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ORIGINAL ARTICLE

Direct evidence of heathland management in the early Bronze Age (14th century B.C.) from the grave-mound Skelhøj in western Denmark

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Abstract Plant macrofossil analysis of soil samples from the grave-mound Skelhøj, western Jutland in Denmark, showed that heather sods had been used as building material. The original vegetation horizon, which was still preserved within the sods allowed the reconstruction of the original vegetation cover of the Bronze Age landscape. It was therefore possible to determine the land-use systems of the Bronze Age societies there during the 14th century B.C. The sods derived from a dry to medium-dry heathland community previously used as pasture. Many grasses and herbs indicate that it was not a very well developed (or old) heathland that was used for the building material of the mound, but a newly re-established heath cover above an older one that had been burnt some years before the sod-cutting activities took place. Charred finds of roots, twig fragments, flowers and seeds of *Calluna vulgaris* L. (heather) dominated the plant spectrum. *Cuscuta epithymum* L. (dodder) was found in 31% of the sod samples. This parasitic plant is known for successfully spreading on burnt heather plants that have started to re-develop with new shoots.

Keywords Denmark · Bronze Age landscape · Heathland burning management · Grave mound building material

Introduction

The large grave-mound Skelhøj (30 m in diameter and 5 m in height) is situated in a totally flat landscape close to the river Kongeå near the village of Tobøl north of the town of Ribe in western Jutland (Jylland), Denmark (Fig. 1). Today the surroundings of the grave-mound are heavily cultivated and flattened. There are settlement traces and barrows dating from the early to the late Bronze Age in the close vicinity. Uncharred heather shoots and flowers were radiocarbon dated, and show that the Skelhøj grave-mound was built in the 14th century B.C. (Kristiansen et al. forthcoming).

During the excavation in 2002–2004, the Skelhøj grave-mound was totally investigated and hundreds of soil samples were taken systematically in order to reconstruct the provenance of the building material, and the ecological conditions in the vicinity of the site (Fig. 2). The anaerobic preservation conditions in the lowest part of the barrow under the iron pan were especially suitable for bio-archaeological research (Holst Kähler et al. 2004). Samples for plant macrofossil, pollen, charcoal and insect analyses were taken from these layers. Here the results of the plant macrofossil analysis will be presented.

Materials and methods

For plant macrofossil analysis, 163 sods representing the original building material of the mound were sampled. The samples were taken by pressing a metal frame into the individual profile faces. This method provided that the surface of the sods was placed in the central part of the sample. The samples measuring $15 \times 8 \times 5$ cm^3 in size were wrapped in plastic film, fastened with adhesive tape in order to keep the original shape and to prevent them from drying out, and were kept in a refrigerator until analysis.

As agreed with the archaeologists, 29 samples were chosen for detailed plant macrofossil analysis. These

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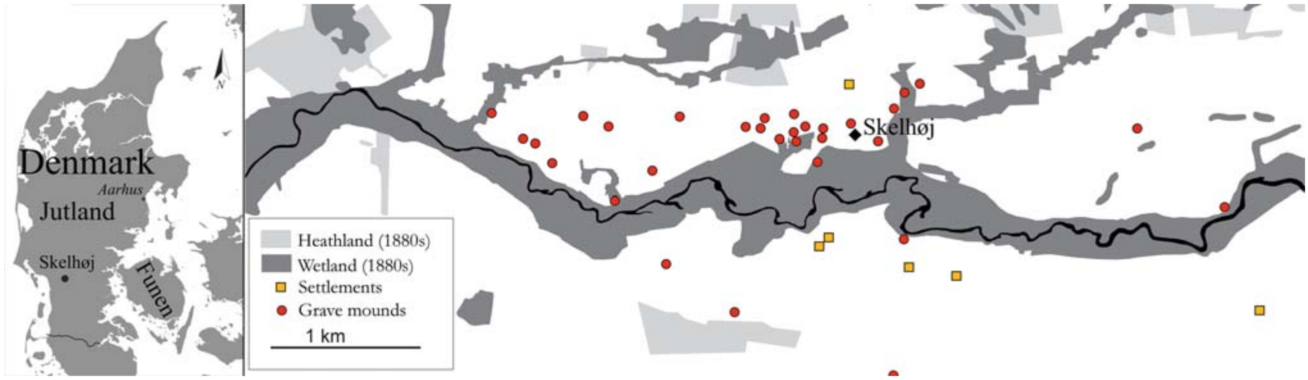

Fig. 1 **a** Map showing the location of Denmark and **b** the grave-mound at Skelhøj in western Jutland (Jylland) close to the town of Ribe. *Design* Mads Kähler Holst

