Charred seeds in Mikkeli Orijärvi -

A study of subsistence strategies of an Iron Age settlement in East Finland

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1 Introduction

Agriculture was introduced in the Middle East ca. 10 000 BC with cultivation of cereals and raising of the domestic animals. From the Middle East agriculture spread out and reached also the northern area of the current Finland, where the first signs of cultivation are seen during the end of the Stone Age, approximately 2500 BC (Vuorela 2002:84). Since then, cereal cultivation has been a part of subsistence in Finland. There are no written sources of prehistoric agriculture, hence it must be studied using other methods. The past agriculture leaves behind various implements and archaeological monuments. These remains can be surveyed, excavated and studied further to obtain information of prehistoric technology. It can yield a lot of information, but some important questions are left unanswered.

If we are asking: What did they cultivate? What kind of animals did they have? When did all this happen? To answer these questions we have to introduce the environmental archaeological methods. These provide tools to study various aspects of Iron Age subsistence strategies. However they have their limitations and only a combined, multidisciplinary study can provide satisfactory results, because single data sets are vulnerable to disproof when compared with other data (Dincauze 2000:4). Plants can be best studied with archaeobotanical methods. Pollen analysis gives a long time perspective and large area reflection of the vegetation and agricultural development. To gain more detailed information of the local plant usage, studies of plant remains in archaeological contexts must be introduced.

The Iron Age field system studied in this master's thesis was discoverd and excavated in Eastern Finland in Mikkeli Orijärvi Kihlinpelto. The fields proved to be the largest fossil fields found and studied in Finland so far. The site was excavated during the end of the 1990's and beginning of 2000 with large scale rescue excavations organized by the National Board of Antiquities. The excavations resulted in over 250 features and 5 ancient fields and numerous finds. (Alenius et al. 2007.) According to the radiocarbon datings, Orijärvi dates to ca. 600–1600 AD and a silver coin hoard found in the fields dates to the end of the Viking Age. According to the rich burials excavated in Mikkeli, the area has been considered to be central during the Iron Age, especially the Viking

Age and the Crusade Period (Kivikoski 1961:214; Huurre 1979:171; Lehtosalo-Hilander 1988:190–224).

In order to gain more information about the environmental and agricultural history, a pollen core was taken from the lake Orijärvi and over 350 archaeobotanical samples were collected. The pollen analytical study has already been published and it contains a lot of valuable information about the vegetation history and agricultural activities in the area of Orijärvi (Alenius et al. 2007). In this study, the theoretical background of the archaeobotanical data is discussed and the Orijärvi site and its environment are presented. The taphonomy of the charred plant material is also discussed. Evans (2003:35) states that "-- abandoned fields and dumped rubbish -- can be more meaningful than their initial creation and use." The abandoned fields found in Orijärvi contained a lot of charred plant remains, which can attach new meanings to these fields. To grasp the meanings, the taphonomy of the charred plant material found in the fields must be studied.

Due to climatic and geological factors, the livelihoods in Finland have been diverse. Subsistence strategies have consisted of agriculture, hunting, fishing and gathering. In this study selected information of Iron Age subsistence strategies mostly from Mikkeli and to some extent from the rest of Finland is combined. The information is collected from different sources: osteological analyses, artefacts, pollen analyses, archaeobotanical studies and the observations made about the prehistoric fields. The other archaeological monuments related to subsistence strategies, such as clearance cairns, are left out, because they are not studied enough by the archaeologists in the area.

This master's thesis begins with the introductionary part, where research questions are presented. The theoretical part will then follow, where environmental archaeology, study of subsistence and meaning of textuality are discussed. This is followed by a longer chapter about archaeobotany, which is the method used in this study. Here the main focus is on the important questions of preservation and taphnomy of archaeobotanical material. After this the site of Orijärvi will be presented together with its environmental and archaeological surroundings. This is followed by a literature study in which the present state of Iron Age agricultural studies in Mikkeli and partly elsewhere in Finland will be discussed. Then the results of the archaeobotanical analysis will be presented in two chapters. The first one will discuss the whole assemblage and the characteristics of the different plants. The second one will present the archaeological features and the archaeobotanical material found in these. After this there will be a discussion part and finally conclusions. The nomenclature of the cultivated plants follows Jacomet et al. (2006) and for the wild plants Hämet-Ahti et al. (1998). For the reader unfamiliar with scientific botanical nomenclature, scientific, English and Finnish names used in this paper are listed in the appendix 1.

