^{14}C and an independent, preferably absolute method, most notably dendrochronology (Reimer et al. 2013). Note that, for ^{14}C, BP does not mean 'Before Present' in the literal sense.

The calibration is shown in figure 5. The blue curve is the calibration curve for the relevant timeframe. The vertical axis is the ^{14}C timescale and the red curve corresponds to the ^{14}C date 1140 ± 30 BP. The horizontal axis is the calendar timescale. The resulting probability distribution for the calendar dates (plotted in black) is 880-970 AD (or calAD, for "calibrated AD"). The ^{14}C measurement is a Gaussian probability distribution (the red curve); the calibrated distribution is not Gaussian due to irregularities in the calibration curve. The numbers quoted correspond to the 1-sigma range (68.2% probability).

In addition to the ^{14}C measurement, the stable isotopes ^{13}C and ^{15}N are also measured. They are a measure of bone collagen quality but also provide additional info about diet (Kohn 1999). They are reported as δ-values, the deviation of the rare to abundant isotope ratio from that of a reference material, expressed in permil:

$$\delta^{13}C = \left(\frac{\left(\frac{^{13}C}{^{12}C}\right)_{sample}}{\left(\frac{^{13}C}{^{12}C}\right)_{reference}} - 1 \right) x1000‰ \quad \text{and}$$

$$\delta^{15}N = \left(\frac{\left(\frac{^{15}N}{^{14}N}\right)_{sample}}{\left(\frac{^{15}N}{^{14}N}\right)_{reference}} - 1 \right) x1000‰$$

For ^{13}C, the reference is PDB which is a belemnite; for ^{15}N, it is ambient air (Mook 2006).

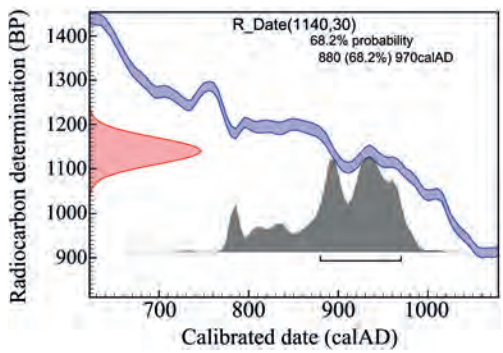

Figure 5. Calibration of the radiocarbon date. The blue curve is (part of) the calibration curve. The red curve corresponds to the 14C date of 1140 ± 30 BP. The black curve is the probability distribution for the calendar age. The 1-sigma (68.2% probability) confidence interval is 880-970 AD (or calAD, for "calibrated AD").

Table 1. Measurements of all skeletal elements of the left front leg of the brown bear from Noordwijk. All measurements were taken with use of the standard measurements established by von den Driesch (1976): GL = Greatest length; BP = (Greatest) breadth proximal end; BD = (Greatest) breadth distal end; SD = Smallest breadth of the diaphysis; HP = Height proximal end; HPC = Height proximal condyle; BPC = (Greatest) breadth across the coronoid process (= greatest breadth of the proximal articular surface); DPA = Depth across the *Processus anconaeus*.

Skeletal element	SubID	GL	BP	BD	SD	HP	HPC	BPC	DPA
Humerus		-	-	83.1	24.4				
Radius		273	34.9	49.1	21.9				
Ulna		309	45.4	19.5				46.8	50.9
Metacarpals	Metacarpal I	66.5	20.1	17.1	9.0				
	Metacarpal II	75.6	15.8	17.7	11.5				
	Metacarpal III	75.3	15.1	17.2	10.2				
	Metacarpal IV	78.3	15.5	16.9	10.8				
	Metacarpal V	78.9	20.0	19.2	10.9				
Phalanx I	1	38.9	17.0	13.7	11.5				
	2	39.5	17.8	14	11.7				
	3	43.7	16.2	13.4	10.5				
	4	39.4	19.1	14.6	12.0				
	5	37.8	-	14.3	11.9				
Phalanx II	1	29.5	14.3	13.9	10.3				
	2	30.2	14.5	-	10.0				
	3	28.9	14.5	14.0	10.3				
Phalanx III	1	-	13.2			21.8	14.1		
	2	-	12.5			22.1	16.9		
	3	-	12.9			-	14.9		

For the bear sample, the measured stable isotope ratios are $\delta^{13}C$ = -21.60 ‰, and $\delta^{15}N$ = 5.08 ‰. These are within the normal range for herbivore mammals.