Fig. 2 The grave-mound at Skelhøj during the archaeological excavation in 2003 viewed from the southwest. The arrangement of the sods is visible in the front profile. *Photo* Per Poulsen

samples came from the following parts of the mound: three samples of the buried soil under the barrow, 14 samples from the primary barrow stage, 5 samples from the facing and seven samples from the first shell (Fig. 3). An inspection of a sub-sample taken from the mineral part of one sod showed that almost no plant remains were preserved there. The promising plant finds could only be expected in the original vegetation cover on the surfaces of the sods. Therefore, all samples were taken from the lowest layer of sods (the original soil cover lying upside down), because of the excellent preservation of the plant remains there.

The original vegetation horizon was preserved as a 4–8 mm thick layer in most sods and consisted predominantly of flattened plant fragments, and samples from this layer were prepared for plant macrofossil analysis.

The visual composition of the plant macrofossil samples was recorded and sub-samples for pollen analysis were taken. The volumes of the samples were measured and the soil was water-sieved using a 0.25 mm mesh size. With the help of this procedure, the clay and fine sand were removed and the concentrated plant remains could more easily be studied under the binocular microscope. In some cases it was necessary to soak the samples in KOH for 12 h, to get the sediment dispersed more quickly.

Plant identification was made using the reference collection of modern seeds and fruits of the National Museum of Denmark, as well as selected literature (Anderberg 1994; Beijerinck 1947; Berggren 1981; Körber-Grohne 1991). Plant nomenclature follows Flora Nordica (Jonsell 2000, 2001) and Jahns (1980), and the English plant names are according to Stace (1991). As seeds of heather were abundant in all samples, the finds were recorded semi-quantitatively in the case of more than 100 finds per sample (>100, >500, >1,000, >5,000 finds, see Table 1). The results of the analysis are stored in a database and selected

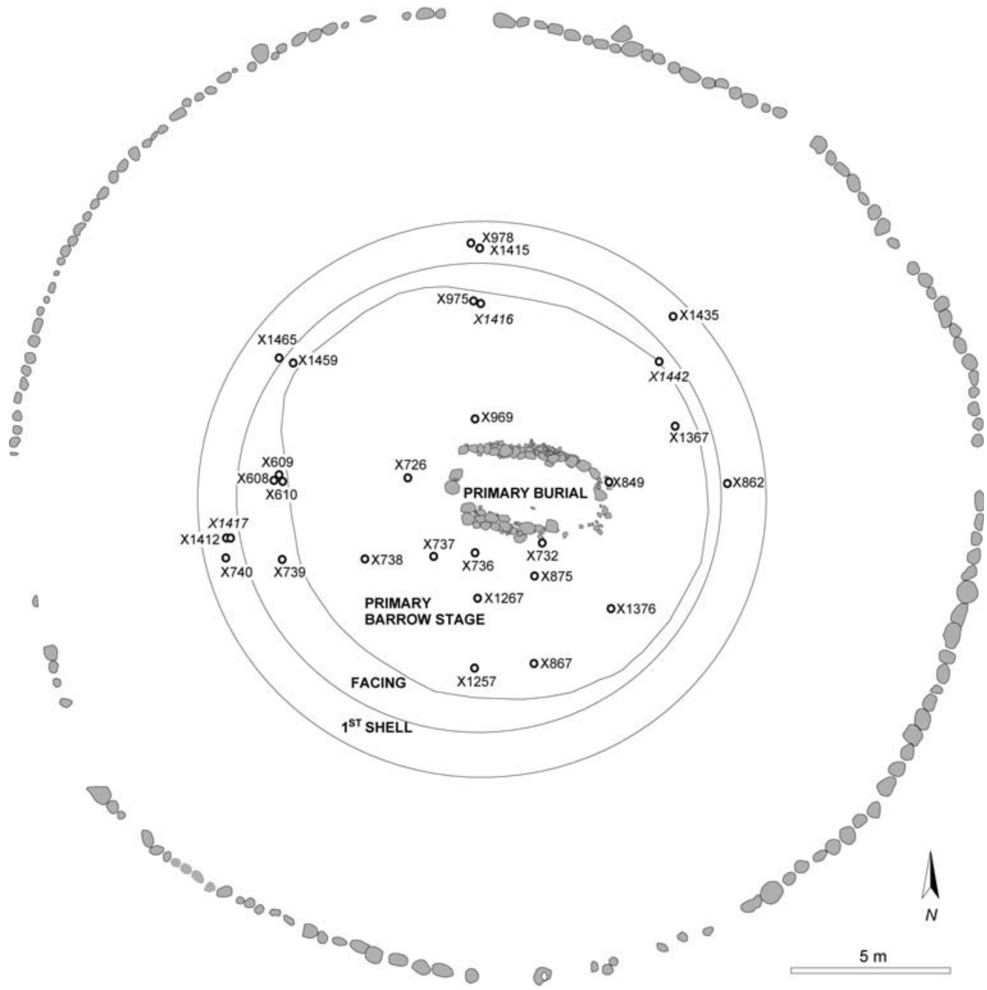

Fig. 3 Plan of the plant macrofossil samples in the different building phases of the grave-mound Skelhøj. *Design* Mads Kähler Holst

