First archaeobotanical plant macro-remain analysis from the Middle Bronze Age wetland settlement of Viverone (Viverone "Emissario" Project: campaign Viv16)

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Zusammenfassung – Erste archäobotanische Untersuchungen in der mittelbronzezeitlichen Seeufersiedlung von Viverone belegen das enorme Potenzial dieses Fundplatzes für entsprechende Analysen. Aufgrund der gut erhaltenen Schichten sind hier zahlreiche Pflanzenreste und eine große Artenvielfalt vorhanden. Der Nachweis von Emmer, Dinkel, tetraploidem Nacktweizen, Spelzgerste, Erbse und Ackerbohne entspricht dem Kulturpflanzenspektrum der mittleren Bronzezeit. Die Wildpflanzen stammen von verschiedenen Standorten in unmittelbarer Nähe und ermöglichen einen Einblick in die damalige Landschaft. Zahlreiche Wildpflanzen wurden von den Siedlern absichtlich genutzt. Zu den gesammelten Früchten zählen Kornelkirschen, Haselnüsse, Holzäpfel und verschiedene Beeren.

Darüber hinaus unterstützen die archäobotanischen Analysen die schon während der Ausgrabung gemachten Beobachtungen, dass es innerhalb der Siedlung mindestens zwei funktional unterschiedliche Bereiche gab. Während sich in Abschnitt 50/51 vor allem Reste der täglichen Lebensmittelzubereitung fanden, ist für das Fundspektrum aus Abschnitt 7 ein Zusammenhang mit Tierfutter anzunehmen.

Schlüsselwörter – Feuchtbodensiedlung, pflanzliche Großreste, Mittelbronzezeit, Kulturpflanzen, Vorratsschädlinge

Abstract – The first archaeobotanical studies of the Middle Bronze Age lakeshore settlement demonstrate the enormous potential of this site for appropriate analyses. On the basis of the well-preserved layers a multitude of plant remains and wide diversity of species are present at this site. Evidence of emmer, spelt, tetraploid naked wheat, hulled barley, peas and broad beans conforms to the basic cultural crop spectrum of the Middle Bronze Age. The wild plants originate from various locations in the direct vicinity and allow an insight into the landscape at that time. Numerous wild plants were intentionally used by the settlers. Fruits gathered include cornelian cherries, hazelnuts, crab apples and a diversity of berries.

Furthermore, archaeobotanical analyses support observations already made on site that within the settlement there are at least two functionally different areas. While in section 50/51 the layers contain the remains of daily food preparation, section 7 indicates a link to animal fodder.

Keywords – Wetland settlement, plant macro-remains, Middle Bronze Age, crops, insect pests

Introduction

The pile-dwelling site Viverone "Emissario" 35[1] is located adjacent to a small inlet on Lake Viverone, Province of Biella, within sight of the Alpine foothills (**fig. 1–2**). The site has been intermittently investigated since the 1970s, with systematic planning of the settlement pile field conducted in the 1990s (Fozzati 1998; Bertone/ Fozzati 2004). Investigation of the ceramic and bronze artefacts from the site confirmed an occupation phase during the Middle Bronze Age (16th–15th centuries BC), with a possible occupation also occurring during the Late Bronze Age (11th–10th centuries BC) (Rubat Borel 2006; idem 2009; idem 2011). Excavations between 2010 and 2014 (funded by the Swiss National Science Foundation) and 2015–2016 (funded by the National Geographic Society) (**fig. 3**) focussed on identifying whether the settlement stood above water or dry (partially wet) land, understanding the natural environment and setting of the site, and defining the chronological situation of the settlement through dendrochronological and radiocarbon dating.

Rapid survey of the site with a Remote Operated Vehicle facilitated the identification of key areas for excavation, and also permitted the recognition of areas of recent erosion and deposition of sediment within the settlement area. The excavations identified a single phase of occupation on the site, relating to the Middle Bronze Age occupation, with no evident layer – within the zones excavated – relating to the possible Late Bronze Age phase. Sediment cores collected during the excavation within the settlement, and from the surrounding dryland environment, suggest that the settlement was constructed on a sand bar adjacent to the lake inlet, surrounded by water, but it remains unclear if the structures were permanently above water – more likely they were elevated to account for seasonal variation in the lake depth (Jennings et al. in prep.) (as seen at other sites in the Alpine region; e. g. Jacomet et al. 2004; Menotti 2004; idem 2015).

Dendrochronological sampling between 2011 and 2016 has been used to refine the wiggle-matched floating sequence for the Viverone site (Rubat Borel et al. 2016), and indicates that the site was likely built and occupied during the

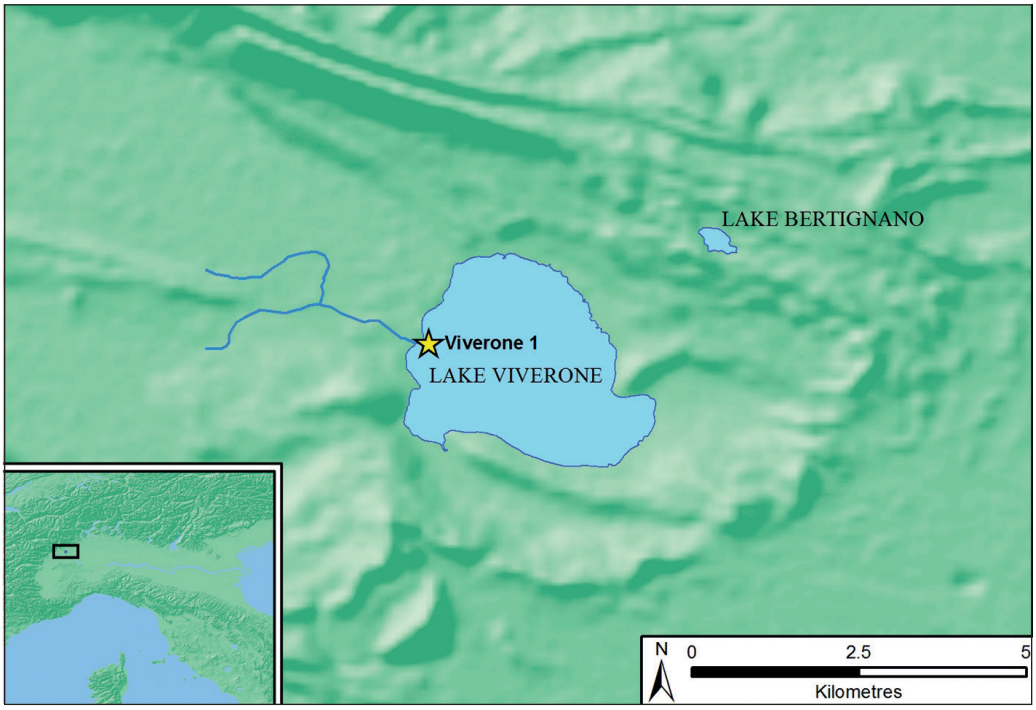

Fig. 1 The location of Viverone "Emissario" 35.