The brown bear in the Netherlands, an overview of the Holocene finds

The Dutch fossil record includes several Pleistocene and Holocene brown bear finds. Pleistocene finds are known from the bottom of the North Sea and from sand/gravel pits on land. Several brown bear remains have been found in Eemian deposits from the sand/gravel pit at Hogebroek near Raalte (Province of Overijssel) (Brewer & Schouwenburg 2009). For the Holocene - the last ca. 10,000 years – the literature lists 50 locations with remains of brown bears. These are listed in table 2 and plotted on a map of the Netherlands (figure 6).

Most of the Holocene finds are from archaeological settings, except for the find from Noordwijk and possibly the one from Schouwen – Meeuwenduinen. The overview given in table 2 indicates that bear remains are generally rare. Usually they consist of a single tooth, bone or a skull fragment. Some bones show cutmarks or traces of gnawing. Perforated canine teeth were used as pendants or amulets. These teeth were possibly obtained through exchange and do not necessarily indicate the presence of bears in the area concerned. Table 2 and figure 6 show that the brown bear was present in the Netherlands during almost the entire Holocene. The oldest finds are from the Mesolithic and the most recent from the early Middle Ages. They indicate the presence of many forested areas in the Netherlands. The situation in Belgium

Table 2. Locations in the Netherlands with Holocene remains of brown bear.

		RD-coördinates						
Location	Site	X	Y	Archaeological period	Period	Part	Remarks	References
Aartswoud	t Hoog/Drie Bunders	126,600	528,820	Neolithic	2150-1950 BC	1 phalanx II		Gehasse 2001: 174
Aartswoud	During survey (surface)	c. 126.6	c. 528.8	Neolithic	2150-1950 BC	1 canine		Theunissen 2001: 112
Almere	Hoge Vaart - A27	151,520	481,000	Neolithic	c. 4050-3750 BC	1 canine, 1 molar, 1 phalanx, 1 scapula		Laarman 2001
Borgharen	Pasestraat	176,264	321,622	Early Medieval	6th-7th century AD	1 canine	artificial hole	van der Jagt et al. 2014
Bornwerd	Friese terpengebied	192,700	594,500	Early Medieval	5th-7th century AD	1 canine		Verhagen 1990
Brandwijk	Het Kerkhof	114,130	433,810	Neolithic	4900-4200 BC	1e max., 1 left metacarpal, 1 third phalanx posterior, 1 right astragalus, 2 left metacarpi	max. 3 individuals	Robeerst 1995, C. Cakirlar pers. comm. 2016
Broek in Waterland	Cleaning ditch	c. 128	c. 494	Neolithic	5300-2000 BC	1 root left lower canine	artificial hole	Bosscha Erdbrink 1982
Cornjum	Friese terpengebied	181	584,190	Early Medieval	5th-7th century AD	1 canine		Verhagen 1990
Den Ham	Vroomshoop (Linderbeek)	232,000	495,300	Neolithic (- Iron Age)	5300-2000 (-12) BC	2 scapulae (1 animal?)		Erdbrink 1953, Groenewoudt et al. 2007
Drechterland	Hoogkarspel (N23/Makerwaardweg)	139,070	523,320	Middle - Early Bronze Age	1800-800 BC	1 left pelvis, 1 lumbar vertebrae		L. Kootker & J. van Dijk pers. comm. 2016
Eenum	Groningse terpengebied	247/248	595/596	Early Medieval	5th-7th century AD	1 mandibula		Verhagen 1990
Emmeloord	J78	178,900	519,900	Bronze Age	2000-1800 BC	1 maxillary canine, 1 first molar mandibular, 1 humerus		Gehasse 1995
Enkhuizen	Kadijken	146,645	525,775	Bronze Age	1600-1000 cal BC	1 femur	cutmarks	Zeiler & Brinkhuizen 2011
Gennep	Stamelberg	194,800	412,600	Early Medieval	350-524 AD	1 mandibula		Verhagen 1990, van der Kamp 1995
Hekelingen	I	81,960	426,850	Neolithic	2900-2600 BC	1 right canine lower mandibula	artificial hole	Modderman 1953
Hekelingen	III - unit A1	82,210	426,750	Neolithic	3000 cal BC	2 maxillary/mandibular teeth		Prummel 1987
Hekelingen	III - unit B2	82,210	426,750	Neolithic	2600 cal BC	1 cranium, 1 maxillary tooth, 1 humerus	gnawing and butchering	Prummel 1987
Hellevoetsluis	Ossenhoek	68,983	429,048	Neolithic	c. 2900 BC	1 left ulna	gnawing of dog	van Dijk 2009
Hoogkarspel	Vindplaats F (HKL 1967)	139,800	522,500	Iron Age	c. 800 – 700 BC	1 neurocranium fragment		Suwijn 1981
Houten	Loerik	I4I.240	448,360	Early Medieval	725-900 AD	1 part ulna		de Vries & Laarman 2001