plant finds were measured and photographed. All plant finds are archived in the store of the National Museum.

Results

Most of the plant remains were very well preserved, both in charred and uncharred condition (Tables 1, 2). The preservation condition of the plant macrofossils was closely connected to the amounts of oxygen and water within the mound stratigraphy. In the upper parts of the mound, the soil had been aerated and drained thoroughly and the organic materials were therefore totally decomposed. Only carbonised seeds and fruits had a chance to survive there. The deeper the archaeologists dug into the oxygen-poor layers, the better the preservation of the uncharred organic materials became. The iron pan encapsulated the lowest metre of the barrow completely. At this level both plant and insect remains were best preserved.

Each of the sod samples represents a small part of the original Bronze Age land surface with an area of between 40 and 80 cm^2, depending on the orientation of the vegetation horizon within the samples. Most of the plants that were identified had grown directly on the sods, which means they are ''in situ finds'' from the original places from which the sods were cut.

The plant finds from the building material of the Skelhøj mound were interpreted according to their modern plant sociological and ecological values and by using the modern analogue method (Behre and Jacomet 1991; Birks et al. 1988). This allows reconstruction of the evolution of past landscapes in relation to the influence of humans and their settlement activities. Tables 1 and 2 include the vegetation units characterized by the relevant plant taxa after Ellenberg et al. (1992).

Plants indicating heaths and grasslands influenced by humans and their domestic animals

The main plant parts in the sieved remains of the sod samples were roots, stalks, twigs, flowers and seeds of *Calluna vulgaris* (heather; Fig. 4). Plants mainly growing on a dry heathland grazed by domestic animals dominated the floras from the sods. The following species were found

Table 1 The uncharred plant macrofossil finds from sods of the Skelhøj grave-mound dated to the early Bronze Age