1.1 Background

It was partly by chance how I came up analysing archaeobotanical samples from Orijärvi. My first contact with field archaeology was during excavations 2005 when I participated in the excavation training as a part of my studies in the University of Helsinki. I made the first contact with archaeobotany in the autumn of the same year when M.A. Tanja Tenhunen working at the National Board of Antiquities was flotating samples and she needed help doing this. After that I aided her doing macrofossil analyses. I worked in Orijärvi also during summer 2006 and gathered archaeobotanical samples. During the fall 2007 I did my bachelor's thesis on the macrofossil material gained from the excavations in Orijärvi. Later M.A. Esa Mikkola from National Board of Antiquities hired me to analyse the rest of the archaeobotanical samples.

During my stay in Umeå from fall 2008 to spring 2009 I made a new identification of the archaeobotanical material with the help of doc. Karin Viklund and prof. emeritus Roger Engelmark in University of Umeå and wrote a Master's Thesis *Ploughing the Profane and Sacred. Archaeobotany at Mikkeli Orijärvi Kihlinpelto in East Finland*. In this work the aim is to discuss the archaeology in the proximity of Orijärvi more thoroughly and discuss the theory of environmental archaeology and archaeobotany in more detail. The whole process has forced me to think quite a lot how to interpret archaeobotanical material and the prehistoric agriculture. Above all, however it has given me a good opportunity to learn archaeobotanical methods.

1.2 Research questions

Prehistoric agricultural history is poorly known in Finland and in Mikkeli area and the amount of excavated archaeological sites relating to agricultural activities is small. Before studies in Orijärvi evidence relating to prehistoric subsistence in Mikkeli has been based on archaeological artefacts, one pollen analysis, some osteological analyses and one macrofossil analysis. The majority of the archaeological knowledge has been deriving from the rich graves first excavated already in the end of the 19th century in the area of Mikkeli, where the Iron Age finds date from the Merovingian Period to the Crusade Period (Lehtosalo-Hilander 1988; Kirkinen 1996:21). The macrofossil analyses made in Mikkeli area have not yielded that much information, probably due to the small amount of sites and samples studied (Lempiäinen 2002; Vanhanen 2009). Two pollen analyses (Alenius et al. 2007; Simola et al. 1988) have been published in the area of Mikkeli and these have started to shed light on the large-scale and long-time picture of the vegetation development and cultivation chronology.

In this paper the following research questions will be discussed:

A. What kind of taphonomical processes have been affecting the archaeobotanical material and what does it represent?

Understanding the taphonomy of the charred plant remains is important to be able to further interpret the material. There are many steps in the taphonomical process which occur both during the usage of a site, after its desertion and also by archaeologists and archaeobotanists. The understanding of these processes makes the interpretation of the archaeobotanical material possible. In Orijärvi the taphonomical processes are especially important, because there have been so many different activities on site during and after its prehistoric period of use. In order to be able to interpret and to know what the archaeobotanical data represents, the taphonomy must be studied.

B. How can the contexts be interpreted according to the archaeobotanical material and how do the contexts differ from each other?

The archaeobotanical material has a wide potential for archaeological interpretation. This potential is not always possible to use, when the sample amounts are too small or the material is too limited otherwise. In this study, the sample amount is large, so the interpretational potential can be used well, when taphonomical factors are taken into account. The archaeobotanical material can give insight to the interpretation of archaeological contexts. The plant content of a context can give hints of its usage of a certain context. For example food preparing can leave remains of food plants, and the different stages of crop processing leave different kind of combinations of plant material in the contexts.

C. What kind of knowledge does the charred plant material give about the subsistence and agricultural history in Orijärvi?

Over 350 soil samples were collected during the excavations in Orijärvi to gain more information on the prehistoric subsistence. All the samples were studied and they contained numerous charred plants remains. The remains can give a lot of information regarding plant usage and agricultural history on a site scale. This will be done by studying the composition and radiocarbon datings of the plant material.

2 Theoretical considerations

2.1 Textuality, agency theory and study of subsistence strategies

As Christopher Hawkes (1954) wrote in his influential article: *Archaeological Theory and Method: Some Suggestions from the Old World,* I also think that reasoning in archaeology should be based on archaeological phenomena. At least in Finnish archaeology there seems to be a certain dichotomy between the archaeological theory and practise. I think it should not be like that and the archaeological theory should be representing the archaeological phenomena as closely as possible. In this study taphony can be considered as a middle-range theory linking the archaeobotanical material with the interpretation. The archaeological data as whole is interpreted in a hermeneutical and interpretative manner as described by Matthew Jonhson (1999:102–103). Explaining is emphasized in the interpretation of the data, though the archaeobotanical data is presented in exact amounts.

