KOEN DEFORCE · JAN BASTIAENS · HANS VAN CALSTER · SOFIE VANHOUTTE

IRON AGE ACORNS FROM BOEZINGE (BELGIUM): THE ROLE OF ACORN CONSUMPTION IN PREHISTORY

In 2005, an Iron Age pit containing an exceptionally large amount of charred acorns was excavated in Boezinge (prov. West-Vlaanderen/B). The discovery raises questions about the role of acorns in prehistoric subsistence strategies. Although acorns are nowadays no longer considered as fit for human consumption, the growing number of archaeobotanical finds of acorns and especially this recent find from Belgium point to their former importance as a staple food.

THE SITE

During an archaeological rescue excavation in November 2005 on the World War I site »Caesar's Nose« at Boezinge, a small village to the north of Ieper (**Fig. 1**; N 49° 17´ 43.81´´/E 2° 18´ 21.83´´), a large, shallow, oval Iron Age pit was discovered (feature code CN.05.I/S34). The pit measured 2.30 by 1.75 m and had a flat bottom with a maximum depth of 0.30 m (**Fig. 2**). It was found directly under a WWI trench which makes it likely that the upper part of the pit was missing. Apart from this pit, no other Iron Age features have been found at the site.

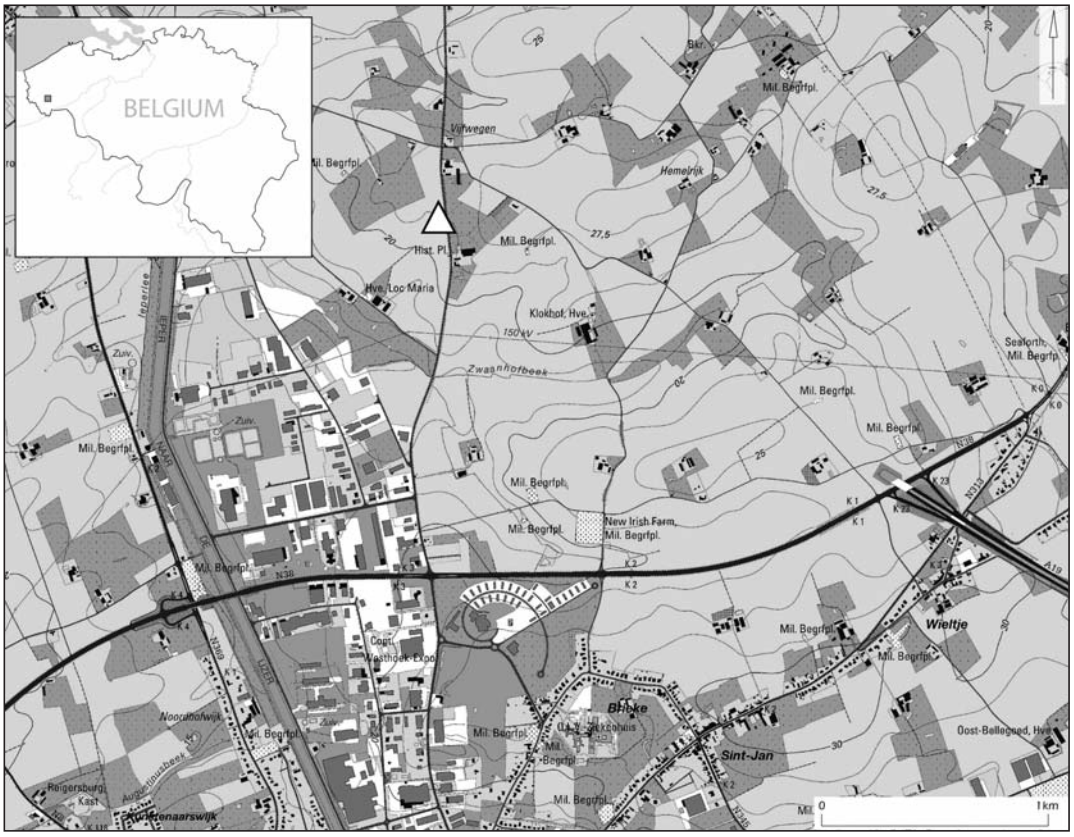

Fig. 1 Location (white triangle) of the site Boezinge/Caesar's Nose, prov. West-Vlaanderen/B. – (Map Nationaal Geografisch Instituut).

Fig. 2 Boezinge/Caesar's Nose, prov. West-Vlaanderen/B: the Iron Age pit containing charred acorns. – (Photo Vlaams Instituut voor het Onroerend Erfgoed).

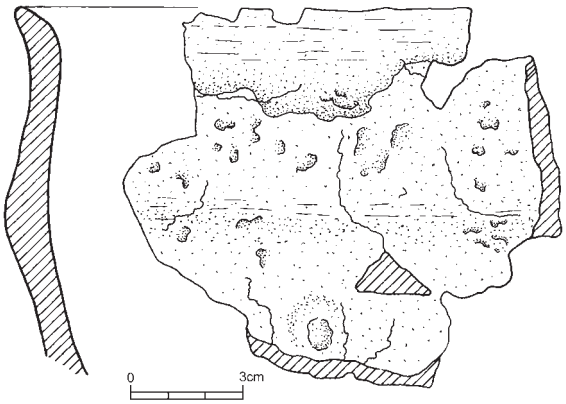

Fig. 3 Boezinge/Caesar's Nose, prov. West-Vlaanderen/B: ceramic rim fragment recovered from the pit. – (Drawing F. Wyffels, Vlaams Instituut voor het Onroerend Erfgoed).

The pit was completely filled with charred organic material. At the top of the fill this charred material was mixed with both burned and unburned loam. The bottom and the sides of the pit were not burned. Only a few dozen fragments of ceramics were recovered from the pit, which all seem to originate from the same recipient: a rather large and robust pot with a diameter at the rim of minimally 36 cm. The clay is coarsely tempered with grog and organic material. The rim fragment shows a slightly bent shoulder and has an S-shaped body profile (**Fig. 3**). The other fragments suggest that the pot had a thick bottom. The orange-red to grey pottery fragments have an irregular external surface and show traces of burning.

sample	1	2	3	4	5	6
volume (l)	1.5	1.25	1	1	1	1
mesh width (mm)	0.5	0.5	0.5	0.5	0.5	0.5
Fallopia convolvulus/Polygonum aviculare			1			
Polygonum lapathifolium		1				
Polygonum sp.					1	
Quercus sp. cotyledon	482	260	341	266	523	207
Quercus sp. embryo fragments	+	+	+	+	+	+
Quercus sp. hilum	91	56	102	71	59	20
Quercus sp. pericarp fragments	+	+	+	+	+	+
Raphanus raphanistrum fruit		1				
Triticum dicoccum					1	
indeterminate					2	

Tab. 1 Counts of seeds and fruits from the pit (Boezinge/CN.05.I/S34), all charred. + Present but not counted.