Fig. 2 Impressions on Lake Viverone. Bronze Age piles are visible under the water surface.

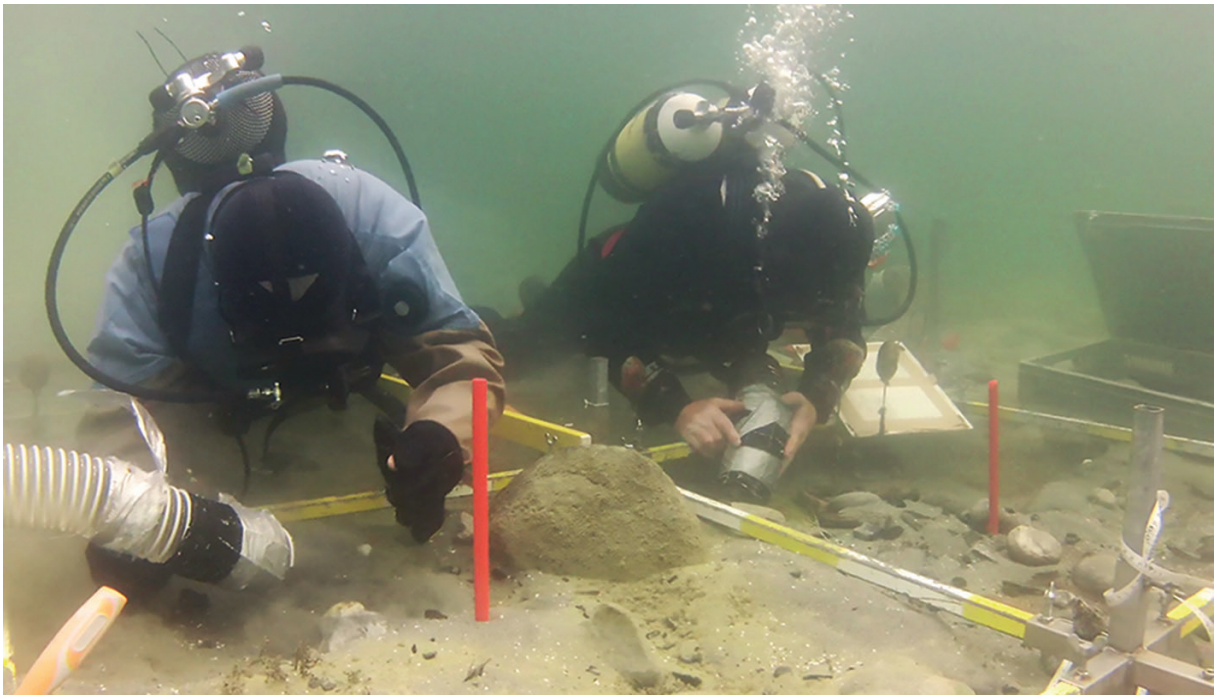

Fig. 3 Working under water. The sandy nature of the lake bed material is evident, with some larger stones and materials present.

1st half of the 14th century and the last quarter of the 13th century BC. Identification of construction units suggests that some of the structures may have been up to 17 m in length, and approaching 7 m in width, constructed parallel to the main settlement walkway (Jennings et al. in prep.). Ongoing dendrochronological research will help to further refine the potential for providing confirmed calendrical dating of the site.

During the excavation campaign in November 2016, 35 samples for an archaeobotanical macro-remain analysis were taken from cultural layers found in sections 50/51 and 7 of the Middle Bronze Age settlement of Viverone "Emissario" 35 (**fig. 4**). In the course of this first preliminary analysis, 19 sediment samples were processed. This report is supplemented by a further sample taken in a vessel from the 2015 campaign (Viv15, sample Number 15-01). Furthermore, a series of individual finds from the 2016 campaign are presented in this report.

Method

The 20 soil samples with a total volume of 10.75 liters were wet washed through a sieve column with four mesh sizes (2; 1; 0.5; and 0.25 mm). All identifiable residues were selected using a stereo microscope with a magnification of 6.3x–40x and soft tweezers and these were identified with the assistance of the reference collection of the archaeobotanical laboratory of the Institute of Archaeological Science of the Goethe-Universität Frankfurt am Main and relevant classification literature (e. g. Cappers et al. 2006). The selected subfossil material was finally preserved in distilled water in crimp-seal vials and test tubes, charred residues were dried and stored in small plastic containers. The recording of the various classes of materials (wood, charcoal, moss, insects) took place in the form of a three-tier scale: + few finds, ++ medium amount of finds, +++ many finds/dominance in sample. Finally, the data was entered into the Archaeobotanical Data Bank system ArboDat (Kreuz/Schäfer 2002). The Oberdorfer based nomenclature (Oberdorfer 2001) and ecological categorization of the species is modified in ArboDat.

Results

The samples contained a total of 7 385 plant residues (**fig. 14, Appendix**). Up to now 112 plant species have been identified. A number of still