Hawkes (ibid.) compares "text-free" and "text-aided" archaeology, and I consider that the study of Iron Age in Finland is at the same time both. Indeed there is no direct written evidence from that time, but the ethnographical and historical data could and should be used in addition to the archaeological material. The contemporary written sources from the other parts of the world should be taken into account. It should also be considered that people living in Orijärvi could have been in contact with people that were literate because there is material, which derive from places where writing has been known.

According to Sven B. F. Jansson (1984:61–62) Finland is mentioned three times in rune stones found in the area of modern Sweden: Finland, actually meaning Finland Proper (see fig. 3) is mentioned in a stone found in Uppland dating to 11th century; Tavastia is mentioned in a rune stone found in Gästrikland and a rune stone discovered in Gotland is dedicated to a man who died in Finland. A silver brooch most probably belonging to a woman with runic inscriptions on its backside was found in Mikkeli Tuukkala, it presumably originated from Gotland and is proposed to date to the beginning of the 12th century (Lehtonen 2002:54, 67). Letters of the alphabeth have been engraved into a ring brooch found in Tuukkala (Nousiainen & Lehtinen 1994:14). Letters written on birch bark found in Novgorod date to 1000–1400 AD and they contain texts written in Baltic-Finn language (Uino 2003a:459–460). The coins found in Orijärvi derive from places where writing was known.

So most probably people living in Orijärvi at this time have known that there are people who are literate and they could have had connections with them. This leads to a different study of archaeology than the study of a truly prehistoric one, because there are points of reference within the historic order. The archaeological studies of this kind should be considered proceeding from known towards the unknown (Hawkes 1954). This means that textual material can and should be used in addition to the archaeological data in the study of Finnish Iron Age. In the study of subsistence, this means that contemporary classical, Scandinavian and continental European written sources affect the results of the study. Also the later historical records of the plant usage in the area and neighbouring areas are important to study, because the food culture and plant usage are often one of the most conservative parts of the society (Viklund 1998). It should be still kept in mind that the inference should not be conducted in an evolutionary manner, where societies get more complicated, technology advances, and the population increases as time goes by. The development should not be simplified.

Hawkes (1954:161–162) proposed that the induction made of the archaeological phenomena should be classed into four levels, which begin from the easiest to induce and end up with the most difficult to induce. The levels are from the easiest to the most difficult: material techniques, subsistence-economics, communal organization and spiritual life. This should not be only straightforward so that the induction goes from the simple to the complicated, but these all aspects should be considered interacting with each other.

Different types of subsistence-economics provide prerequisites for different types of communal organization, as more centralized societies allow greater economic specialization and efficiency in production. In this study, the subsistence-economy is seen as an indication of the complexity of the society where the increased food production makes the society more complex. By simplifying things much it can be said that the more food was produced in a certain geographic area, the more complicated the society was. (Renfrew & Bahn 2006:178–180, 207; Hawkes 1954:161–162.)

How did they get their food ie. what were the subsistence strategies? This can be reconstructed by studying the technological aspects of the archaeological material and by using ethnological and historical analogies. Technology gives prerequisites for different kind of subsistence strategies. By studying various implements used in hunting, fishing and agriculture, the methods used in these subsistence strategies can be inferred.

In the study of subsistence, the question has traditionally been: What did they eat? The answer to this question can be gained by studying different kinds of archaeological remains. Artifacts, pollen spores, seeds, bones, isotopic studies of human bones etc. can tell much about the human subsistence and it can be eventually reconstructed at least to a some degree. The aim of this study is to get more information on the Iron Age subsistence strategies. In order to elicit the most convincing results, data from different sources should be combined. Historical, ethnographical and other data should be combined with the results gained by archaeological studies. Environmental archaeology is used to study the subsistence strategies, often with emphasis on the plant and animal species used by the prehistoric societies. In this study, the emphasis is on the plant species used by the Iron Age societies, but the different aspects of subsistence are also taken into account. Subsistence strategy is understood as a cultural phenomenon, not only as a means of survival.