At the Iron Age site of De Panne-Oosthoekduinen (western Belgian coast, prov. West-Vlaanderen) a similar rim fragment from a pot with a smaller diameter of 18.4 cm has been found, which was dated to the middle or late La Tène period (Bot 2005, 91).

DESCRIPTION OF THE ASSEMBLAGE OF CHARRED ACORNS

Half of the fill of the pit has been sampled. From this, six subsamples (6.75 litre in total) were taken for macrobotanical analyses and sieved over a 0.5 mm mesh. These subsamples consisted almost entirely of (fragments of) charred acorns (**tab. 1**). The bulk was formed by cotyledons (seed leaves), sometimes the parts of the original pair still attached to each other, but mostly single ones or only fragments of cotyledons, and always without the pericarp (fruit wall) (**Fig. 4**). A lot of detached hilums (attachment scars), embryos (which were sometimes slightly germinated), and fragments of pericarp were also present. Not a single cupule (cup) has been found.

As the stalks of the acorns were missing, it was not possible to identify to which species the remains belong. The length of the stalks is the diagnostic character for the differentiation between acorns of pedunculate oak (*Quercus robur*) and sessile oak (*Quercus petraea*), the two oak species native to northern Belgium (Maes et al. 2006; Lambinon et al. 1998).

Apart from the acorns, other species are virtually absent. Only a few seeds of wild radish (*Raphanus raphanistrum),* pale persicaria *(Polygonum lapathifolium),* black-bindweed/knotgrass (*Fallopia convolvulus/ Polygonum aviculare*) and emmer (*Triticum dicoccum*) have been found (**tab. 1**). No wood charcoal has been found in any of the subsamples.

To estimate the total number of acorns in the pit, their number was counted in six subsamples of 1 litre. This was done by assessing the »minimum number of individuals« by counting a clearly distinguishable character that occurs only one time on each cotyledon: in this case the place where the embryo is (or was) attached to the cotyledon was used. Embryos and pericarp fragments were not counted because of their high degree of fragmentation. Counting hilums, which could also be used to determine the minimum number of acorns, resulted in lower numbers than counts based on the place where the embryo is (or was) attached (see **tab. 1**). The counts resulted in a median number of acorns of 147 per 1 litre of sediment (range: 104-262; two cotyledons for one acorn). For an estimated volume of the pit of 470 litres, this gives

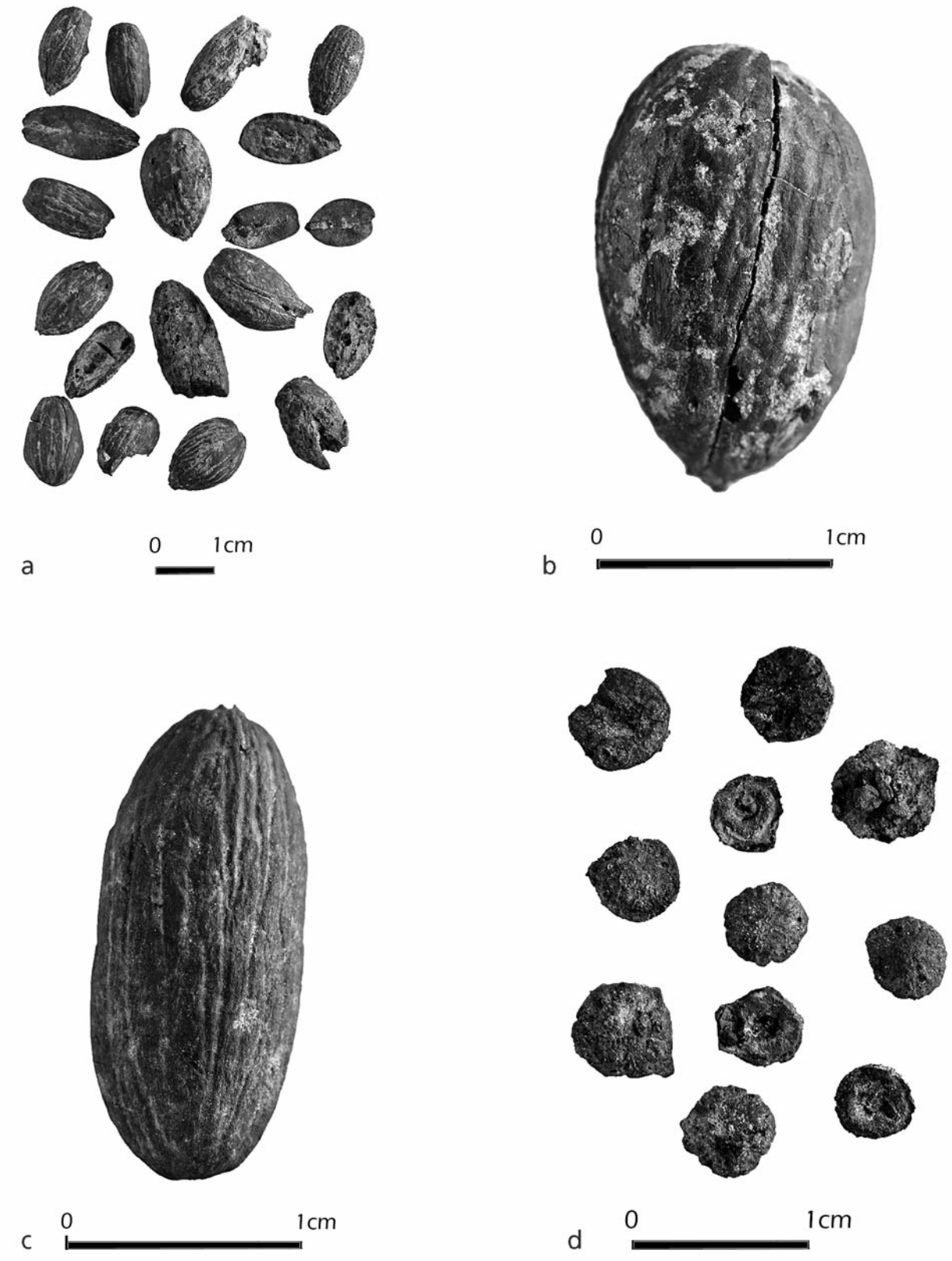

Fig. 4 Boezinge/Caesar's Nose, prov. West-Vlaanderen/B, charred acorns from the pit: **a-c** cotyledons. – **d** Hilums.