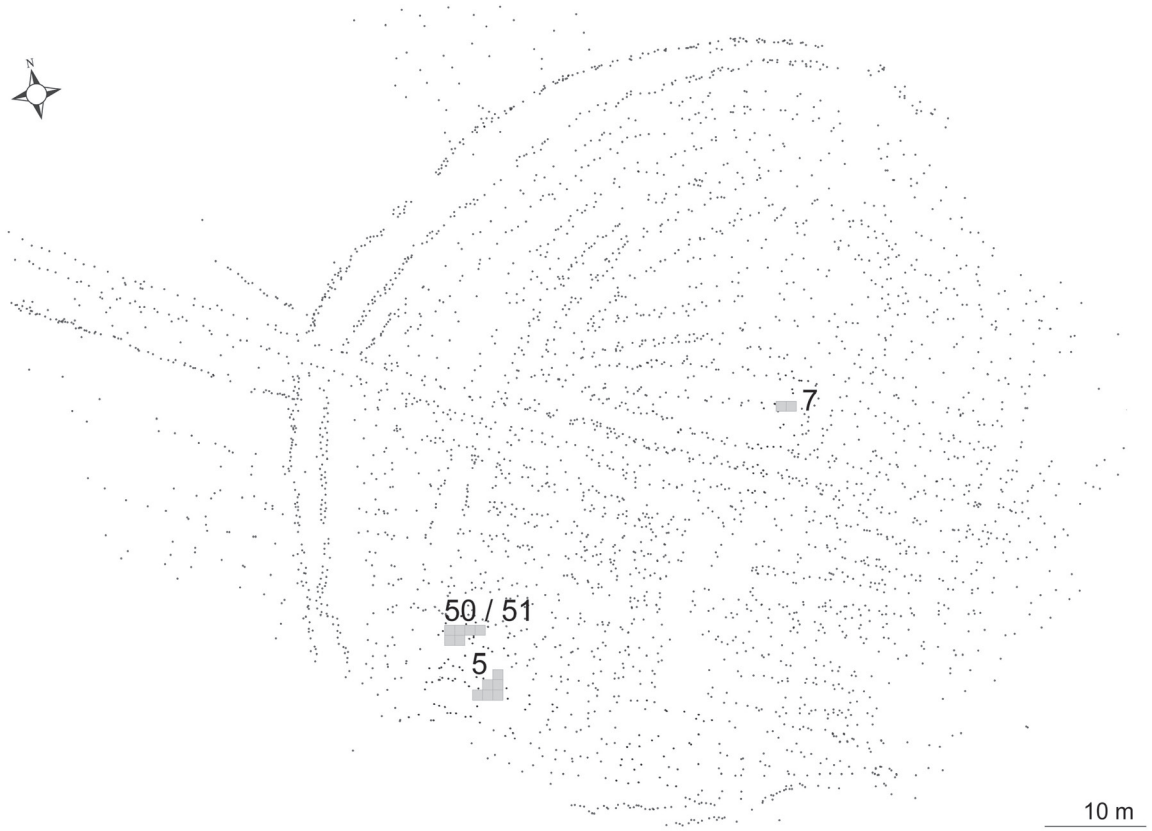

Fig. 4 Site plan with piles and sections 7 and 50/51 where samples were taken.

unidentified objects await further investigation. Needles of silver fir (*Abies alba*) from section 7 were the most frequently occurring remains found in Viv16 and represent 34 % of the spectrum.

The impressive variety of distinctive cultural layers in both settlement areas already observed during the excavation, are supported by the archaeobotanical investigations. Section 50/51 and section 7 display significant differences in composition (**fig. 5**) and indicate two functionally different areas of this site.

Section 50/51

The cultural layer encountered in section 50/51 is 2–4 cm thick. The organic detritus is embedded in a sandy matrix. The high proportion of water plant diaspores (**fig. 14, Appendix**), the modest state of conservation of the subfossil plant remains (often mushy) and the smoothed surface of (maybe eroded?) charcoal (and wood) speak for lacustrine influences in this part of the settlement. Additionally, in some places, the large number of fine rhizomes indicates recent root penetration of the cultural layer. The rhizomes/shoot fragments of reeds (*Phragmites australis*) also point to disturbance.

3 061 plant remains from the samples from section 50/51, however, is a considerable quantity of finds. The plant spectrum is dominated, above all, by cultural plants and species that flourish in locations influenced by human activities: weeds and ruderals, grassland species, clearings/shrubbery or ruderals which prefer moist to wet eutroph conditions (shore/settlement). The high proportion of the group "deciduous wood/shrubbery" can be traced back to a large amount of oak fragments (*Quercus*) found in the samples.

Almost all cultural plant remains, mostly cereals, come from section 50/51[2]. Amongst the subfossil remains, emmer wheat (*Triticum dicoccon*) is dominant over spelt (*Triticum spelta),* tetraploid *durum/turgidum* wheat (*Triticum*

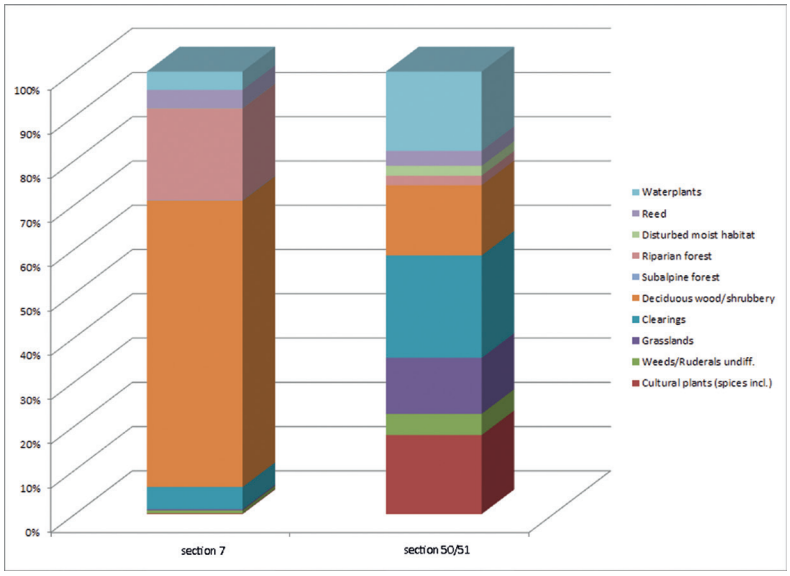

Fig. 5 Composition of the ecological spectrum in section 7 (n = 4 130) and section 50/51 (n = 2 861).

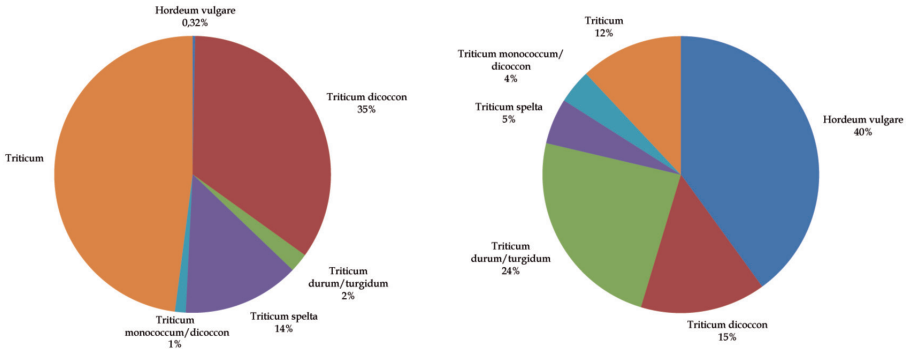

Fig. 6 Absolute cereal proportions. Left: uncharred, subfossil material (n = 315). Right: charred material (n = 75).

durum/turgidum), and hulled barley (*Hordeum vulgare*)[3] (**fig. 6**). However, on account of the poor state of preservation almost 50 % of the cereal remains could only be identified as genus (*Triticum*). Fragments of seed coats (*testae*) that were present in almost all samples from section 50/51 have been classified generally as Cerealia indet. (Cereals).

Taking into account the proportion of charred cereal remains, the find spectrum shifts towards hulled barley (**fig. 7a,b**) which now dominates with 40 %, followed by naked *durum/turgidum* wheat (24 %) (**fig. 7c,d**), emmer wheat (15 %) and spelt (5 %). However, in order to make further representative propositions regarding the cereal spectrum more investigations are necessary.

The identified pod fruits/legumes in Viv16 are broad beans (*Vicia faba*) (**fig. 8d**) and peas (*Pisum sativum*). Additionally, in the samples

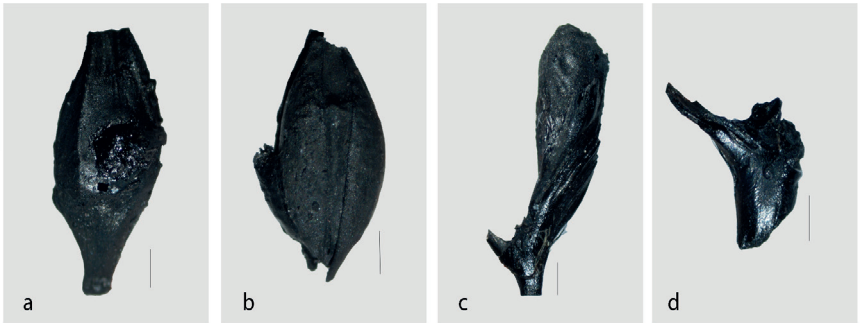

Fig. 7 Cereal remains: **a,b** caryopses *Hordeum vulgare*, **c** caryopses in internod *Triticum durum/turgidum*, **d** internod *Triticum durum/turgidum*. Scale 1 mm.