However, I do not consider these questions to be enough. As we eventually want to know something about prehistoric people, we probably are not satisfied with knowing only about the functional aspects of the subsistence, because people are not solely functional and they should also be considered cultural. If we consider that people have only farmed and hunted to get their stomach full, we are on a wrong track. People in the prehistoric times did not use all their energy just to stay alive. As Dena Dincauze (2000:6) writes, humans have the same basic needs as all living beings: food, shelter and reproduction and besides this she proposes that humans have the need for society. It is suggested by John Evans (2003:19, 28) that agency theory can describe interaction between people and their environment. He sees (2003:19) the agency theory as “the study of the way in which people used past human environments to understand and reproduce their lives”. He (2003:28) proposes that the environments are related primarily to the development of socialities and only secondly to producing food or gaining shelter and there is no activity lacking a social component and there is no functional domain, but everything is social. He (2003:28) notes that it is difficult to socialize within a wholly social medium and the social meanings could have been embedded in soils and different social acts could have been mediated through acts which change the soils (Evans 2003), so in this way cultivated fields and other structures can also be seen as media for socialization.

In a similar manner Sven Isaksson (2010) implies that knowledge is expressed usually through words, but this use of knowledge leaves material traces. He concentrates on culture of food, which deals with knowledge concerning food and eating. Cultural signals of food can not be directly grasped by archaeologists, but they are affected by various cultural and natural processes. People have transformed selected parts of the nature to be part of their menu, and before it has been consumed it has gone through various culturally influenced processes: production, preparation, representation and consumption. Through these processes food can end up in residue or ritual contexts and after this it faces also other taphonomical processes discussed later in chapter 3.4. For archaeobotany this means that subsistence can be most often studied through residue contexts, which come into being through the different processes.

Various plants could have had ritual meanings. Plants are given to the deceased in modern society and they have been also important during the prehistoric period. Due to the lack of written information the plant offerings of the prehistoric period can only be studied by archaeological methods. Nevertheless, some inspiration for the interpretation of these remains can be taken from the societies where written sources had already been introduced. The texts and depictions made by Ancient Romans contain information on plant offerings and the offerings have been studied also archaeobotanically. The offerings are basically categorized as burial, household, and foundation offerings (Matterne & Derreumaux 2008; Rovira & Chabal 2008; Bouby & Marinval 2003; Robinson 2002; Zach 2002). Probably the easiest one to study in the scope of prehistoric archaeology are the burial offerings. Maybe the second easiest to study are the foundation offerings, but household offerings can be easily mixed with other household material. According to Isaksson (2010) it is fruitful to compare pronouncedly ritual contexts with apparently mundane contexts i.e. graves with settlements and study various degrees of ceremoniousness. This phenomenon can be also discussed as ritualization, which is a form of action and a social strategy of a disctinctive kind and any kinds of objects can have been ritualized (Bradley 2003:11–12).

Archaeobotanical material found in the offerings are often food plants and also wild plants, which are also found in profane contexts. Ann-Marie Hansson and Liselotte

Bergström (2002) have categorized the plant remains found in graves as: symbols, ritual markers, food, decoration and functional containers. In Sweden the material found in graves contains often more pulses, whereas cereals are more common in the settlements (e.g. Viklund 2002). This may be due to the different kinds of food preparation and processing methods employed as in these all plants were not in contact with fire (Robinson 2002:99). For the archaeobotanical material to be preserved, the contact with fire is often necessary. This may occur during a cremation or a ritual. Hence food and subsistence have had many social meanings; why would they have not been present during the Finnish Iron Age? Sacrificing food, using food as a social medium and selecting what to eat have indeed been relevant during this time.

2.2 Environmental archaeology as human ecology

According to Butzer (1982:5 and cited literature) the ultimate goal of environmental archaeology should be to understand the interrelationship between the culture and the environment and try to achieve this goal by aiming research towards the archaeological studies of human ecology of prehistoric communities. This aim can be reached by studying archaeological sites or networks as part of human ecosystem, in their contexts (Butzer 1982:7).

Ecology studies the relationships between organisms and their environment and ecosystem comprises all the living plants and animals interacting as an ecological unit. Environment is defined as all the physical and biological elements and relationships that affect a living being. In this study, the archaeological site is seen as a part of the past ecosystem. The ecosystem is not stable and all its parts are constantly changing, which makes it challenging subject to study. Humans are an interdependent part of the environment and they can not be separated from it. (Dincauze 2000:3–5, xxiii–xxiv & literature cited.)