an estimated total of approximately 69,000 acorns. This is probably an underestimation, as acorns that were highly fragmented might not have been counted.
Radiocarbon analysis of one of the charred acorn cotyledons from the pit gave a result of 2,275 ± 25 BP (KIA-30044) and a calibrated date range of 400-350 BC (57.8%) and 300-210 BC (37.6%) (2σ) which corresponds to the late Iron Age period in Belgium (calibration was done with Oxcal 3.10, © Bronk Ramsey 2005; see Ramsey 1995; atmospheric data from Reimer et al. 2004).

ACORNS AS A FOOD RESOURCE

As the Boezinge assemblage clearly did not originate through a set of natural processes, the find must represent an anthropogenic deposition. The charring, the monotonous species composition, and the removal of cupules clearly point to this interpretation. The question to be answered remains what the purpose of collecting and handling of such a large number of acorns was. The large number might suggest a use for some kind of proto-industrial activity or small-scale craftsmanship like the tanning of skins. Oak bark is a lot more useful for this purpose however, as it contains more taninns. There is also no need to remove the cupules for the tanning with acorns. Disregarding ritual contexts (for which no proof or contextual information can be found), food provision seems the most likely explanation. Theoretically, this could have been done both for humans and animals.
Fresh acorns contain 48-50% starch, ±2% proteins and ±2% fat; dried acorns contain 60-70% starch, 5-6% proteins and ±3% fat (ten Cate 1972). According to these values, acorns have a high nutritional value, comparable with cereals. Most acorns, however, also contain tannins which give them a bitter, astringent taste and which make them poisonous to some consumer species (Bauer / Karg / Steinhauser 1995; Van Genderen / Schoonhoven 1997). Cattle and horses e.g. do not easily digest acorns and might even get poisoned (Dixon et al. 1979) – but, until late Medieval times, acorns were widely used as fodder for pigs (see Tack / Van den Bremt / Hermy 1993 and Ervynck et al. 2007 for northern Belgium). It is known from several historic sources that during Medieval times pigs were herded in the forests to feed on the acorns that lay on the ground (ten Cate 1972; Laurans 1975; Mane 1997). Usually, this was done against a payment called *pannage* (Rackham 2003). In several parts of north-western Europe this practice still existed until the 20th century. In South-West Spain, pigs are still turned loose in large oak groves called *dehesas* (Groove / Rackham 2001; Tovar / Giraldo 2006).
Acorns can be used for human consumption as well, though most oak species first need to be processed in a certain way to make them edible. Except for a few southern European species which produce acorns very low in tannins, tannins must be removed first to make the acorns suitable for human consumption. This can be done by peeling, roasting and/or boiling. Historical records of acorn processing from Sardinia mention the addition of iron-rich clay and ashes to the boiled and crushed acorns for a better removal or neutralisation of tannins (Johns / Duquette 1991a; 1991b; Mason 1992). Finally, the processed acorns can be grinded and used to make bread or porridge (Mason 1995). Sometimes acorns are not only roasted for the removal of tannins but also for a better conservation, preventing the sprouting of the acorns during storage. It also stops the infestation of acorn stocks by pests like the acorn weevil (*Curculio glandium*).
It seems that the acorns found at Boezinge have been collected to be used as food by humans. The material could have been collected for the use as fodder for pigs or for tanning, but in that case there is no need to remove the cupules, which has clearly been done here. Although ripe acorns normally loosen their cupules when falling from the tree, a high percentage of acorns fall on the ground with their cupule still attached, because they are not full-grown (Jones 1959). As no cupules have been found on the large number of acorns

investigated, some kind of selection must have been done in favour of ripe, full-grown acorns. It is unlikely that this would have been done if the acorns were to be used as fodder or for tanning.
The fact that the acorns have been found together with other (possible) food plants, both wild and cultivated, could be another indication for the use of acorns in human diet. However, at Boezinge, only a very small number of other plant species have been found. Emmer is the only cultivated plant of which a single specimen was recovered from the pit. Pale persicaria and black-bindweed, which have been found as well, are common weeds often collected in prehistoric times to be used as part of the human diet (Behre 2008) – but again, the number of seeds of these plants is too low to conclude that they were intentionally collected for consumption. These remains and the single emmer grain seem to have been charred accidentally together with the acorns.
It is not clear however how the acorns in the pit got charred. Most of the cotyledons were charred in a very homogeneous way which makes it unlikely that they have been roasted in an open fire. The way they were charred suggests that this happened very slowly and in an atmosphere with very little oxygen (Wright 2003). This makes it most likely that the acorns have accidentally been charred while being stored in the pit. Another explanation would be that they accidentally got charred during roasting. However, no wood charcoal, stones, or any other remains pointing towards the processing of the acorns have been found. But as the upper part of the pit is probably missing, it can not be excluded that these remains were no longer present at the moment of excavation.
It is also not clear whether the acorns have been shelled or not. As mentioned, no cotyledons have been found with the pericarp still attached. As loose fragments of charred pericarp were recovered in the pit, it is likely that the acorns have lost their pericarp during the carbonisation process, although it cannot be excluded that this has happened during the excavation and/or sieving. Several authors report that pericarps are missing in large collections of charred acorns (see e.g. Bouby / Ruas in preparation) – but, once detached, the thin and fragile fragments of acorn pericarp are hard to recover from an archaeological context and difficult to identify (Mason 1995). Moreover, Cunningham (2008, 278) reports from several roasting experiments with acorns that, when acorns char, the shell disintegrates, leaving behind a charred cotyledon. This means that it is very hard to tell whether acorns have been shelled on the basis of a find of charred acorns without pericarp. As fragments of pericarp have been found in the pit from Boezinge, we conclude here that the acorns have not been peeled.