Fig. 8 Fruits and seeds: **a** *Anthemis tinctoria*, **b** *Anethum graveolens*, **c** *Apium graveolens*, **d** *Vicia faba*, **e** *Juniperus*, **f** *Valeriana officinalis*, **g** *Vitis vinifera* ssp. *sylvestris*. Scale 1 mm.

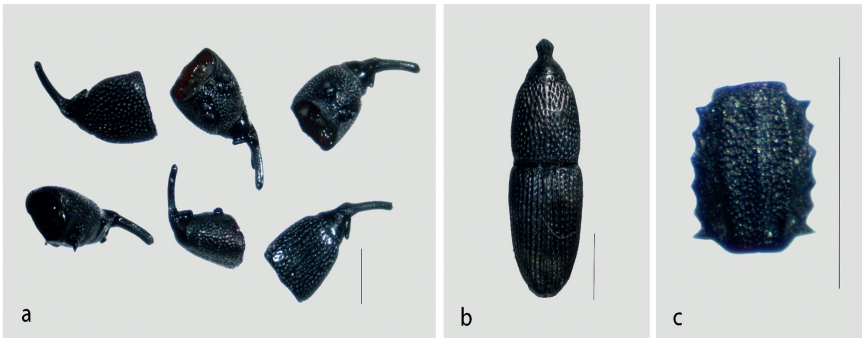

Fig. 9 Remains of storage pests: **a** wheat weevil, subfossil (*Sitophilus granarius*); **b** almost complete wheat weevil, charred; **c** pronotum (dorsal) of sawtoothed grain beetle (*Oryzaephilus surinamensis*). Scale 1 mm.

from sections 50/51, there are large numbers of pod fragments, in all likelihood, from lentils (cf. *Lens culinaris*). Generally, pod fruits are underrepresented in wetland contexts because their seeds swell and rupture in water and in a highly fragmented state are no longer to be found.

On to the oil and fibre plants: the role of the opium poppy (*Papaver somniferum*) in Viverone remains open as only one uncertain poppy seed has been identified up to now. Confirmed species found in contemporary settlements, such as einkorn wheat (*Triticum monococcum*), broomcorn millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*) and, above all, flax (*Linum usitatissimum*), which is a cultivated plant that is generally found in all wetland settlements, have not been found in Viv16 to date. In Viv16, the spices dill (*Anethum graveolens*) (**fig. 8b**) and celery (*Apium graveolens*) (**fig. 8c**) were identified.

The wild plants: there were also the remains of various weeds in the deposits with the cultural plants. Detailed assessment regarding the methods of planting and harvesting, the conditions of the fields, the cultivated crops and the weeds, should be part of further investigations in Viverone, particularly on the basis of a broader data pool. The same applies to the ruderals and grassland species, whereas the complex discussion on the development of grasslands is still ongoing and these species are more likely to be seen as part of a Bronze Age field-grass economy (e. g. Schibler et al. 1997, 363; Rösch 2011).

Additionally, in section 50/51 the remains of various forest communities (mesophilic deciduous woodlands and riparian forest) as well

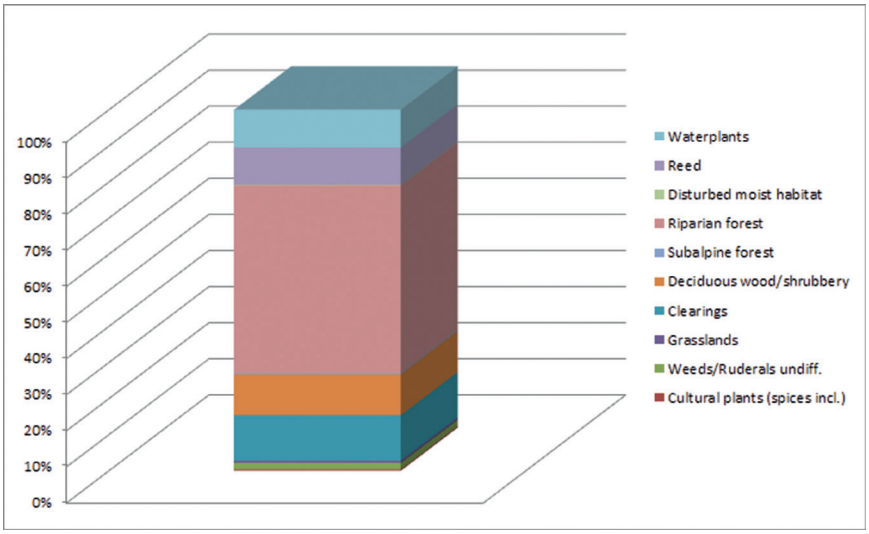

Fig. 10 Composition of the ecological spectrum in section 7 without fir remains (n = 1 646).

plants growing at the shore (reed vegetation) and aquatic plant communities have been found (**fig. 14, Appendix**). Classical gathered plants were hazel (*Corylus avellana*), blackberry (*Rubus fruticosus*), raspberry (*Rubus idaeus*), wild strawberry (*Fragaria vesca*) and crab apple (*Malus sylvestris*).

Not forgetting to mention the 615 bracken leaf fragments (*Pteridium aquilinum*) in section 50/51. This fern is an indicator of increased human impact and expanding habitat intrusions. It grows in woodlands, and at the edges of pastures, where it is poisonous to grazing stock. Its competitive strength benefits considerably from any kind of forest clearing and in particular from the use of fire, which strongly promotes the growth of its rhizomes. Moreover its cuttings were used for bedding in stables (Russels 1908; Ellenberg 1996; Birch et al. 2000).

The constant and massive occurrence of the remains of wheat weevils (*Sitophilus granarius*) in all samples from section 50/51 was striking (**fig. 9a,b**). The remains were particularly numerous in samples 3 and 6 from Q511B. Based on the elytra a minimum number of individuals could be calculated for both samples: sample 6 = 60 weevils, sample 3 = 120 weevils. These are extremely high figures considering the relatively small volumes of both samples (sample 3 = 750 ml, sample 6 = 250 ml). Additionally, there were individual finds of sawtoothed grain beetles (*Oryzaephilus surinamensis*) (**fig. 9c**) in the samples. Both kinds of beetles are stock pests and in all probability must have given the settlers at Viverone "Emissario" serious concerns about the secure storage of their harvested reserves.