Vegetation units			Buried soil under the barrow			Primary barrow stage														Facing					First shell						
						NW-W		NE-E		E-SE	SE-S					SE-S or S-SW	SW-W			SW-W	SW-W			W-NW	NW-N		N-NE	NE-E	SW-W		W-NW
	Sample code		1416	1417	1442	969	975	849	1367	1376	732	867	875	1257	1267	736	726	737	738	608	609	610	739	1459	978	1415	1435	862	740	1412	1465
	Size (cm^2)		-	70	70	70	75	75	70	70	80	40	70	50	70	80	36	40	70	-	-	-	70		75	60	70	70	70	55	70
5.1	*Calluna vulgaris* (L.) Hull	s	>100	>100	>1,000	>500	>500	>500	>500	>500	>100		>5,000	>100	>500	>1,000	>100	>100	>5,000	1		>100	>500	57	>1,000	>5,000	>500	>500	>5,000	>500	12
5.1	*Calluna vulgaris* (L.) Hull	f	212	33	159	115	124	112	83	43	61		299	28	276	142	63	211	294	243	1	178	128	148	114	84	130	34	337	158	23
5.1	*Calluna vulgaris* (L.) Hull	shfr	628	218	672	381	1258	132	467	236	266	5	379	103	461	599	377	914	697	496	40	714	434	294	1187	358	827	256	898	294	106
5.11	*Carex ovalis* Good	s																													1
5.1	*Carex pilulifera* L.	s	4		8	2	14	1			1			3	1		10	2	7	6		7	2	1	1	1			21	1	2
5.1	*Cuscuta epithymum* L.	s											4	1		1	1	3	1				5	8					1		
5.1	*Danthonia decumbens* (L.) DC.	s				1	3	51	2						4					1			1		5	1	3		1	2	
5.1	*Danthonia decumbens* (L.) DC.	spfr						2																							
5.1	*Potentilla erecta* (L.) Räuschel	s	4			2										1		13				3			1				22		
5.112	*Dianthus deltoides* L.	s											1																		
5.3	*Pimpinella saxifraga* L.	s											4					2													
5.41	*Lychnis flos-cuculi* L.	s																									1				
5.4	*Plantago lanceolata* L.	s								1																					
5.4	*Ranunculus acris* L.	s																											2		
5.4	*Rumex acetosella* L.	s	1	4	20	24	2	7	1							1				2				2	11	11					
5.415	*Polygonum aviculare* s.l.	s																	1												
6.1	*Hypericum perforatum* L.	s			16	1	2	59	2				1		2			1							3						
3.3	*Chenopodium album* L.	s	3						7				1	1		1		1	2	1						3					1
3.31	*Persicaria lapathifolia* s.l.	s				2	1																10					1		2	
3.3	*Stellaria media* L.	sfr																						1							
8.211	*Alnus glutinosa* (L.) Gaertn.	s																1													
1.51	*Eleocharis palustris/uniglumis*	s																							1				1		
1.51	*Poa palustris* L.	s					1						1												3			2			1
1.611	*Stellaria alsine* Grimm	s	2	6	1	1	1	2			3		1			16		4	1				2		1		1		1	4	
x	*Agrostis* sp.	s				2	1						1												1						
x	*Agrostis/Phleum*	s											1																		
x	Asteraceae	s	1																												
x	*Atriplex/Chenopodium*	s							1												1										
x	*Atriplex* sp.	s			1																										
x	*Betula* sp.	s																											1		
x	cf. *Calamagrostis* sp.	s																										1			
x	*Campanula rotundifolia* L.	s			2	2	1	17	10				1				1	7	3					2	2				1		
x	cf. *Cardamine hirsuta* L.	s														1															
x	*Carex* sp.	s						1						1									1							2	
x	*Deschampsia flexuosa* (L.) Trin.	s																					1								
x	*D.* cf. *flexuosa* (L.) Trin.	s																													
x	*D.* cf. *cespitosa* (L.) P. Beauv.	s																							2						
x	*Deschampsia* sp.	s																1													
x	Ericaceae (cf. *Calluna*)	rtwfr	110	19	60	191	50	25	102	54	5		68	91	5	95	47	105	74	58	11	60		4	396	62	125	40	66	15	59
x	*Euphrasia/Odontites*	s							1																						
x	*Festuca rubra/ovina*	s														1															
x	*Lapsana communis* L.	s	25																												
x	*Luzula* sp.	s	1	1	12	9	9	12	8				7			10	2	3	3				7	2	4	1	16		6	7	1
x	*Mentha* sp.	s																							1						
x	*Odontites verna* (Bellardi) Dumort. coll.	s																											1		
x	*Persicaria* sp.	s	1																							1					
x	*Phleum* sp.	s				1																									
x	*Poa annua* L.	s																													
x	*Poa* sp.	s				2	5						1					1	1	1			1						1		
x	Poaceae	s			9	8	4	6	4	1					2	3	1		1	2			4		17	13	2	1	2		2
x	Poaceae	st					10	5					3														1				
x	*Potentilla* sp.	s	11	1	1	4	4	7			1				1	4		3	5	1	1	11	7		1				25		
x	*Ranunculus* sp.	s														1											1		2		
x	*Rorippa* sp.	s																	1												
x	*Sagina* sp.	s																						3							
x	*Stellaria graminea/palustris*	s				1		1						7									3	2					6		
x	*Stellaria* sp.	s							1																						
x	cf. *Stellaria* sp.	sfr																					1		1						
x	*Veronica* sp.	s			1																			1							
x	*Viola* sp.	s	1	1	5	1	3	5	5		2		10		4	5	3	1	1	4		4	6	2	1	2	10	2	7		
x	Indeterminata	s, sfr	3	6	2	2			4		6		3	2		6	2	1	5	2			1	4	4	6	2		8	8	1
x	Bryophyta	l	111	9	312	60	87	15	45	59	12			5	10	8	788	55	14	268	12	74	114	20	12	24	16	43			5
x	*Plagiomnium affine* (Bland.) T. Kop.*	l	4																												

◀ The samples are grouped according to the defined building sequences of the mound (Fig. 3). Nomenclature of the vascular plants according to ICBN and ICNCP (International Code of Botanical Nomenclature and International Code for Cultivated Plants, Erhardt et al. 2002). Moss nomenclature after Jahns (1980). Vegetation units after Ellenberg et al. (1992): 1.5 = Phragmitetea, 1.6 = Montio-Cardaminetea, 3.3 = Chenopodietea, 3.5 = Artemisietea, 5.1 = Nardo-Callunetea, 5.3 = Festuco-Brometea, 5.4 = Molinio-Arrhenatheretea, 6.1 = Trifolio-Geranietea, 8.2 = Alnetea glutinosae, 8.4 = Querco-Fagetea, *x* = indifferent ecological and sociological values

s seed, *sfr* seed fragment, *f* flowers, *l* leaves, *rtwfr* root- and twig fragments, shfr = shoot fragments, *spf(f)r* spikelet (fork)fragment, *st* stem fragments. Analysis by S. Karg, P. S. Henriksen, J. A. Harild, *moss determined by G. S. Mogensen