COMPARATIVE DATA

There are numerous ethnographical and historical records of the use of acorns for human consumption, not only in periods of famine but also as a more common nutrient source (Mason 1992; McCorriston 1994). In particular, the use of acorns by the native population of California is very well documented (Gifford 1971; Basgall 1987; Jacknis 2004), but also in the Korean (Logan 2005), Japanese (Matsuyama 1981) and southern Italian (Mason 1992) cuisine, acorns were a popular food product until recently. Also in Spain and Greece roasted acorns have been eaten until modern times (De Cleene / Lejeune 2000). In north-western Europe acorn-eating during the last centuries has probably been restricted to periods of famine (Karg / Haas 1996; De Cleene / Lejeune 2000).
For Mediterranean Europe there are several descriptions of the use of acorns for human consumption in the past by classical authors like Juvenalis (Juvenalis, Sat. 6), Lucretius (Lucretius I.5), Strabo (Strabo III, 3.7) and Plinius (Plinius, Naturalis Historia 16.6). The use of acorns for human consumption in the medieval Arab world is described by Ibn al-'Awwâm (2000).

Next to these literary records, there is a vast amount of archaeobotanical finds indicating the use of acorns in human diet. Several authors like Knörzer (1972), Hopf (1986), Karg / Haas (1996), Vencl (1985; 1996), Aurenche (1997), de Hingh (2000), Matterne (2001), Cunningham (2008) and Jacomet (2009) have listed prehistoric finds of acorns in different parts of Europe and the Middle East. Only some of the more exceptional finds and some more recent finds are given below.

The oldest archaeobotanical find of acorns is probably the one at Gesher Benot Ya'aqoc/IL which dates to the Early-Middle Pleistocene (oxygen isotope stage 19; Goren-Inbar et al. 2002). Another Palaeolithic record of acorns was found at Ohalo II/IL, dating to ca. 23,000 BP (Kislev / Nadel / Carmi 1992). Most other Palaeolithic and Early Mesolithic records of acorn use are restricted to the Middle East and to southern Europe as oak had not yet spread into north-western Europe. In Spain e.g. acorns represent the most frequent taxon in the archaeobotanical finds of the Magdalenian, Epipalaeolithic and Mesolithic deposits from the cave site of Santa Maira, Alicante (Aura et al. 2005). Also in other Epipaleolithic, Mesolithic and Neolithic cave sites in Spain like Cova Matutano and Cova Fosca, both in Catalonia, acorns are one of the most frequent archaeobotanical finds (Mason / Hather / Hillman 2002).

Important acorn finds come from circum-alpine regions of Europe, i.e. from the Swiss Neolithic lake sites of Horgen Scheller (Favre 2002), Zürichsee-Mozartstrasse (Brombacher / Jacomet 1997), Cortaillod/Sur les Roches (Akeret 2005) and Arbon-Bleiche (Hosch / Jacomet 2004). However, the most remarkable archaeobotanical finds of acorns in this region are those found at the Bronze Age sites of Hauterive-Champréveyres/CH, Fiavé-Carera/I and Zug-Sumpf/CH, where ceramics with charred acorns inside have been found (Jacquat 1989; Evans 1994; Karg / Haas 1996). The acorns were all peeled and covered by a mushy matrix.

Another important archaeobotanical find of acorns derives from the Bronze Age site of Moers-Hülsdonk/D (Knörzer 1972). At this site, a large rectangular pit containing charred acorns, emmer (*Triticum dicoccum*), barley (*Hordeum* sp.), oat (*Avena* sp.), apples (*Malus sylvestris*) and hazelnuts (*Corylus avellana*) has been excavated. According to Knörzer (1972) the pit has been used to roast acorns.

A well known archaeobotanical record of acorns from Denmark consists of ca. 671 charred acorns found in the floor level of a burnt down Neolithic house (Jørgensen 1977). Here, the charred acorns were found together with hazelnuts, apples and barley. More recently, 40-50 litres of charred acorns have been found in Gilmosevej, a Late Neolithic site in central Jutland (Jensen 2008). The acorns were mixed with spelt (*Triticum spelta*) and naked six-rowed barley (*Hordeum vulgare*).

Recent finds of acorns from Southeast-Europe have been discovered at the Grapčeva cave/HR (Borojević et al. 2008) and at the Eneolithic pile dwelling site Hočevarica/SLO (Jerai / Velušček / Jacomet 2009). At the Grapčeva cave, charred acorns were the most abundant of all plant remains throughout the Neolithic, Copper Age and Bronze Age occupation layers. At Hočevarica, a large number of uncharred fragments of acorns has been found. Here, acorns are only outnumbered by fat hen (*Chenopodium album*) type.

In France, large numbers of charred acorns have been found at the Bronze Age sites of Questembert, Dép. Morbihan (De Closmadeuc 1863), Lyon, Dép. Rhône (Vital et al. 2007) and Fort-Harrouard, Dép. Eure-et-Loir (Bakels 1984; 1985). At Questembert, the charred acorns were associated with fragments of quern stones. Silos with acorns have been found at several archaeological sites such as the Late Bronze Age site of Planches-près-Arbois, Dép. Jura (Barbier et al. 1981), the Iron Age site Saint-Marcel du Pègue, Dép. Drôme (Marinval 1988) and several Iron Age sites in northern France (Matterne 2001). Ceramics filled with charred acorns have been found at Boussangues, Dép. Hérault (Chalcolithic) and Le Cayla, Dép. Aude (Iron Age) (Marinval 1988). A large number of possibly roasted acorns have been found at the Iron Age site of l'abri Sous-les-Rideaux, Dép. Haute Garonne (Bouby / Ruas in preparation).

Large numbers of charred acorns have been found in the Netherlands as well, most of them in Iron Age pits. Examples include the ±20,000 charred acorns found at Amersfoort-Zocherpad (Buurman 1990) and ±1800 charred acorns excavated at Dalen-Huidbergsveld (Van Zeist / Palfenier-Vegter 1994). An Iron Age pot and a silo, both filled with charred acorns, have been found in Colmschate (Buurman 1986).
For Belgium, there are only a small number of archaeobotanical records of acorns. But this is most probably the result of the scarcity of archaeobotanical research on prehistoric sites than a reflection of a supposedly limited role of acorns in the local prehistoric food economy (Bastiaens / Cooremans 2008). Charred acorns have been found at several Late Mesolithic sites at Doel, together with a variety of other collected wild plants (Bastiaens et al. 2005; 2007). About 2100 charred acorns have been found at the Iron Age site of Evergem-Ralingen, together with cultivated plants like common millet (*Panicum miliaceum*), six-rowed barley (*Hordeum vulgare*), emmer (*Triticum dicoccum*), spelt (*Triticum spelta*) and horse bean (*Vicia faba*) (De Ceunynck 1984; 1991). Another large quantity of charred acorns has been found at a Roman Age site at Zele (De Clercq et al. 2003).