Section 7

In section 7 most of the remains discovered represent various woodland locations and, of course, some disturbed areas in the direct vicinity of the settlement (**fig. 5** and **fig. 14, Appendix**). The silver fir (*Abies alba*) is the dominant type. If we exclude the remains of the silver fir in the depiction of the ecological spectrum, species of the riparian forest dominate (**fig. 10**). Present, and also well represented, in the samples are plants which grow directly at the shore – reed vegetation. Species of aquatic plant communi-

Fig. 11 Cone cf. *Larix decidua*. Scale 1 cm.

Fig. 12 Fruitstones *Cornus mas*. Scale 1 cm.

ties are rarer in section 7 than in section 50/51. Cultural plants and synanthropic species are almost completely absent in the range of species from section 7.

The compact detritus layer in section 7 has hardly been affected by the lake, or at least less than the cultural layer from section 50/51 which seems to have been, more or less, completely mixed up.

If anything the cultural layer in section 7 has a completely different character to that of section 50/51. Section 7 consists of a 2–20 cm thick coarse detritus layer. It contains mainly wood remains (splinters and chips, remains of twigs and bark) and leaf fragments, with buds being also quite common. Accordingly, there doesn't appear to be a link to human diets or the processing of cultural plants (only sparsely). The absence of dung fragments in the samples speaks against a direct link to animal excrement. It is possible that here we are concerned, at least partially, with the remains of animal fodder. The large amounts of fir needles would support this as fir brushwood is excellent animal fodder. Fir wood fragments as well as fir needles were identified in dung fragments from the Horgen settlement Arbon-Bleiche 3 (Zibulski 2004, 321). For further evaluation of the cultural layer of section 7, however, wood analysis is necessary.

Individual Finds

During the excavation campaign some 50 botanical individual finds were recovered. The material consists of conifer cones (probably European larch cf. *Larix decidua*) (**fig. 11**), pits of the European cornelian cherry (*Cornus mas*) (**fig. 12**), which has also been a very popular gathering plant (Hosch/Jacomet 2004, 155 f.), common hazelnut shells (*Corylus avellana*), acorn remains, common dogwood (*Cornus sanguinea*), cocklebur

square	sample	cow/goat/ sheep	goat/sheep	rodents
506D	Fnr. 8			+ sf/vk
506C	Fnr. 1000			+ vk
75B	Fnr. 9			+
511B	Fnr. 10			+ sf
75A	Fnr. 19			+ sf
74B	Fnr. 3			+ sf
505A	Fnr. 17			+ sf
74A	Fnr. 1			+ sf
74D	Fnr. 7			+
511B	Fnr. 4	+ sf		+ sf
502C	Fnr. 11	+ sf		+ sf
75B	Fnr. 10	+ sf		+ sf
502B	Fnr. 2	+ sf		+ sf
511	Fnr. 3	+ sf		+ sf/vk
74C	Fnr. 8	+ sf		+ sf
511B	Fnr. 6	+ sf	+ sf	+ sf

Fig. 13 Excrement remains in the analyzed samples. + present, sf subfossil, vk charred.

(*Xanthium*), charred caryopsis of emmer, spelt and the remains of tree fungi.

Excrement/Dung

The remains of animal coprolites were found in several samples. The dung remains were very fragmented which is why, with one exception, they could only be categorized together as originating from cattle/sheep/goat (**fig. 13**). There were rodent droppings in almost all samples. Pollen analysis and parasitological evaluation of the cultural layer material and of the dung remains for future investigations.

Comparison to contemporary sites

The Middle Bronze Age material from the cultural layer at Viverone is unique in north western Italy. Even in the Lake Garda region, which is rich in finds, reliably dated bioarchaeological analysis of Middle Bronze Age cultural layers are extremely rare. Comparison of the botanical spectrum from Viverone with contemporary sites in northern Italy is difficult as comprehensive publications of contemporary lakeshore sites like Lavagnone, Lucane and Fiavé have yet to be published. However, the cultivated crops: emmer, spelt, hulled barley, *Triticum durum/turgidum*, broad beans, peas, (lentils) and opium poppy found at Viverone represent quite a number of the contemporary Middle Bronze Age species of northern Italy (Mercuri et al. 2006; Stika/Heiss 2013a, 193; idem 2013b, 351 f.).

Notes

[1] Thanks to the former project manager: Prof Dr Francesco Menotti, the leader of the excavation: Dr Joachim Köninger as well to Jamie MacIntosh for the translation.

[2] Only three cereal remains come from section 7.

[3] Barley is underrepresented as threshed barley, in an uncharred state, does not preserve as well as threshed wheat species (Schibler et al. 1997, 227).

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Image reference

Fig. 1–4 terramare/J. Köninger.
Fig. 5–14 Ch. Herbig.

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Appendix

feature				710	710	720	720	721	721	721	721	721	5020	5020	5020	5020	5021	5021	5121	5121	5121	5121	510
sample number				9	10	19	21	1	3	7	8	9	8	16	17	1000	2	11	3	4	6	10	15-01
square				74C	75B	75A	75C	74A	74B	74D	74C	75B	506D	505B	505A	506C	502B	502C	511B	511B	511B	511B	-
Volume (l)				0.75	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.75	0.5	0.75	0.75	0.5	0.5	0.75	0.75	0.25	0.25	0.25
	remain	**agg**	**sum**																				
Cultural plants																							
Hordeum vulgare	seed/fruit	charred	26										2			8			7	3	3		3
Hordeum vulgare	awn	charred	11													4	2		5				
Hordeum vulgare	internod	charred	5																3	1	1		
Hordeum vulgare	internod	subfossil	1																	1			
Triticum dicoccon	seed/fruit	charred	4															1	1		1		1
Triticum dicoccon	glume base	charred	5													1			1	1	2		
Triticum dicoccon	glume base	subfossil	57										7	3	1	10	4	10	16	6			
Triticum dicoccon	spikelet fork	charred	2										1					1					
Triticum dicoccon	spikelet fork	subfossil	52								1		3	1		9	10	3	18	3	1		3
Triticum durum/turgidum	seed/fruit	charred	5															1	1	1	1		1
Triticum durum/turgidum	spikelt	charred	2																1	1			
Triticum durum/turgidum	internod	charred	11													1	1		5	1	3		
Triticum durum/turgidum	internod	subfossil	4													1			3				
Triticum cf. *durum*/turgidum	internod	subfossil	3														3						
Triticum spelta	seed/fruit	charred	1																				1
Triticum spelta	spikelet	subfossil	1																				1
Triticum spelta	glume base	charred	2																2				
Triticum spelta	glume base	subfossil	24										1						11	2			10
Triticum spelta	spikelet fork	subfossil	15						1										3	2	1		8
Triticum cf. *spelta*	glume base	subfossil	2														2						
Triticum cf. *spelta*	spikelet fork	charred	1													1							
Triticum cf. *spelta*	spikelet fork	subfossil	1														1						
Triticum monococcum/dicoccon	glume base	charred	1																	1			
Triticum monococcum/dicoccon	glume base	subfossil	3																3				
Triticum monococcum/dicoccon	spikelet fork	charred	2																	1	1		
Triticum monococcum/dicoccon	spikelet fork	subfossil	1							1													
Triticum	seed/fruit	charred	2																		1		1
Triticum	glume base	charred	1													1							
Triticum	glume base	subfossil	151													14	20		94	23			
Triticum	spikelet fork	charred	6													2	2			1	1		
Cerealia indet.	seed/fruit	charred	32										4	3		3			14	4	3		1
Cerealia indet.	glumes	charred	23										4	1		8	1	1	5	3			
Cerealia indet.	internod	charred	4																4				
Cerealia indet.	testae	subfossil													+	+	+		+	+	+		+
Cerealia indet.	stem fragment	subfossil	2													1					1		
Pisum sativum	seed/fruit	subfossil	1																1				
Vicia faba	seed/fruit	charred	1																	1			
Vicia faba	seed/fruit	subfossil	1																	1			
Fabaceae (cult.) cf. *Lens culinaris*	pod fragments	subfossil	42										2	2			1		13	12	8	1	3
Papaver cf. *somniferum*	seed/fruit	subfossil	1																1				