(see Tables 1, 2): *Carex ovalis*, *C. pilulifera* (oval and pill sedges), *Cuscuta epithymum* (dodder) which often grows on sprouting heather that has been burnt (Fig. 5; Møller Jensen and Nagstrup 2004), *Danthonia decumbens* (heath-grass), *Hieraceum* cf. *aurantiacum* (hawkweed), *Potentilla erecta* (tormentil), and *Dianthus deltoides* (maiden pink). In addition, *Pimpinella saxifraga* (burnet saxifrage) was found as a species characteristic of nutrient poor, sandy soils. The species of the Molinio–Arrhenatheretea are characterized by their higher demand for moisture and nitrogen, and include the following: *Lychnis flos-cuculi* (ragged robin), *Plantago lanceolata* (ribwort plantain), *Ranunculus acris* (meadow buttercup), *Rumex acetosella* (sheep's sorrel) and *Polygonum aviculare* (knotweed). In addition, *Hypericum perforatum* (perforate St John's wort) is a perennial plant growing on poor soils in different habitats, among others also in heathlands.

Plants of disturbed places (pathways, arable land etc.)

Chenopodium album (fat-hen), *Persicarialapathifolia* (pale persicaria) and *Stellaria media* (common chickweed) are present in several samples (Tables 1, 2). These plants might indicate that cornfields (or manured land) had been in the close vicinity of the heathland, or that the heath itself had been burnt and used as arable land. More evidence for the cultivation of heathland can be seen in the charred spikelet fragments of *Triticum dicoccum* (emmer) and *T. spelta* (spelt wheat) that were recorded in three samples (primary barrow stage and first shell, Table 2). They might represent waste in the form of manuring residues that are generally often found in the near surroundings of Bronze Age settlements (Bakels 1997).

Trees and shrubs

Only four species of trees and shrubs were recorded: *Alnus glutinosa* (alder), *Myrica gale* (bog-myrtle), both growing in wet places, *Betula* sp. (birch) and *Corylus avellana* (hazel). The single finds of alder and birch in the primary barrow stage and the first shell could have been transported by the wind. Hazelnut shells were found in one sample (first shell) and they were all charred. How did the hazelnuts find their way to the heather sods? As hazelnuts have always served as supplementary food for humans, they may just represent settlement waste.

Plants of damp biotopes

Seeds from four different plants growing close to wetlands (ditches, river banks etc.) were identified. The most frequent species recorded by uncharred seeds was *Stellaria alsine* (bog stitchwort), found in 55% of all the samples. The name of this annual plant allows one to draw conclusions about its original habitat, which is normally close to springs or along the edges of ditches. A secondary habitat where the plant nowadays grows frequently is along woodland paths.

Eleocharis palustris/uniglumis (spike-rush) was only recorded twice in samples from the first shell, *Poa palustris* (swamp meadow-grass) and *Myrica gale* only once, in a sample from the first shell, and in the facing. All four plants grow in wet habitats and the question is how they found their way into the heather sods. It does not seem possible that they were growing on the heathland sods themselves. The single seed of alder in sample ×737 might have been transported by wind. Moss remains were abundant, however *Plagiomnium affine*, the only one identified to species level, can either grow on damp or dry woodland soils, but also in wet grasslands.

Discussion

Reconstruction of the landscape surrounding the grave-mound

The results of the plant macrofossil analysis from the buried soil under the barrow, as well as those from the different building sequences (primary barrow stage, facing and first shell) were very similar in the composition of the vegetation. Therefore it seems very likely that the sods for building this enormous monument were dug up close to the grave mound. We may have to imagine a treeless landscape covered with dry and grassy heathland vegetation. The plants represented in the samples from the primary barrow stage reflect a more diverse picture. This may be due to the larger number of samples analysed and not to sods of a different origin. The vegetation can also be attributed to heathland in its pioneer phase, where the remaining cover of bryophytes

Table 2 The charred plant macrofossil finds from sods of the Skelhøj grave-mound dated to the early Bronze Age. The samples are grouped according to the defined building sequences of the mound; further explanations see Table 1. Analyses by S. Karg, P.S. Henriksen, J. A. Harild