THE ROLE OF BALANOPHAGY IN PREHISTORIC FOOD ECONOMY

Based on ethnological, historical and archaeobotanical data, it is clear that acorns have been frequently used as food by humans (balanophagy) in the past. However, as the use of wild plants by post-Mesolithic prehistoric cultures and their role in their subsistence system has received little attention so far (Vencl 1996; De Hingh 2000), the role of acorns amongst these wild plants has most probably been underestimated. This might be partly the consequence of taphonomic reasons. Collected plants, with a few exceptions like hazelnuts, are normally underrepresented at dry sites (Jacomet 2009). Moreover, just like for most other starch-rich seeds, the preservation of acorns in waterlogged conditions is not very good (Jacomet / Kreuz 1999). Acorns only do preserve well once charred because the elemental carbon of charcoal is not attacked by chemical or biological processes in sediments. However, when they are fragmented during or after charring, it can be hard to identify them.
At the submerged Mesolithic site of Tybrind Vig/DK which is known for its excellent preservation conditions, acorn use has only been attested by the identification of small fragments of acorn parenchyma and a few pieces of acorn epidermis, on the basis of their internal anatomical structure, using a scanning electron microscope (SEM) (Kubiak-Martens 1999). Also at sites like Cova Fosca and Roc de Migdia (Spain), which had no previous evidence of acorns, the presence of acorn parenchyma was attested only by a later SEM analysis (Holden / Hather / Watson 1995; Peña-Chocarro 1999; Mason / Hather / Hillman 2002). Another indication of a possible taphonomic bias comes from eastern North America, where archaeobotanical finds of acorns are often abundant but where the majority of finds consist of fragments of acorn shell of 2 mm or less. This might indicate that in Europe most of the evidence of acorn use may have been overlooked or was not preserved (Mason 1995). Despite all these taphonomic restrictions for the recovery and identification of acorns from archaeological contexts, the number of acorn finds is still high. At several Mesolithic sites in Europe, acorns are only outnumbered by hazelnuts, the husks of which are far more durable (Vencl 1996). According to Billard et al. (1994), acorns are the most frequently found wild fruits at protohistoric archaeological sites in France. In Spain, acorns are third (after wheat and barley) in terms of frequency of occurrence among archaeobotanical remains, thus even more frequent than staple cultigens as peas and lentils (Vencl 1996).
Finally, it should be realised that there are not only taphonomic constraints hampering the evaluation of the role of balanophagy in prehistoric subsistence. Also the fact that acorns are no longer considered as edible

but only suited as pig fodder makes it hard to see them as a possible staple food with a relative importance in prehistoric food economy (Vencl 1996). However, the high number of prehistoric sites where acorns have been found and the large number of acorns recovered from some of these sites make it unlikely that the consumption of acorns by man has been restricted to periods of famine. The growing number of archaeobotanical finds of acorns should stimulate us to reconsider the role of acorn eating in prehistoric food economy.

Bibliography

Akeret 2005: Ö. Akeret, Plant remains from a Bell Beaker site in Switzerland, and the beginnings of Triticum spelta (spelt) cultivation in Europe. Vegetation History and Archaeobotany 14, 2005, 279-286.

Aura et al. 2005: J. E. Aura / Y. Carrion / E. Estrelles / G. Pérez Jorda, Plant economy of hunter-gatherer groups at the end of the last Ice Age: plant macroremains from the cave of Santa Maira (Alacant, Spain) ca. 12000-9000. Vegetation History and Archaeobotany 14, 2005, 542-550.

Aurenche 1997: O. Aurenche, Balanophagy: mythe ou réalité? Paléorient 23, 1997, 75-85.

Bakels 1984: C. C. Bakels, Carbonized seeds from Northern France. Analecta Praehistorica Leidensia 17, 1984, 1-28.

1985: C. C. Bakels, Les graines carbonisées de Fort-Harrouard (Eure-et-Loir). Antiquités Nationales 14/15, 1985, 59-63.

Barbier et al. 1981: A. Barbier / R. C. Boudin / L. Chaix / G. Delibrias / J. Eroux / K. Lundström-Baudais / F. Passard / A. M. Petrequin / P. Petrequin / P. Picard / J. F. Piningre / H. Rutkowski / G. Sene / J. P. Urlacher / D. Vuaillat, La grotte des Planches-Près-Arbois (Jura). Gallia Préhistoire 24, 1981, 201-228.

Basgall 1987: M. E. Basgall, Resource intensification among hunter-gatherers: acorn economies in prehistoric California. Research in Economic Anthropology 9, 1987, 21-52.

Bastiaens / Cooremans 2008: J. Bastiaens / B. Cooremans, Zaden en Vruchten. In: Onderzoeksbalans Onroerend Erfgoed Vlaanderen [www.onderzoeksbalans.be/onderzoeksbalans/archeologie/natuurwetenschappen/archeobotanie/zaden_en_vruchten vom 12. 09. 2009].

Bastiaens et al. 2005: J. Bastiaens / K. Deforce / B. Klinck / L. Meerschaert / C. Verbruggen / L. Vrydaghs, Palaeobotanical analyses. In: Ph. Crombé (ed.), The last hunther-gatherer-fishermen in Sandy Flanders (NW Belgium). The Verrebroek and Doel excavation projects I. Archaeological Reports Ghent University 3 (Ghent 2005) 251-278.

2007: J. Bastiaens / K. Deforce / B. Klinck / L. Meerschaert, Two late mesolithic sites along the river Scheldt (Doel, Belgium): focus on woodland and the use of Viscum album and Hedera helix. In: A. Bieniek (ed.), 14th Symposium of the International Work Group for Palaeoethnobotany (Kraków 2007) 118.

Bauer / Karg / Steinhauser 1995: I. Bauer / S. Karg / R. Steinhauser, Kulinarische Reise in die Vergangenheit. Ein Kochbuch mit Rezepten von der Steinzeit bis ins Mittelalter. Schriften des Kantonalen Museums für Urgeschichte Zug 44 (Zug 1995).