Fig. 14 Plant remains in the samples from sections 50/51 (5020–5121) and 7 (710–721), both campaign 2016, as well as sample 15-10, campaign 2015, of the Middle Bronze Age settlement of Viverone "Emissario" 35 (**parts 2–6** on **pages 13–17**).

			feature	710	710	720	720	721	721	721	721	721	5020	5020	5020	5020	5021	5021	5121	5121	5121	5121	510
			sample number	9	10	19	21	1	3	7	8	9	8	16	17	1000	2	11	3	4	6	10	15-01
			square	74C	75B	75A	75C	74A	74B	74D	74C	75B	506D	505B	505A	506C	502B	502C	511B	511B	511B	511B	-
			Volume (l)	0.75	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.75	0.5	0.75	0.75	0.5	0.5	0.75	0.75	0.25	0.25	0.25
	remain	agg	sum																				
Spices																							
Anethum graveolens	seed/fruit	subfossil	3							1	1								1				
Anethum cf. *graveolens*	seed/fruit	subfossil	1	1																			
Apium graveolens	seed/fruit	subfossil	2																1		1		
Weeds																							
Aphanes arvensis	seed/fruit	subfossil	3																1	1	1		
Brassica oleracea ssp. *campestris*	seed/fruit	subfossil	45										13				4	1	20	5	2		
Bromus arvensis	seed/fruit	subfossil	1																1				
Chenopodium polyspermum	seed/fruit	subfossil	3	1							1								1				
Papaver argemone	seed/fruit	subfossil	4														1		2	1			
Papaver dubium/rhoeas	seed/fruit	subfossil	1												1								
Polygonum aviculare agg.	seed/fruit	subfossil	3									1					1		1				
Polygonum convolvulus	seed/fruit	subfossil	3	1	1															1			
Polygonum persicaria	seed/fruit	subfossil	5															1	2	2			
Setaria viridis et sim.	seed/fruit	subfossil	2	1																1			
Silene cretica	seed/fruit	subfossil	1					1															
Stellaria media agg.	seed/fruit	subfossil	1																		1		
Valerianella dentata	seed/fruit	subfossil	3													1	1		1				
Vicia hirsuta	seed/fruit	charred	2																1	1			
Ruderals																							
Anthemis tinctoria	seed/fruit	subfossil	20										1				2		13	3	1		
Arctium	seed/fruit	subfossil	1								1												
Galium aparine	seed/fruit	subfossil	1																1				
Hyoscyamus niger	seed/fruit	subfossil	1	1																			
Lamium album	seed/fruit	subfossil	7																5		2		
Lapsana communis	seed/fruit	subfossil	7												2	1	2		2				
Ruderals/Weeds not diff.																							
Cerastium glomeratum	seed/fruit	subfossil	2															1	1				
Cerastium cf. *glomeratum*	seed/fruit	subfossil	1																	1			
Chenopodium album-Typ	seed/fruit	subfossil	36	4	4	1	3	1	3			1	1		4	1	1	1	6	3	2		
Echinochloa crus-galli	seed/fruit	subfossil	10								1								4		5		
Galeopsis tetrahit-Typ	seed/fruit	subfossil	1	1																			
Solanum nigrum	seed/fruit	subfossil	2				1												1				
Grasslands																							
Campanula	seed/fruit	subfossil	2						1					1									
Carex muricata agg.	seed/fruit	subfossil	1								1												
Daucus carota	seed/fruit	subfossil	1																		1		
Heracleum sphondylium s.l.	seed/fruit	subfossil	1																		1		
Hieracium	seed/fruit	subfossil	1					1															
Juncus	seed/fruit	subfossil	12															2	6	1	3		
Linum catharticum	seed/fruit	subfossil	1						1														
Luzula campestris/multiflora	seed/fruit	subfossil	3																2		1		
Lythrum salicaria	seed/fruit	subfossil	1																	1			
Poa	seed/fruit	subfossil	8									1					2		2	2	1		
Potentilla cf. *erecta*	seed/fruit	subfossil	1																1				
Potentilla reptans	seed/fruit	subfossil	10										1			2		1	3	2	1		
Prunella vulgaris	seed/fruit	subfossil	6									1						1	3	1			
Ranunculus bulbosus	seed/fruit	subfossil	4		1		1					2											
Rumex acetosella agg.	seed/fruit	charred	2																2				
Rumex acetosella agg.	seed/fruit	subfossil	303										10		4	16	19	11	149	22	67	5	
Silene vulgaris	seed/fruit	subfossil	1						1														
Verbena officinalis	seed/fruit	subfossil	14														3	2	5	2	1		1
Vicia cf. *cracca*	seed/fruit	subfossil	1																1				