Table 2, continued

Houten	Schalkwijkseweg	141,200	446,880	Roman period	50 BC - 50 AD	2 fragments pelvic girdle		Buitenhuis 2001
Tjongerdal	Prandinga	c. 214	c. 558	Mesolithic - Roman period	8800 BC - 450 AD	1 canine		Prummel 2013
Tjongerdal	Jardinga (Johannahoeve)	c. 214	c. 559	Mesolithic - Roman period	8800 BC - 450 AD	2 canine		Prummel 2013
Tjongerdal	Makkinga (Lochtenrek)	c. 212.8	c. 556.6	Mesolithic - Roman period	8800 BC - 450 AD	1 cranium		Prummel 2013
Maasstricht	O.L. Vrouwebasiliek (pandhof)	176,578	317,578	Early Medieval	400-425 AD	1 mandibula		Ervynck 1997
Mijnsheeren-land	Hofweg	92,216	423,052	Bronze Age	1800-1100 BC	1 mandibula fragment		Lauwerier 1995, v. Heeringen & Lauwerier 1996
Molenaarsgraaf	Hazendonk	116,755	430,460	Neolithic	3400-2850 BC	1 second phalanx , 1 right patella, 1 lumbar vertebra	cutmarks	Zeiler 1997
Molenaarsgraaf	Polder Molenaarsgraaf	117,991	431,147	Neolithic - Bronze Age	1800-1500 BC	1 bone		Louwe Kooijmans 1974
Noordoost-polder	Schokland P14	181,580	518,000	Neolithic	4900-4100 calBC	1 metacarpus II		Gehasse 1995
Noordoost-polder	Schokland P14	181,580	518,000	Neolithic	2600-1900 calBC	1 tibia, 1 femur, 1 radius, 1 ulna		Gehasse 1995
Noordwijk	Amsterdamse Water-leidingduinen	95	482	Early Medieval	880-970 calAD	nearly complete frontleg		this article
Opmeer (Aartswoud)	Molenkolk I	127,260	528,840	Neolithic	2150-1950 BC	1 bone		Theunissen 2001
Schipluiden	Harnaschpolder	81,620	448,320	Neolithic	3550-3490 BC	9 cranium fragments, 2 phalanges, parts left and right maxilla, left incisor, right mandibula fragment, left M2 mandibula		Zeiler 2006
Schouwen	Meeuwenduinen	c. 37	c. 413	Roman period - Medieval	1th-2th? century AD	Parts frontleg young animal: humerus and radius		Nooren 2016
Schouwen	Beach			Holocene?	not dated	1 canine	artificial hole	AWN 2015
Swifterbant	S3	168,170	510,214	Neolithic	4100-4000 calBC	1 phalanx I, 2 phalanx II, 3 fragments metacarpals		Zeiler 1997
Tiel	Dominicuskwartier	158	433	Modern time	1500-2000 AD	1 distal articulation tibia		van Renswoude & Habermehl (eds.) 2014
Tiel	Passewaaij	156,121	430,988	Late Roman period	270-350 AD	1 canine		Groot 2008