Behre 2008: K.-E. Behre, Collected seeds and fruits from herbs as prehistoric food. Vegetation History and Archaeobotany 17, 2008, 65-73.

Billard et al. 1994: C. Billard / B. Aubry / G. Blancquaert / J.-R. Bourhis / G. Habasque / P. Marinval / C. Pinel / A. Ropars, Poses – Le Vivier – Le Clos-Saint-Quentin (Eure): l'occupation de la plaine inondable au Néolithique et au début de l'âge du Bronze. Revue Archéologique de l'Ouest 11, 1994, 53-113.

Borojević et al. 2008: K. Borojević / S. Forebaher / T. Kaiser / F. Berna, Plant Use at Grapčeva Cave and in the Eastern Adriatic Neolithic. Journal of Field Archaeology 33, 2008, 279-303.

Bot 2005: B. Bot, De IJzertijdbewoning in De Panne-Oosthoekduinen: een materiaalstudie [unpubl. diss. University of Ghent 2005].

Bouby / Ruas in preparation: L. Bouby / M. P. Ruas, Séchage ou grillage d'orge et de glands au premier âge de Fer: données carpologiques du site pyrénéen de l'abri Sous-les-Rideaux (Lepugue, Haute Garonne) (in preparation).

Brombacher / Jacomet 1997: C. Brombacher / S. Jacomet, Ackerbau, Sammelwirtschaft und Umwelt: Ergebnisse archäobotanischer Untersuchungen. In: J. Schibler / H. Hüster-Plogmann / S. Jacomet / C. Brombacher / E. Gross-Klee / A. Rast-Eicher, Ökonomie und Ökologie neolithischer und bronzezeitlicher Ufersiedlungen am Zürichsee. Monographien der Kantonsarchäologie Zürich 20 (Zürich 1997) 220-299.

Buurman 1986: J. Buurman, Graan in ijzertijdsilo's uit Colmschate. Nederlandse Archeologische Rapporten 3, 1986, 67-73.

1990: J. Buurman, Verkoolde eikeltjes uit de IJzertijd. Nieuwsblad gemeentewerken Amersfoort. Monumentenzorg en Archeologie 22, 1990, 3-4.

Cunningham 2008: P. Cunningham, Food for thought: exploitation of nuts in prehistoric Europe [unpubl. diss., University of Exeter 2008].

De Ceunynck 1984: R. De Ceunynck, IJzertijd – kuil te Evergem – Ralingen. VOBOV-Info 16, 1984, 15-21.

1991: R. De Ceunynck, A find of charred acorns in Evergem-Ralingen near Ghent (Belgian Iron Age). In: J. M. Renfrew (ed.), New light on early farming. Recent developments in palaeoethnobotany (Edinburgh 1991) 289-294.

De Cleene / Lejeune 2000: M. De Cleene / M. C. Lejeune, Compendium van rituele planten in Europa (Gent 2000).

De Clercq et al. 2003: W. De Clercq / J. Bastiaens / I. Bourgeois / K. Deforce / V. Gelorini / H. Tency / A. Van Petegem, Een plaats bij de Schelde in de eerste eeuwen van de jaartelling. Het Gallo-Romeinse Zele op basis van de opgravingen op de Kamershoek en de Zuidelijke Omleiding. VOBOV-Info 57, 2003, 25-35.

de Closmadeuc 1863: G. de Closmadeuc, Notes et considérations archéologiques sur les bronzes gaulois découverts aux environs

de Questembert. Bulletin de la Société Polymathique de Morbihan 3, 1863, 10-20.

de Hingh 2000: A. E. de Hingh, Food production and food procurement in the Bronze Age and Early Iron Age (2000-500 BC). Archaeological Studies Leiden University 7 (Leiden 2000).

Dixon et al. 1979: P. M. Dixon / E. A. McPherson / A. C. Rowland / W. Maclennan, Acorn poisoning in cattle. The Veterinary Record 104, 1979, 284-285.

Ervynck et al. 2007: A. Ervynck / A. Lentacker / G. Müldner / M. Richards / K. Dobney, An investigation into the transition from forest dwelling pigs to farm animals in medieval Flanders, Belgium. In: U. Albarella / K. Dobney / A. Ervynck / P. Rowley-Conwey (eds), Pigs and humans. 10,000 years of interaction (Oxford 2007) 171-193.

Evans 1994: J. Evans, Organic residues from Fiavé, Italy. In: R. Perini (ed.), Scavi archeologici nella zona palafitticola di Fiavé-Carera Parte 3, Campagne 1969-1976. Resti cultura materiale ceramica. Patrimonio Sorico e Artistico del Trentino 12 (Trento 1994) 1095-1098.

Favre 2002: P. Favre, Archäobotanik. In: Ch. Achour-Uster / U. Eberli / R. Ebersbach / P. Favre (eds), Die Seeufersiedlungen in Horgen. Die neolithischen und bronzezeitlichen Fundstellen Dampfschiffsteg und Scheller. Monographien der Kantonsarchäologie Zürich 36 (Zürich 2002) 150-180.

Gifford 1971: E. Gifford, California balanophagy. In: R. F. Heizer / M. A. Whipple (eds): The California Indians: a Source Book (Berkeley 1971) 301-305.

Goren-Inbar et al. 2002: N. Goren-Inbar / G. Sharon / Y. Melamed / M. Kislev, Nuts, nut cracking, and pitted stones at Gesher Benot, Israel. Proceedings of the National Academy of Sciences 99, 2002, 2455-2460.

Groove / Rackham 2001: A. T. Groove / O. Rackham, The nature of Mediterranean Europe. An ecological history (Yale, New Haven, London 2001).

Holden / Hather / Watson 1995: T. G. Holden / J. G. Hather / J. P. N. Watson, Mesolithic plant exploitation at Roc del Migdia, Catalonia. Journal of Archaeological Science 22, 1995, 769-778.

Hopf 1986: M. Hopf, Eicheln. In: H. Beck / H. Jankuhn / R. Wenskus (eds), Reallexikon der Germanischen Altertumskunde 6 (Berlin 1986) 534-536.