During the Iron Age people living in Orijärvi had interrelationships with many kinds of plant and animal species, which have been introduced into their living spheres. Various animals have been domesticated, hunted and fished. Plants have been cultivated and collected from the wild. Also soils have been affected by ploughing, ditch digging, and other cultivation activities.

Ploughing has exposed the soil for wind and water erosion, thus changing the requirements for plants and animals. Manure of herding animals has changed soil conditions. Digging of irrigation ditches changed sedimentation environments, water flow and water tables. (Dincauze 2000:15 & literature cited.)

People have not only "used" the environment, but they have been a part of it. People have not lived in a virgin nature during the Iron Age, but the environment has been deeply affected by the humans and vice versa. Interaction in this ecosystem is studied by archaeobotanical methods and combined with other studies. The archaeobotanical record is seen as deriving from cultural phenomena interacting with the environment. "By changing the distribution and densities of flora and fauna, humans have always lived in a world partly of their own making. The physical remains of such behaviour and its consequences make an archaeology of paleoenvironments and paleoecology possible." (Dincauze 2000:10).

In a paleoenvironmental study, one must take into account that the environment consist of physical, biological and social aspects (Dincauze 2000:17). Analogical reasoning is fundamental for paleoenvironmental and archaeological research, but it rarely leads to new knowledge and typically shows that some phenomena had or have wider distributions than was previously known. Analogy can be used also when observing present phenomena in order to learn more about the past. A challenge is the no-analog problem which means that no set of environmental circumstances is ever precisely replicated. Therefore no modern situation can serve as an accurate analog for any multivariate environment in the past. Another challenge is the equifinality which means that same results may be produced by different causes. (Dincauze 2000:28–29, 31.)

According to Dena Dincauze (2000:24), the three C-goals of environmental archaeology are: **Complementarity,** which means that diverse data sets are able to create interpretations more nearly complete than any single discipline can achieve.

Consistency requires that the reconstruction of any one aspect of paleoenvironments be compatible with the reconstructions of others. All the evidence should agree. **Congruency** recognizes the need to mediate among data sources at different scales. In the case of Orijärvi, complementarity means that the results gained with pollen analysis and the study charred seeds gives more knowledge together than any of these alone. Consistency means that the results should be compatible so that they agree with each other or the possible disagreements should be explained. Congruency means that it should be kept in mind that the pollen analysis and the study of charred seeds have different spatial and temporal scales, which should be considered when interpreting the results of these studies. All other data should also be considered in the same manner.

Plants are considered to be a part of the culture and environment at the same time. The plant material is in itself organic and 'natural', but by human actions it has become a part of the culture (Driver 2001). The most important cultural and technological factor behind this study is agriculture, which is the means of adaptation to the environment. This adaptation consists of changing and stable relationships between human groups and nature (Driver 2001). In this study, agriculture is seen as a complex which includes cultivation, grazing and meadow usage. These different aspects of agriculture can be studied by the means of archaeobotany. In addition to agriculture; gathering, fishing and hunting are taken into account as subsistence strategies. Also trade is studied superficially, but handicrafts are not taken into account.

2.3 Theoretical background

The textual nature of Finnish Iron Age was underpinned as it influences the study. Textuality makes it possible to use different kind of source material than the study of purely "text-free" archaeology. In the case of Orijärvi it is possible to use contemporary European and classical sources, and also later Finnish sources which give information on subsistence and agriculture. Also ethnographical analogies are used as these give great deal of information on crop processing and other activities. Plant material can also be discussed by using the agency theory. This underlines the social aspects of all activities and it can also be considered that the plant material serves as a social medium, thus also in rituals. The study of subsistence should be done by using different data sources, which are able to give most reliable results. Environmental archaeology is understood as human ecology in this study. The site of Orijärvi is seen as a part of a past ecosystem, where humans and their actions are in the focus of the study. The interactions with the ecosystem are studied mostly by archaeobotanical means, but also using other data sets.

3 Archaeobotany

Archaeobotany is defined precisely by Mark Nesbitt (2006:20) as "the study of plant remains from archaeological sites, with the aim of understanding past human diet, food gathering and cultivation, and environmental change. The term encompasses both macroremains (seeds and wood/charcoal) and microremains (pollen and phytoliths). Most archaeobotanists work on seed remains, including in modern forensic science, here broadly defined to include all kinds of propagules".