Table 2, continued

Toornwerd	Groningse terpengebied	238	597	Early Medieval	5th-7th century AD	1 canine		Verhagen 1990
Uitgeest	Waldijk (Assum)	108,700	502,900	Bronze Age	950-750 BC	1 M3 mandibula		de Vries 2008
Utrecht	De Meern (LR 57)	131,000	455,850	Bronze Age	1400-1275 BC	1 maxilla fragment with canine- and incisors (premaxillare)		Meijer 2009
Valkenburg a.d. Rijn	Dorpsheuvel (castellum)	89,700	466,100	Roman period	40-240 AD	1 canine		Clason 1961
Valkenburg a.d. Rijn	De Woerd	90,300	465,230	Roman period/early Medieval	0-1000 AD	1 right mandibula, 1 cranium (2 individuals)		Verhagen 1990
Veldhoven (Oerle)	Touterfout - Halve Mijl	151,900	380,950	Bronze Age	1800-1100 BC	1 phalanx	cremation, in burial pit	Theunissen 1993 (1996)
Velsen (castellum)	N.Spaarndammer Polder	106,460	496,180	Roman period	15-55 AD	1 canine, 1 phalanx II		Verhagen 1990, Schnitger 1988
Vlaardingen	Arij Koplaan	81,390	435,650	Neolithic	c. 2300 BC	1 neurocranium, 1 upper frontal part rostrum (remains M2 on left side), 1 proximal part right mandibula, 1 proximal part right intermaxillare, 1 part right maxillare	artificial hole	van Bree 1961
Voorschoten	Boschgeest	89,710	459,610	Neolithic	3400-2000 BC	1 tooth	artificial hole	Groenman-van Waateringe et al. 1968
Westwoud	Noorderboekert	137,284	522,910	Neolithic (late)	2850-2000 BC ?	1 lunare	cutmark	J. Aal pers. com. 2016
Wieuwerd	Friese terpengebied	175	569	Early medieval	5th-7th century AD	1 canine		Verhagen 1990
Wijk bij Duurstede	De Geer	151,113	443,616	Roman period	270-450 AD	1 femur fragment		Bekkema et al. 2011
Wijk bij Duurstede	De Horden	151,228	443,018	Bronze Age	1800-1100 BC	2 metacarpals		Laarman 1996
Zeewijk (Winkel)		124.65	530.83	Neolithic	2450-2100 calBC	1 phalanx II		Zeiler & Brinkhuizen 2014
Zutphen	Ooijershoek	212,200	459,930	Mesolithic	7160-6870 BC	1 tooth	cutmarks	Groenewoudt et al. 2001, Peeters & Niekus 2005

Figure 6. Map of locations in the Netherlands where Holocene remains of brown bear were found. *Drawing*: *W. Laan (Archol)*.

and Luxembourg was more or less the same. It is possible that bears were still present in the southern and eastern parts in these countries until the 12th century (Ervynck 1993).

The origin and age of the finds from Tiel – Dominicuskwartier are uncertain. The authors report (translated from Dutch) that: "In this period, the brown bear was described to be almost certainly extinct in the Netherlands. Given the origin of the fragment, it is more likely that it dates from the early Middle Ages." (Renswoude & Habermehl (eds.) 2014). In addition, it is also possible that we are dealing with a dancing bear that died in Tiel.

Historical sources

A statement from 943 AD in the charters of the Bishop of Utrecht about the right to hunt for brown bears in the east of the country, can be taken as reliable since the brown bear still occurred frequently in the adjoining West-German area in the 10th century until 1650 (IJsseling & Scheygrond 1950: 119).

According to Liesenborghs (2007), the brown bear was already extinct in the Low Countries during the Roman occupation. The species then rather quickly disappeared from Western Europe, although a few relict populations remain even today.

The book 'Jacht-Bedryff', probably written by C.J. van Heenvliet and later edited by Swaen (1948) describes hunting practice and the animals hunted around 1600 AD. The writer was the forester of Holland and West-Friesland, including the dunes of Holland, exactly the area where the brown bear of Noordwijk was found. The book reports on the animals that could be hunted: deer, fallow deer, roe deer, hare, rabbit (and many bird species). Of wild boar, wolf and fox it is written: 'zijn daer eertijdts veel geweest, doch in lange jaren gene' (= in former times there were many, though for a long time there have been none). The cause of these animals disappearing was the conversion of forests to agricultural areas and marshes to pastures and hay meadows. This shows that the brown bear was not present in the dune forests around this time (1600 AD). Bears apparently disappeared from the dune area long before wild boar, wolf and fox and had even disappeared from the memory of man.

Discussion

The find of a brown bear in Noordwijk in the Netherlands is remarkable. It is the first time that so many bones (an almost complete left front leg) have been found in a natural setting in the Netherlands. The good state of preservation and the location both support the idea that originally, an entire skeleton might have been preserved. The dimensions of the Noordwijk brown bear are well within the current size range of the European brown bear, although it is much smaller than Pleistocene individuals from the Netherlands.