feature				**710**	**710**	**720**	**720**	**721**	**721**	**721**	**721**	**721**	**5020**	**5020**	**5020**	**5020**	**5021**	**5021**	**5121**	**5121**	**5121**	**5121**	**510**
sample number				9	10	19	21	1	3	7	8	9	8	16	17	1000	2	11	3	4	6	10	15-01
square				74C	75B	75A	75C	74A	74B	74D	74C	75B	506D	505B	505A	506C	502B	502C	511B	511B	511B	511B	-
Volume (l)				0.75	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.75	0.5	0.75	0.75	0.5	0.5	0.75	0.75	0.25	0.25	0.25
	remain	**agg**	**sum**																				
Fringes																							
Moehringia trinervia	seed/fruit	subfossil	5	2		1					2												
Origanum vulgare	seed/fruit	subfossil	1	1																			
Physalis alkekengi	seed/fruit	subfossil	1										1										
Sambucus ebulus	seed/fruit	subfossil	2	1							1												
Clearings																							
Betula pendula	seed/fruit	subfossil	106	28	19	8	3	2	4	10	10	5			1	2		1	7		5	1	
Betula pendula	inflorescence	subfossil	10		2		5	1		2													
Betula pendula	fruit scale	subfossil	59	10	13	8	2	2	10	1	7	5							1				
Fragaria vesca	seed/fruit	subfossil	20	1	1	3	1	1	1	1	2	1							5		2		1
Hypericum cf. *hirsutum*	seed/fruit	subfossil	1														1						
Pteridium aquilinum	leave	charred	5		1								1			2				1			
Pteridium aquilinum	leave	subfossil	618							1	2		12	13	36	12	186	66	168	50	68	2	2
Rubus fruticosus agg.	seed/fruit	subfossil	18							1		2							9	2	4		
Rubus idaeus	seed/fruit	subfossil	23	4	3	3	3	1	4	1	4												
Deciduous Wood/Shrubbery																							
Abies alba	leave	charred	2	1							1												
Abies alba	leave	subfossil	2484	313	308	217	180	128	379	225	513	215	1		1		1	3					
Abies alba	cone	subfossil	7			1						6											
Abies cf. *alba*	seed/fruit	subfossil	8		5		2		1														
Acer spec.	seed/fruit	subfossil	1									1											
cf. *Fagus sylvatica*	bud	subfossil	2																2				
Clematis vitalba	seed/fruit	subfossil	5		1	1		1				1										1	
Cornus mas	seed/fruit	subfossil	7										1					2	1	1	2		
Cornus sanguinea	seed/fruit	subfossil	11	2			2		1		2	4											
Corylus avellana	seed/fruit	charred	4																4				
Corylus avellana	seed/fruit	subfossil	9	1		1			1				1	1			1	1		1	1		
Fraxinus excelsior	leave	subfossil	1								1												
Oxalis acetosella	seed/fruit	subfossil	4			1				1	1	1											
Pinus	seed/fruit	subfossil	6	2				2		1		1											
Pinus	leave	charred	3						1	1	1												
Pinus	leave	subfossil	77	6	13	13	5		18	3	8	9										2	
Prunus spinosa	seed/fruit	subfossil	1															1					
Quercus	seed/fruit	charred	2																2				
Quercus	seed/fruit	subfossil	429	1				1	2	3	3	1	19	18	6	112	33	10	143	30	43	2	2
Quercus	bud	subfossil	10			2	1	1			1	5											
Sambucus nigra	seed/fruit	subfossil	30	3	11	2	5	1		1	1	1			1	1			2		1		
Sambucus	seed/fruit	subfossil	1								1												
Tilia cordata	seed/fruit	subfossil	21	1		3	9	3	1		1	3											
Vaccinium myrtillus	seed/fruit	subfossil	1							1													
Subalpine Forests																							
Pinus cf. *cembra*	seed/fruit	subfossil	1									1											
Pinus cf. *cembra*	leave	subfossil	4			1						3											

			feature	710	710	720	720	721	721	721	721	721	5020	5020	5020	5020	5021	5021	5121	5121	5121	5121	510
			sample number	9	10	19	21	1	3	7	8	9	8	16	17	1000	2	11	3	4	6	10	15-01
			square	74C	75B	75A	75C	74A	74B	74D	74C	75B	506D	505B	505A	506C	502B	502C	511B	511B	511B	511B	-
			Volume (l)	0.75	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.75	0.5	0.75	0.75	0.5	0.5	0.75	0.75	0.25	0.25	0.25
	remain	**agg**	**sum**																				
Riparian Forest																							
Alnus glutinosa	seed/fruit	charred	1	1																			
Alnus glutinosa	seed/fruit	subfossil	132	14	13	14	17	9	7	14	15	11			1	3	3	1	7	2	1		
Alnus glutinosa	bud	subfossil	1					1															
Alnus glutinosa	cone	subfossil	4								4												
Alnus incana	seed/fruit	subfossil	70	13	11	11	3	1	8	6	11	4								1		1	
Alnus	seed/fruit	subfossil	26	3	7	11			2		2							1					
Alnus	bud	subfossil	8	2	4	2																	
Alnus	cone	subfossil	24		1	2	8			2		10								1			
Eupatorium cannabinum	seed/fruit	subfossil	2						1							1							
Humulus lupulus	seed/fruit	subfossil	3						1	1	1												
Malus sylvestris	seed/fruit	subfossil	7												1		1						5
Malus sylvestris	pericarp	subfossil	11								1					1		1	6	1	1		
Populus	bud	subfossil	23	3	1	2	5	2	2	1	1	5								1			
Prunus padus	seed/fruit	subfossil	2				1	1															
Rubus caesius	seed/fruit	subfossil	2		1						1												
Salix	seed/fruit	charred	1		1																		
Salix	seed/fruit	subfossil	554	80	55	65	39	38	107	56	46	65		1						1	1		
Salix	leave	subfossil	3		1			1				1											
Salix	inflorescence	subfossil	1						1														
Salix	bud	subfossil	1								1												
Urtica dioica	seed/fruit	subfossil	27	1	1	2		2	2	1	2	1	2		1	1			6	4	1		
Valeriana officinalis (agg.)	seed/fruit	subfossil	1							1													
Vitis vinifera ssp. *sylvestris*	seed/fruit	subfossil	13	2	1		1	1	1		1	3		1	1			1					
Ruderals of eutroph conditions																							
Polygonum hydropiper	seed/fruit	subfossil	20														10	1	6	2	1		
Polygonum lapathifolium agg.	seed/fruit	subfossil	3								1						1				1		
Polygonum mite	seed/fruit	subfossil	2																1	1			
Ranunculus sardous	seed/fruit	subfossil	40	1											2	4	1	2	9	12	9		
Reed/Large Harrow Reed																							
Alisma plantago-aquatica agg.	seed/fruit	subfossil	1																		1		
Carex elata	seed/fruit	subfossil																					2
Cladium mariscus	seed/fruit	subfossil	9													2		1	3		2		1
Cyperus flavescens	seed/fruit	subfossil	27										2				3	4	15	2	1		
Cyperus fuscus	seed/fruit	subfossil	1																		1		
Eleocharis ovata/uniglumis	seed/fruit	subfossil	2								1			1									
Holoschoenus vulgaris	seed/fruit	subfossil	2																1	1			
Lycopus europaeus	seed/fruit	subfossil	3			1													2				
Lysimachia vulgaris	seed/fruit	subfossil	2								2												
Myosoton aquaticum	seed/fruit	subfossil	1																1				
Phragmites australis	seed/fruit	subfossil	4		1			1				1							1				
Phragmites australis	vegeta. remain	charred	122	16	17	16	12	6	16	18	9							12					
Phragmites australis	vegeta. remain	subfossil	51		1	3	4		8	3		12	3		6	1	2	1		7			
Polygonum minus	seed/fruit	subfossil	1																		1		
Potamogeton	seed/fruit	subfossil	17	1	2	2		3	1	1	1	1			1	1	1		2				
Scirpus lacustris	seed/fruit	subfossil	20	3	2		2		1	1		1					1	1	5	2			1
Solanum dulcamara	seed/fruit	subfossil	1									1											
Sparganium minimum	seed/fruit	subfossil	1																		1		
Typha	seed/fruit	subfossil	1																1				