In this study, archaeobotany means the study of charred seeds (in the widest sense) in archaeological contexts. The charred seeds are called macroremains, because they can be seen with the naked eye and they are often called macrofossils in Finnish literature. The remains can also be called macrobotanical remains (Renfrew & Bahn 2006:250) which I think is a better term in English as it is clear that remains are botanical not faunal. Microbotanical remains, for example pollen spores, are plant products that require magnification to study (Dincauze 2000:330). In this study, charred seeds are used mostly to study subsistence strategies and in a lesser extent to reconstruct the environment. The food of domestic animals is studied as the remains of it have been preserved in the form of charred seeds. In addition to this, the results of pollen analysis and other data sets are taken into account in order to reach understanding about the human ecology and by trying to reach an interpretation that is agreed by the different data sources.

3.1 What is archaeobotany?

First archaeobotanical studies were made in the late 19th century. The most important of these are the finds of desiccated plant remains in the ancient Egyptian tombs and the studies of plant remains in Swiss Neolithic lake villages conducted by Oswald Heer.

The recovery of plant remains was occasional and a part-time occupation of botanists and agronomists until 1960s, when interest in economic and environmental aspects of ancient societies grew and flotation techniques allowed better retrieval of plant remains. Plants were until then recovered only from obvious depositions such as burnt storerooms containing jars or silos of seeds. Pioneering Danish archaeobotanist Hans Helbæk (1907–1981) showed much way for the future work. Archaeobotany has evolved into a discipline of its own and it is an integral part of many archaeological projects. (Nesbitt 2006:20–21.) Since archaeobotany is a relatively young discipline, it has not yet developed its own theory, but it borrows its theory from other disciplines like botany, archaeology and anthropology or ethnology (Dincauze 2000:331). However theories are formed as the amount of data grows and more scholars work with archaeobotany.

It is the role of archaeobotany to interpret the plant remains and seek the underlying processes behind them. The composition of the charred plant material in contemporaneous and same types of structures forms patterns. (Viklund 2004:56.) When the patterns are found, archaeobotanical material can be used for the interpretation of different structures. Analogies for the archaeobotanical reasoning can be based on ethnographical studies, probably most famous of them being the studies of Gordon Hillman (1984) in Turkey. The reasoning can also be based on experiments that are undergone with the level of technology that is equivalent to the one used during prehistory. Iron Age farming methods have been studied experimentally in Scandinavia, where the Danish studies in Lejre (Hendriksen 1996) and Swedish studies in Umeå (Gustafsson 2000; Viklund 1998) are the best known and give most information on the subject.

In Finland archaeobotanical studies have been conducted since 1970s, when the first course on the subject was organized in Oulu. Since then many theses and papers have been written on the subject. Studies have been concentrating on prehistoric sites, but since the 1980s many Middle Age and later sites have been studied. Approximately 25 archaeobotanical studies have been conducted from sites dating to the period between 800 and 1150 AD. The majority of the studies have been conducted by doc. Terttu

Lempiäinen, but Marjatta Aalto and Merja Seppä-Heikka have published also quite many studies and Roger Engelmark and Karin Viklund have conducted some studies on Ostrobothnian material. Most the archaeobotanical studies have been done in Southern Finland. The archaeobotanical studies have contributed much to studies on the cultivation history and the history of cultivated plants. Also the environments of the archaeological sites and history of medicinal plants have been studied using archaeobotanical methods. Some studies on tree anatomy have been conducted on the wooden artifacts, for example coffins. Though some archaeobotanical studies have been conducted in Finland, a lot should still be done as there are many places and periods where no studies have been made. (Lempiäinen 2006.)

3.2 The modes of preservation and taphonomy of the archaeobotanical material

Taphonomy is the study of the processes leading to fossilization of biological remains and is essential to the interpretation of the remains (Dincauze 2000:28, 331). The majority of seeds do not preserve in the ground as they germinate or are consumed by animals or micro-organisms (Nesbitt 2006:21). The archaeobotanical material has different modes to be preserved. These modes are: carbonization ie. charring, waterlogging, mineralization, desiccation, impressions on clay, preservation in ice and preservation by metals. Usually only one or two of these preservation modes are present in one site. The modes of preservation differ from each other, because they are found in different kind of environmental and cultural contexts. The different modes of preservation also favour different plants and plant parts. (Van der Veen 2007:968 & literature cited; Körber-Grohne 1991:12; Renfrew 1973:15–16, 19.) In this chapter the different modes of preservation are shortly introduced and later taphonomy of charred seeds is discussed in more detail as it has been the most important mode of preservation in the Orijärvi site.