Vegetation units			Buried soil under the barrow			Primary barrow stage														Facing					First shell						
						NW-W		NE-E		E-SE	SE-S					SE-S or S-SW	SW-W			SW-W	SW-W			W-NW	NW-N		N-NE	NE-E	SW-W		W-NW
	Sample code		1416	1417	1442	969	975	849	1367	1376	732	867	875	1257	1267	736	726	737	738	608	609	610	739	1459	978	1415	1435	862	740	1412	1465
5.1	*Calluna vulgaris* (L.) Hull	s																						2							
5.1	*Calluna vulgaris* (L.) Hull	f	16	21	27	34	89	95	48	42	76	5	44	22	114	106	4	65	23	154		25	27	50	99	44	28	15	20	19	79
5.1	*Calluna vulgaris* (L.) Hull	shfr	95	89	59	60	245	34		201	500	23	209	58	55	34	25	44	38	79	5	90	41	54	44	41	42	21	69	114	14
5.1	*Carex pilulifera* L.	s				1																									
5.111	*Hieraceum* cf. *aurantiacum* L.	s					1																								
5.1	*Potentilla erecta* (L.) Räuschel	s																1				5									
5.3	*Pimpinella saxifraga* L.	s								1																					
5.4	*Plantago lanceolata* L.	s								1																					
5.4	*Rumex acetosella* L.	s				1																									
6.1	*Hypericum perforatum* L.	s						3																							
8.212	*Myrica gale* L.	s																						1							
8.4	*Corylus avellana* L.	s																								2					
1.611	*Stellaria alsine* Grimm	s																1													
x	*Deschampsia* cf. *flexuosa* (L.) Trin.	s																							1						
x	Ericaceae (cf. *Calluna*)	rtwfr							30								32	8		3	2	60									
x	*Euphrasia/Odontites*	s					1																								
x	*Poa/Phleum*	s																											1		
x	Poaceae	s		1			1			1			1																		
x	*Potentilla* sp.	s													1																
x	*Ranunculus* sp.	s																											2		
x	*Stellaria graminea/palustris*	s								1											1										
x	*Stellaria* sp.	s																							1						
x	*Triticum dicoccum/spelta*	spffr									1																				
x	*Triticum spelta* L.	spffr										1													1						
x	*Viola* sp.	s							1																						
x	Indeterminata	s					1	1																							
x	Unidentified buds	b									1																				
x	Wood, charcoal	w	23			4	7	13		10	21	45		15		15							22		10			13	15	9	19
x	Bryophyta	l	19	16		3			1	93	500			43	31		5	25		21		23	18	25							1

(mosses) was abundant and other vascular plants were at their maximum. In such a pioneer phase the heather plants would have been 3–10 years of age (Gimingham 1972).

At least four of the vascular plants indicate that the heathland was mown and/or grazed, since they are species of the Molinio–Arrhenatheretea class of grassland plant communities, *Plantago lanceolata*, *Ranunculus acris*, *Rumex acetosella* and *Lychnis flos-cuculi*. Heather is an important fodder plant for several herbivores, and heathland was, and still is in some parts of Europe, heavily grazed, particularly in winter, when the biomass of grass plants is at a minimum (Odgaard 1994).

Reconstruction of the land-use system during the earlier Bronze Age period

The charred finds of heather and some charred seeds of accompanying herbs such as *Carex pilulifera, Euphrasia/Odontites* (eyebright/bartsia), *Hypericum perforatum*, *Pimpinella saxifraga*, *Plantago lanceolata*, *Potentilla erecta*, *Rumex acetosella*, *Stellaria* sp. and mosses, clearly show that the heathland had previously been burnt (Table 2). The uncharred shoots of heather indicate that the burning had taken place some years before the sods were cut. A new vegetation layer on top of the burnt heather had by then already re-established itself.