		feature		**710**	**710**	**720**	**720**	**721**	**721**	**721**	**721**	**721**	**5020**	**5020**	**5020**	**5020**	**5021**	**5021**	**5121**	**5121**	**5121**	**5121**	**510**
		sample number		9	10	19	21	1	3	7	8	9	8	16	17	1000	2	11	3	4	6	10	15-01
		square		74C	75B	75A	75C	74A	74B	74D	74C	75B	506D	505B	505A	506C	502B	502C	511B	511B	511B	511B	-
		Volume (l)		0.75	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.75	0.5	0.75	0.75	0.5	0.5	0.75	0.75	0.25	0.25	0.25
	remain	**agg**	**sum**																				
Waterplants																							
Butomus umbellatus	seed/fruit	subfossil	78	3	3	6		4	7	2		7	3		4	15	4	10	7	3			
Chara	seed/fruit	subfossil	422	17	7	8	1	9	8	1	10	4	15	27	82	100			46	17	9	61	
Myriophyllum spicatum	seed/fruit	subfossil	7					1		1	1	3				1							
Najas flexilis	seed/fruit	subfossil	53	6	6	4	3	1	2	2	4	4	1	3	5	2			1	2	2	1	4
Najas marina	seed/fruit	subfossil	104	4	4	5	3	3	1	4	3	5	9	2	7	7		6	14	12	12	3	
Najas minor	seed/fruit	subfossil	8											1	2		1	1	3				
Nymphaea alba	seed/fruit	subfossil	3			1		1							1								
Ranunculus aquatilis agg.	seed/fruit	subfossil	9						1	1								1	3	1	2		
Trapa natans	seed/fruit	subfossil	2			1													1				
Various																							
Apiaceae	seed/fruit	subfossil	1		1																		
Artemisia	seed/fruit	subfossil	2						1							1							
Asteraceae	seed/fruit	charred	1						1														
Asteraceae	seed/fruit	subfossil	1							1													
Asteraceae	inflorescence	subfossil	4						1										2		1		
Betula	inflorescence	subfossil	3			1					1												1
Bromus	seed/fruit	subfossil	1		1																		
Carex	seed/fruit	charred	2			1													1				
Carex	seed/fruit	subfossil	59	5	4	11	5	3	1	4	3	8	1				2		6	3	3		
Caryophyllaceae	seed/fruit	subfossil	2		2																		
Cerastium	seed/fruit	subfossil	8						1					1			1		4		1		
cf. Indeterminata	seed/fruit	charred	100										100										
cf. *Portulaca*	seed/fruit	subfossil	1																	1			
Cirsium/Carduus	seed/fruit	subfossil	1												1								
Epilobium	seed/fruit	subfossil	1								1												
Fabaceae	seed/fruit	subfossil	1																	1			
Fragaria/Potentilla	seed/fruit	subfossil	3									2									1		
Hypericum	seed/fruit	subfossil	1																1				
Indeterminata	seed/fruit	charred	9	1					1		1							1	5				
Indeterminata	seed/fruit	subfossil	82	3	14	6	2	9	7	2	4	12			5	1	2	1	8	3	3		
Indeterminata	vegetative remair	charred	13	1				11											1				
Indeterminata	vegetative remair	subfossil	22	9	1		4	1			2								5				
Food remains	food	charred	4													1			2	1			
Juniperus	seed/fruit	subfossil	1												1								
cf. *Juniperus*	leave	subfossil	2						1			1											
Lamiaceae	seed/fruit	subfossil	1																1				
Lamium	seed/fruit	subfossil	2	1																1			
Myosotis	seed/fruit	subfossil	1																1				
Pinaceae	seed/fruit	subfossil	19	1	4	3		4				7											
Pinaceae	inflorescence	subfossil	1				1																
Pinaceae	cone	subfossil	3	3																			
Poa trivialis s.str.	seed/fruit	subfossil	2													1					1		
Poaceae	seed/fruit	charred	1																1				
Poaceae	seed/fruit	subfossil	1																1				
Polygonum	seed/fruit	charred	1					1															
Polygonum	seed/fruit	subfossil	5								2								1		2		
Potentilla	seed/fruit	subfossil	2														1		1				
Ranunculus repens	seed/fruit	subfossil	2			2																	
Ranunculus	seed/fruit	subfossil	4		1						1				1								1

feature				710	710	720	720	721	721	721	721	721	5020	5020	5020	5020	5021	5021	5121	5121	5121	5121	510
sample number				9	10	19	21	1	3	7	8	9	8	16	17	1000	2	11	3	4	6	10	15-01
square				74C	75B	75A	75C	74A	74B	74D	74C	75B	506D	505B	505A	506C	502B	502C	511B	511B	511B	511B	-
Volume (l)				0.75	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.75	0.5	0.75	0.75	0.5	0.5	0.75	0.75	0.25	0.25	0.25
	remain	**agg**	**sum**																				
Various																							
Rumex	seed/fruit	subfossil	1																		1		
Scabiosa columbaria agg.	seed/fruit	subfossil	1	1																			
Scrophularia	seed/fruit	subfossil	2		1							1											
Silene	seed/fruit	subfossil	4	1		2				1													
Solanum	seed/fruit	subfossil	1													1							
Stellaria graminea/palustris	seed/fruit	subfossil	1														1						
Thalictrum	seed/fruit	subfossil	2		1				1														
Vicia	seed/fruit	subfossil	3																3				
Viola	seed/fruit	subfossil	10	1						1	1					1		1	2	2	1		
		sum	**7 385**	**584**	**553**	**450**	**334**	**261**	**622**	**380**	**702**	**441**	**222**	**80**	**179**	**359**	**340**	**169**	**982**	**289**	**306**	**80**	**54**
Materials																							
Rhizomes (recent)				+	+	+	+	+	+	+	+	+	+++	+++	+++	+++	+++	++	+++	+++	+++	+++	++
Undetermined remains	leave	subfossil		++	++	++	++	++	++	++	++	++	+			+	+			+	+		+
Budscales	bud	subfossil		26	27	38	28	12	20	43	19	23	1		1		1		3	2	2		+
Bark	bark	subfossil		+++	+++	+++	+++	+++	+++	+++	+++	+++	+		+					+			+
Wood	wood	subfossil		+++	+++	+++	+++	+++	+++	+++	+++	+++	+	+	+		+	+	++	++	+	+	++
Charcoal	wood	charred		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	++
Mosses	moss	subfossil		+	+	+	+	+	+	+	+	+						+	+	+	+		
Insects	insects	subfossil			+	+		+	+	+	+	+	+	+	+	+	+	+	++	+	++	+	
Molluscs	molluscs								+	+			+	+		+	+	+	+	+	+		+++
Cow/Goat/Sheep dung	faeces	charred							+		+		+			+	+	+	+	+	+	+	
Small rodents faeces	faeces	subfossil		2		5			2	2	2	4	21		1	7	6	1	38	1	34	2	

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