Hosch / Jacomet 2004: S. Hosch / S. Jacomet, Ackerbau und Sammelwirtschaft. Ergebnisse der Untersuchung von Samen und Früchten. In: S. Jacomet / U. Leuzinger / J. Schibler (eds), Die jungsteinzeitliche Seeufersiedlung Arbon Bleiche 3. Umwelt und Wirtschaft. Archäologie im Thurgau 12 (Frauenfeld 2004) 112-157.

Ibn al-'Awwân 2000: Ibn al-'Awwân, Kitâb al-filâha. Le Livre de l'Agriculture (traduction de l'arabe par J. J. Clément-Mullet) (Paris 2000).

Jacknis 2004: I. Jacknis, Food in California Indian Culture (Berkeley 2004).

Jacomet 2009: S. Jacomet, Plant economy and village life in Neolithic lake dwellings at the time of the Alpine Iceman. Vegetation History and Archaeobotany 18, 2009, 47-59.

Jacomet / Kreuz 1999: S. Jacomet / A. Kreuz, Archäobotanik. Aufgaben, Methoden und Ergebnisse vegetations- und agrargeschichtlicher Forschung (Stuttgart 1999).

Jacquat 1989: Ch. Jacquat, Les plantes de l'âge du Bronze. Contribution à l'histoire de l'environnement et de l'alimentation. Archéologie Neuchâteloise 8 (Hauterive 1989).

Jensen 2008: P. M. Jensen, Agern og korn fra Gilmosevej. En senneolitisk grube med agern og korn fra Gilmosevej (HEM 4086), Moesgård Museum – Konserverings – og Naturvidenskabelig Afdeling, Rapport 2-2008 (Moesgård 2008).

Jerai / Velušček / Jacomet 2009: M. Jerai / A. Velušček / S. Jacomet, The diet of Eneolithic (Copper Age, fourth millennium cal. B.C.) pile dwellers and the early formation of the cultural landscape south of the Alps: a case study from Slovenia. Vegetation History and Archaeobotany 18, 2009, 75-89.

Johns / Duquette 1991a: T. Johns / M. Duquette, Traditional detoxification of acorn bread with clay. Ecology of Food and Nutrition 25, 1991, 221-228.

1991b: T. Johns / M. Duquette, Detoxification and mineral supplementation as functions of geophagy. The American Journal of Clinical Nutrition 53, 1991, 448-456.

Jones 1959: E. W. Jones, Quercus L. The Journal of Ecology 47, 1959, 169-222.

Jørgensen 1977: G. Jørgensen, Acorns as a food-source in the later stone age. Acta Archaeologica (København) 48, 1977, 233-238.

Karg / Haas 1996: S. Karg / J. N. Haas, Indizien für den Gebrauch von mitteleuropäischen Eicheln als prähistorische Nahrungsressource. In: I. Campen (ed.), Spuren der Jagd – die Jagd nach Spuren. Festschrift für Hansjürgen Müller-Beck. Tübinger Monographien für Urgeschichte 11 (Tübingen 1996) 429-435.

Kislev / Nadel / Carmi 1992: M. E. Kislev / D. Nadel / I. Carmi, Epipalaeolithic (19,000BP) cereal and fruit diet at Ohalo II, Sea of Galilee, Israel. Review of Palaeobotany and Palynology 73, 1992, 161-166.

Knörzer 1972: K.-H. Knörzer, Eine bronzezeitliche Grube mit gerösteten Eicheln von Moers-Hülsdonk. Bonner Jahrbücher 172, 1972, 404-412.

Kubiak-Martens 1999: L. Kubiak-Martens, The plant food component of the diet at the late mesolithic (Ertebølle) settlement at Tybrind Vig, Denmark. Vegetation History and Archaeobotany 8, 1999, 117-127.

Lambinon et al. 1998: J. Lambinon / J.-E. De Langhe / L. Delvosalle / J. Duvigneaud, Flora van België, het Groot-Hertogdom Luxemburg, Noord-Frankrijk en de aangrenzende gebieden (Pteridofyten en Spermatofyten) (Meise 1998).

Laurans 1975: R. Laurans, L'élevage du porc à l'époque médiévale. In: R. Pujol (ed.), L'homme et l'animal. Premier colloque d'ethnozoologie (Paris 1975) 523-34.

Logan 2005: W. B. Logan, Oak: the frame of civilization (New York 2005).

Maes et al. 2006: B. Maes / J. Bastiaens / O. Brinkkemper / K. Deforce / C. Rövekamp / P. Van Den Bremt / A. Zwaenepoel, Inheemse bomen en struiken in Nederland en Vlaanderen (Amsterdam 2006).

Mane 1997: P. Mane, »Toujours pourceaux paitront glands« ou l'élevage du porc à travers l'iconographie médiévale. In: J. Kubkorá / J. Klápště / M. Ježek / P. Meduna (eds), Život v archeologii středověku (Life in the archaeology of the middle ages) (Praha 1997) 439-50.

Marinval 1988: Ph. Marinval, L'alimentation végétale en France du Mésolithique jusqu'à l'âge du Fer (Toulouse 1988).

Mason 1992: S. L. R. Mason, Acorns in human subsistence [unpubl. diss., University College London 1992].

1995: S. L. R. Mason, Acornutopia? Determing the role of acorns in past human subsistence. In: J. Wilkins / D. Harvey / M. Dobson (eds), Food in antiquity (Exeter 1995) 12-24.

Mason / Hather / Hillman 2002: S. L. R. Mason / J. G. Hather / G. C. Hillman, The archaeobotany of European hunter-gatherers: some preliminary investigations. In: S. L. R. Mason / J. G. Hather (eds), Hunter-gatherer archaeobotany. Perspectives from the northern temperate zone (London 2002) 188-196.

Matsuyama 1981: T. Matsuyama, Nut gathering and processing methods in traditional Japanese villages. In: S. Koyama / D. Thomas (eds), Affluent Foragers: Pacific Coasts East and West. Senri Ethnological Studies 9 (Osaka 1981) 117-139.

Matterne 2001: V. Matterne, Agriculture et alimentation végétale durant l'âge de Fer et l'époque gallo-romaine en France septentrionale. Archéologie des Plantes et des Animaux 1 (Montagnac 2001).

McCorriston 1994: J. McCorriston, Acorn eating and agricultural origins: California ethnographies as analogies for the ancient Near East. Antiquity 68, 1994, 97-107.