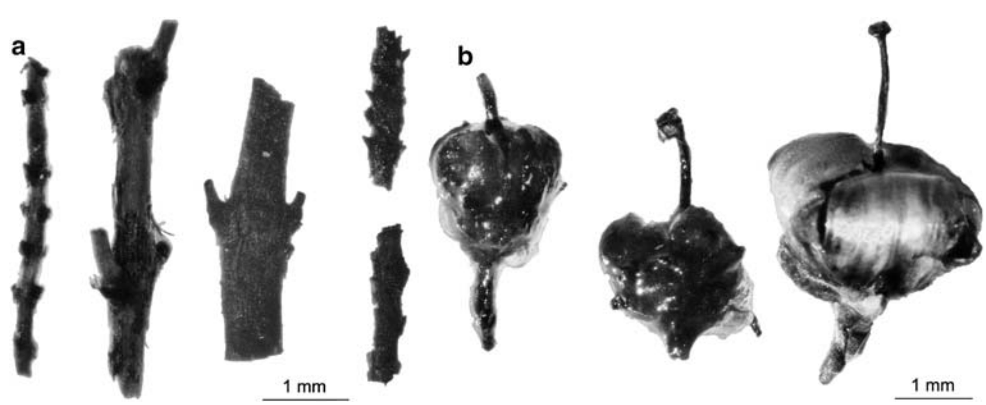

Fig. 4 **a** Charred and uncharred finds of heather twigs dated to the early Bronze Age. **b** Uncharred inflorescences of *Calluna vulgaris* (heather), the two on the left are dated to the early Bronze Age, the right one is modern; *scale bars* 1 mm (*photo* Jan Andreas Harild)

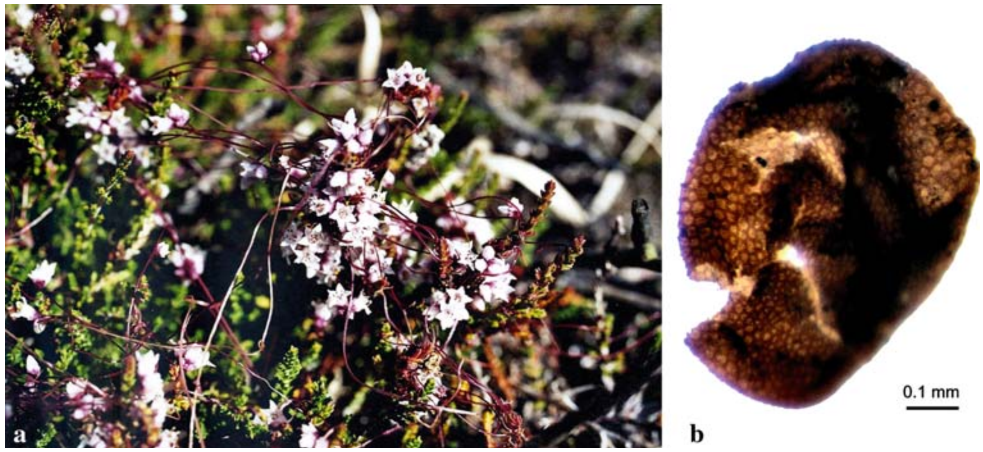

Fig. 5 **a** *Cuscuta epithymum* (dodder) growing and flowering on a burnt heath in western Jutland in July 2004 (*photo* Inge Lise Møller). **b** Seed find from a Skelhøj sod, size 0.8 × 0.7 mm (*photo* Jan Andreas Harild)

The fire management of heathland is an old land-use system and it was practised in order to fertilize the soil for agriculture and to get rid of shrubs that become established on heathland when grazing is infrequent or has been given up (Gimingham 1972). The charred hazelnut shells in sample number ×1415 (first shell) might have come from such a shrub vegetation that had been removed by fire, as Andersen (1988) showed by burnt hazel pollen from the Neolithic double passage-grave Klekkendehøj, on the island of Møn. The shells from the Skelhøj grave might also just represent settlement waste, as discussed earlier.

In general terms it seems that pastoral farming required large areas for grazing during the period 2100–1200 B.C. in western Jutland (Odgaard 1994). According to pollen analyses, pastoral farming was the dominant land-use system during this period. It was from the fourth millennium B.C. onwards that people began this process of replacing woodland by plant communities of a different, simpler and more open structure (Høgestøl and Prøsch-Danielsen 2006; Kaland 1986; Odgaard 1988, 1994; Odgaard and Rostholm 1987; Prøsch-Danielsen and Simonsen 2000). Apart from the cultivated land, areas from which woodland was removed were allowed to be colonized by naturally occurring plants, many of which had already been frequent in glades and openings in the woods. On the poor soils and in exposed localities these communities were heaths, in other places grasslands developed (Gimingham 1972). Charcoal layers indicate in many instances the use of fire in helping to clear patches of woodland (Odgaard 1994). Grazing by domestic animals may have been largely sufficient to destroy tree seedlings coming up on the newly opened landscape.

In Scandinavia it was a common practice during the 19th century A.D. that shepherds burnt their pasture in a 10-year rotation (Højrup 1980). The chief objectives of burning were to maintain the dominance of heather, and to ensure that the feeding value of the stand in terms of quantity and nutrient concentration was kept high. Young shoots or plants of heather have the highest nutritional value and were much appreciated as winter fodder for domestic animals up to modern times.