We also have information about the geological and botanical history of the site. The expected age of the find, based on the geological setting, was confirmed by the result of the ^{14}C date 880-970 calAD. After the formation of the Older Dunes there was a prolonged phase when deposition did not take place. Forests developed on the surface and swamps and dune lakes were present in the wetter locations. In the dune area between Velsen and Noordwijk a virtually closed forest area formed, estimated to be several hundred square kilometres in size. The area was large enough to support a viable population of brown bears. Around 1300 AD the area was still a 'wilderness' (van Til and Mourik 1999).

The finds of the brown bear in Late-Holocene deposits and the historical data about the disappearance (around 1000 AD) of the species in the Netherlands, fit well together, implying that the remains from Noordwijk belong to one of the last wild brown bears in the Netherlands.

Acknowledgements: H. Vader (Hillegom) reported the presence of a species of a land snail which no longer lives in this dune area. This was the reason to start research at the site which gave important malacological and zoological results. W.H. Nekkers (Noordwijk) drew our attention to the presence of the bear bones at a malacological sampling point. N. den Ouden (Naturalis, Leiden), W. Prummel and C. Cakirlar (GIA, Groningen), F. Laarman (RCE, Amersfoort), J.T. Zeiler (ArchaeoBone), K. Esser and A.L. van Gijn (Faculty of Archaeology, Leiden), J. Aal (Archol, Leiden), L. Kootker and J. van Dijk (Archeoplan Eco, Delft) were helpful in providing the information for table 2. A. Verbaas (Faculty of Archaeology, Leiden) examined the bones on possible traces (e.g. cutmarks, gnawing traces) and C.E. Vermeeren (BIAX, Zaandam) identified the trees that would have been present on the site. P. van Hoof took the photograph of a brown bear. Y.M. Haring and N. Parrott corrected the

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Samenvatting

Een van de laatste wilde bruine beren (*Ursus arctos*) in Nederland (Noordwijk)

Tijdens onderzoek van Holocene bodems in de Amsterdamse Waterleidingduinen ten noorden van Noordwijk kwamen enkele resten van de bruine beer tevoorschijn. Het materiaal is beschreven en gemeten. Het bleek om een vrijwel complete linkervoorpoot van een individu van gemiddelde grootte te gaan. Door de hoogteligging en door vergelijking met geologische bodemprofielen van de directe omgeving kwam een jong-Holocene ouderdom in aanmerking. Het gaat om een vondst in een bodem gevormd in de top van de Oude Duinen. Deze duinen zijn omstreeks het jaar 1000 overstoven door de Jonge Duinen. Door een ^{14}C datering werd dit bevestigd: de ouderdom ligt tussen de 880 en 970 kalenderjaren AD. Het betreft daarmee een van de laatste in het wild levende bruine beren in Nederland. Door ontbossingen en jacht verdween de bruine beer omstreeks 1000 AD uit Nederland.

Het onderzoek in het Noordwijkse duingebied betrof een malacologische analyse van jong-Holocene afzettingen. De schelpen waren van soorten die aangeven dat hier vroeger een oud, ongestoord, vochtig loofbos aanwezig was. Enkele waterslakken en planten (zaden) geven plaatselijke, natte omstandigheden aan. Andere zoogdieren waarvan de resten werden aangetroffen zijn noordse woelmuis (*Microtus oeconomus*), bosmuis (*Apodemus sylvaticus*) en edelhert (*Cervus elaphus*). De vondst van de bruine beer past goed in dit beeld van het landschap.

Uit geologisch, botanisch (pollen) en historisch onderzoek weten we dat in de duinen tussen Velzen en Noordwijk een groot bosgebied aanwezig was. Het betreft het grensgebied tussen Rijnland en Kennemerland.
Aanvullend op ons onderzoek geven we een actueel overzicht van alle Holocene vondsten van beren in Nederland. Hiermee is dit een vervolg op de publicaties van Verhagen (1989) en Ervynck (1993). De meeste resten in dit overzicht komen uit archeologische opgravingen. Vooral wanneer het een doorboorde tand betreft is het niet zeker dat de beer ook in het gebied rond de onderzochte nederzetting leefde. De vondsten van Noordwijk en (mogelijk) Schouwen zijn in ongestoorde afzettingen gedaan, dit in tegenstelling tot alle andere vondsten in Nederland en België. Deze zijn door toedoen van de mens in of bij nederzettingen terecht gekomen. Uit het overzicht blijkt dat de bruine beer gedurende vrijwel het gehele Holoceen in Nederland leefde. Hoewel zeldzaam, zijn de botten en tanden verspreid over het gehele land aangetroffen.

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