Peña-Chocarro 1999: L. Peña-Chocarro, Prehistoric agriculture in southern Spain during the Neolithic and Bronze Age. BAR International Series 818 (Oxford 1999).

Rackham 2003: O. Rackham, Ancient woodland: its history, vegetation and uses in England (Colvend 2003).

Ramsey 1995: C. B. Ramsey, Radiocarbon calibration and analysis of stratigraphy: the OxCal program. Radiocarbon 37, 1995, 425-430.

Reimer et al. 2004: P. J. Reimer / M. G. L. Baillie / E. Bard / A. Bayliss / J. W. Beck / C. J. H. Bertrand / P. G. Blackwell / C. E. Buck / G. S. Burr / K. B. Cutler / P. E. Damon / R. L. Edwards / R. G. Fairbanks / M. Friedrich / T. P. Guilderson / A. G. Hogg / K. A. Hughen / B. Kromer / F. G. McCormac / S. W. Manning / C. B. Ramsey / R. W. Reimer / S. Remmele / J. R. Southon / M. Stuiver / S. Talamo / F. W. Taylor / J. van der Plicht / C. E. Weyhenmeyer, IntCal04 terrestrial radiocarbon age calibration, 26-0ka BP. Radiocarbon 46, 2004, 1029-1058.

Tack / Van Den Bremt / Hermy 1993: G. Tack / P. Van Den Bremt / M. Hermy, Bossen van Vlaanderen: een historische ecologie (Leuven 1993).

ten Cate 1972: C. L. ten Cate, Wan god mast gift. Bilder aus der Geschichte der Schweinezucht im Walde (Wageningen 1972).

Tovar / Giraldo 2006: M. A. A. Tovar / J. D. V. Giraldo, Considerations on ethics and animal welfare in extensive pig production: breeding and fattening Iberian pigs. Livestock Science 130, 2006, 237-242.

Van Genderen / Schoonhoven 1997: H. Van Genderen / L. M. Schoonhoven, Chemisch-ecologische flora van Nederland en België (Utrecht 1997).

Van Zeist / Palfenier-Vegter 1994: W. Van Zeist / R. M Palfenier-Vegter, Zaden en vruchten uit prehistorisch en vroeg-historisch Dalen: een archeobotanisch onderzoek. Nieuwe Drentse Volksalmanak 1994. Jaarboek voor Geschiedenis en Archeologie 111, 1994, 146-160.

Vencl 1985: S. Vencl, Žaludyn jako potravina – acorns as food. Archeologické Rozhledy 37, 1985, 516-565.

1996: S. Vencl, Acorns as food: again. Památky Archeologické 87, 1996, 95-111.

Vital et al. 2007: J. Vital / L. Bouby / F. Jallet / P.-J. Rey, Un autre regard sur le gisement du boulevard périphérique nord de Lyon (Rhône) au Néolithique et à l'Âge de Bronze. Gallia Préhistoire 49, 2007, 1-126.

Wright 2003: P. Wright, Preservation or destruction of plant remains by carbonisation? Journal of Archaeological Science 30, 2003, 577-583.

Zusammenfassung / Abstract / Résumé

Eisenzeitliche Eicheln aus Boezinge (Belgien): zur Rolle des Verzehrs von Eicheln in vorgeschichtlicher Zeit
2005 wurde in Boezinge (Belgien) eine eisenzeitliche Grube mit einer besonders hohen Zahl an verkohlten Eicheln (geschätzte Gesamtzahl ca. 69 000) ausgegraben. Die Entdeckung einer derart hohen Zahl stellt die Frage nach der Rolle von Eicheln in der vorgeschichtlichen Ernährung. Obwohl Eicheln heute als nicht mehr für die menschliche Nahrung geeignet angesehen werden, wird ihre Bedeutung innerhalb der vorgeschichtlichen Verpflegung aber durch die wachsende Zahl archäobotanischer Nachweise und besonders durch diesen Fund aus Belgien aufgezeigt. Berücksichtigt man die Faktoren, welche die Erhaltung, die Fundbergung und die Identifizierung von Eicheln an archäologischen Fundstellen beeinflussen, so ist zu vermuten, dass die Rolle von Eicheln bei der prähistorischen Ernährungs noch nicht vollständig erkannt ist.

Iron Age acorns from Boezinge (Belgium): the role of acorn consumption in prehistory
In 2005, an Iron Age pit containing an exceptionally large amount of charred acorns (i.e. an estimated total of approximately 69,000 acorns) was excavated in Boezinge (Belgium). The discovery of such a large number of acorns raises questions about the role of acorns in prehistoric subsistence. Although acorns are nowadays no longer considered suitable for human consumption, the growing number of archaeobotanical finds of acorns and especially this recent find from Belgium reveal their importance in prehistoric subsistence. Taking into account the factors influencing the preservation, recovery and identification of acorns from archaeological sites, it is very probable that the role of acorns in prehistoric food economy has not fully been recognized.

Les glands de l'âge du Fer de Boezinge (Belgique):
le rôle des glands dans l'économie d'alimentation préhistorique
En 2005, une fosse datant de l'âge du Fer et contenant une quantité exceptionnelle de glands carbonisés a été fouillée à Boezinge (Belgique). Le nombre de glands a été estimé environs 69 000. La découverte d'un tel nombre de glands pose des questions de leur rôle dans l'alimentation préhistorique. Bien que le gland aujourd'hui ne soit plus considéré propre à l'alimentation humaine, la découverte faite à Boezinge ainsi que le nombre croissant de contextes archéo-botaniques contenants des glands indiquent leur importance pour l'alimentation durant la préhistoire. Le rôle de ce fruit est probablement encore sous-estimé car beaucoup de facteurs en influencent la conservation, la trouvaille et la détermination.

Schlüsselwörter / Keywords / Mots clés

Belgien / Eisenzeit / Latène / Eicheln / Balanophagie / Ernährung
Belgium / Iron Age / La Tène / acorns / balanophagy / nutrition
Belgique / âge du Fer / La Tène / glands / balanophagie / alimentation

Koen Deforce
Jan Bastiaens
Hans Van Calster
Sofie Vanhoutte
Vlaams Instituut voor het Onroerend Erfgoed
Koning Albert II Laan 19 bus 5
B - 1210 Brussels
koen.deforce@rwo.vlaanderen.be
jan.bastiaens@rwo.vlaanderen.be
hvancalster@gmail.com
sofie.vanhoutte@rwo.vlaanderen.be