Heather, as well as many other herbs and grasses, are highly favoured by the burning as shown by a couple of experiments published by Hansen (1964). *Cuscuta epithymum* was recorded in 31% of the sod samples, deriving from material from all the building phases of the Skelhøj mound, except the buried soil under the barrow. This parasitic plant, according to Møller Jensen and Nagstrup (2004), successfully spreads on burnt heather plants growing up again with new shoots.

The charred crop remains in samples ×978 (first shell), ×732 and ×867 (both from the primary barrow stage) might indicate that the burnt heathland had also been used as arable land for some time. But better evidence for ploughing there is provided by ploughing marks and charcoal remains at the bottom of the underlying sod in sample ×1435 (first shell). Together with the burnt heather remains and other charred seeds, it seems that the soil was ploughed some years before the sods were cut. The presence of *Rumex acetosella* in all three sods placed at the bottom of the burial mound indicates that those sods were cut in an area that had either been cultivated land in earlier times, or an area where sods were cut some years before. In an extant experiment at Hammer Bakker close to Nørre Sundby in western Jutland, sods were cut on a heathland (Böcher 1980). Some years later, *Rumex acetosella* was the dominant plant growing there and after 15 years, heather was the dominant plant again (Böcher 1980). The seeds of *Carex*, *Viola* (violet) and *Luzula* (wood-rush) do support the hypothesis that Bronze Age people did practise such a kind of land management system.

The missing O-horizon in the sods is another argument for our proposal that the sods were cut in an area previously used for sod cutting.

To conclude, the plant macrofossil analysis of the Skelhøj sods reflects a picture of a relatively newly developed and rather dry heather landscape around 1350 B.C. Plants from disturbed places, as described earlier, were abundant among this freshly growing heather and were obviously not yet suppressed by competition from the heather. The uncharred heather remains in all of the samples clearly show that the burning of the area had been practised some years before the heather sods were cut. A new vegetation cover had already grown over the charred layer. The analysis showed that an O-horizon was missing prior to the burning. A burnt O-horizon leaves a badly weathering layer of charred plant remains that can be traced years later (Böcher 1980). This could not be traced in the samples.

A possible explanation for the presence of the wetland plants in the sods?

In 55% of the samples, seeds of *Stellaria alsine* were found. As this plant does not grow on a dry to medium-dry heathland, and as we assume a homogenous vegetation cover and not a mosaic pattern as described for the southwestern part of Norway (Prøsch-Danielsen 2001), the origin of this plant must therefore be of secondary nature. The seeds might have been deposited on the heathland via excrement from domestic animals.

It seems reasonable to suppose that the domestic animals were not only grazing on the heathland, but also in meadows along the river Kongeå and in boggy areas nearby. This means that the animals could also browse on wetland plants. When the seeds pass the digestive system, they are normally not destroyed but come out among droppings unharmed. Back on the heathland pasture, the animals would have left their faeces everywhere. Resistant seeds, such as obviously those of *Stellaria alsine*, a plant only growing close to open waters, were deposited on the heath in the excrement of the domestic animals. In the same way, the seeds of *Eleocharispalustris/uniglumis*, *Poa palustris* and *Myrica gale*, all plants of damp habitats along flowing waters, might have been deposited on the sods. Charred seeds of *Stellaria alsine* and *Myrica gale* were also found (primary barrow stage: x737 and facing: ×1459), a proof that seeds of those plants had already been present in the heather area, when it was burnt.

Comparison of the results from Skelhøj with similar investigations

In Denmark the tradition of plant macrofossil analysis of soil under and within grave-mounds can be traced back to the 1920s, when plant remains from the grave-mound of Egtved were analysed by Knud Jessen (Thomsen 1929). In 1939 Iversen published the plant finds of the grave-mounds at Arnum, Jels and Skrydstrup, in southern Jutland. The species lists resemble the plants that have been identified in these Skelhøj samples. In the case of the Arnum mound, Iversen thought that this monument had been constructed of sods that reflect a vegetation type strongly influenced by humans, a developing heath (Iversen 1939). No evidence of burning was recorded, but the group of the plants of disturbed places (pathways, arable land etc.) that was described earlier in this article from the Skelhøj samples, was also present in the heather sods from Arnum.

Another investigation is published from a burial mound, Lusehøj in southwestern Fyn. Troels-Smith took a few samples and could identify remains of herbs (Thrane 1984). All the investigations mentioned proved that the landscape around the prehistoric grave-mounds was heavily influenced by human activities. For western Jutland it could be shown by pollen analysis that human activities created the heathlands as early as the third millennium B.C. (Odgaard 1988). We have thus traced a land-use system involving heathland management by the Bronze Age people living in the vicinity of the Skelhøj mound, a practice with traditions extending back to the middle Neolithic period in Denmark.

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