Carbonization or charring of the archaeobotanical material means that the grains and seeds are reduced to carbon. This process requires a temperature of approximately 150–400°C which is most often caused by fire. Charring may occur when the combustion occurs with minimal amount of oxygen. If there is not enough heat, the plant material does not get charred and gets destroyed and if there is too much heat it turns into dust. Usually only solid plant parts, such as seeds, fruits, nuts and other propagules are preserved by charring. In charring the archaeobotanical material retains its characteristic shape, but the proportions of the seeds can change and they can get mutilated. Usually carbonized seeds loose their finer morphological details. Still sometimes even the cell structures survive and this makes it possible to identify pieces of grain in charred bread loaves. The charred remains are affected by mechanical wear, which can break and destroy them. (Nesbitt 2006:21; O'Connor & Evans 2005:165; Greig et al. 1989:16; Renfrew 1973:9–14.)

Plant material can leave negative **impressions** in baked clay. This can happen when plant material is introduced into the clay during the making process of ceramic vessel or when making something else from clay. The plant material then turns into dust, but an impression leaves in the clay. It depends on the particle size and the mixture ratio of the clay how fine details of the plant material have preserved. The finer the particle size, the finer the impression. The impressions are best studied by pouring latex into the cavities and thereby getting a positive image of the plant material, which can then be studied. One advantage of studying impression on pottery is that they can be connected with the archaeological culture. (Renfrew 1973:15–16.) Plant impressions could also be studied with the ceramics and burned clay found in Orijärvi.

The **desiccation** of plant material happens when the conditions of preservation are extremely dry. The preservation is excellent and the plant material can look identical to modern plants. The vegetative plant parts are also present, for example the delicate parts of garlic, onion and artichokes have been found. The density of remains is high and the species richness is commonly much higher than in charred assemblages. The desiccated plant material can also be found as insulation in European houses and there the plant material is in its original place, but still represents refuse. (Van der Veen 2007:969–970 & literature cited; Renfrew 1973:18–19.) The insulation could be also studied in Finland, but as far as I know, it has not been done yet.

Waterlogged material is preserved when the plant parts are constantly in anaerobic and wet conditions. This kind of preservation has been found in peat bogs, shipwrecks, bog bodies, wells, lakes, riversides and Middle Age towns and other places where the environment is suitable. (Greig et al. 1989:11–12, Renfrew 1973:17.)

Mineralization can occur in mineral-rich deposits. These kind of deposits can be for example latrines. In this process, the plant tissues are replaced by inorganic materials, which can survive and retain the morphological features of the plant part. (Nesbitt 2006:21, Renfrew 1973:16–17.) Plant remains preserve deep frozen **in ice** exceptionally well, as can be seen with the best known example of Neolithic iceman Ötzi found in the Alps on the border between Austria and Italia (Oeggl 2008). Preservation can also occur in the vicinity of some **metals** (Körber-Grohne 1991:12), this has also happened in Orijärvi, where a barley grain was found in the vicinity of a bronze artefact.

It is important to know about taphonomy in order to interpret the archaeobotanical material. On the other hand archaeobotanical studies can contribute to the studies of the formation processes. In this study, taphonomy means the whole process from the plant growing to the archaeobotanist studying the plant remains and writing about it. Riku Mönkkönen (2008) has studied in his master's thesis how tillage has effected the archaeological material in Orijärvi both theoretically and by comparing distribution of all archaeological finds, spread and wear of the ceramics, and the spread of the silver coin hoard. In the same way, tillage and other factors have affected the taphonomy of the plant macrofossil material. In fully aerated conditions such as in Orijärvi plant macrofossils survive only if they become charred. Usually charred remains preserve well, but they can be affected by mechanical wear. The taphonomic processes leading to charred macrofossil deposition are quite complicated. (O'Connor & Evans 2005:165.) According to Van der Veer (2007:978) "[c]harred assemblages are very suited to a reconstruction of agricultural practices, including the role of animals in the farming system, animal diet, and the use of crop by-products as fodder, bedding temper, etc. -- [U]nderstanding of their deposition can identify important social practices that go far beyond reconstructions of agronomic behaviour."

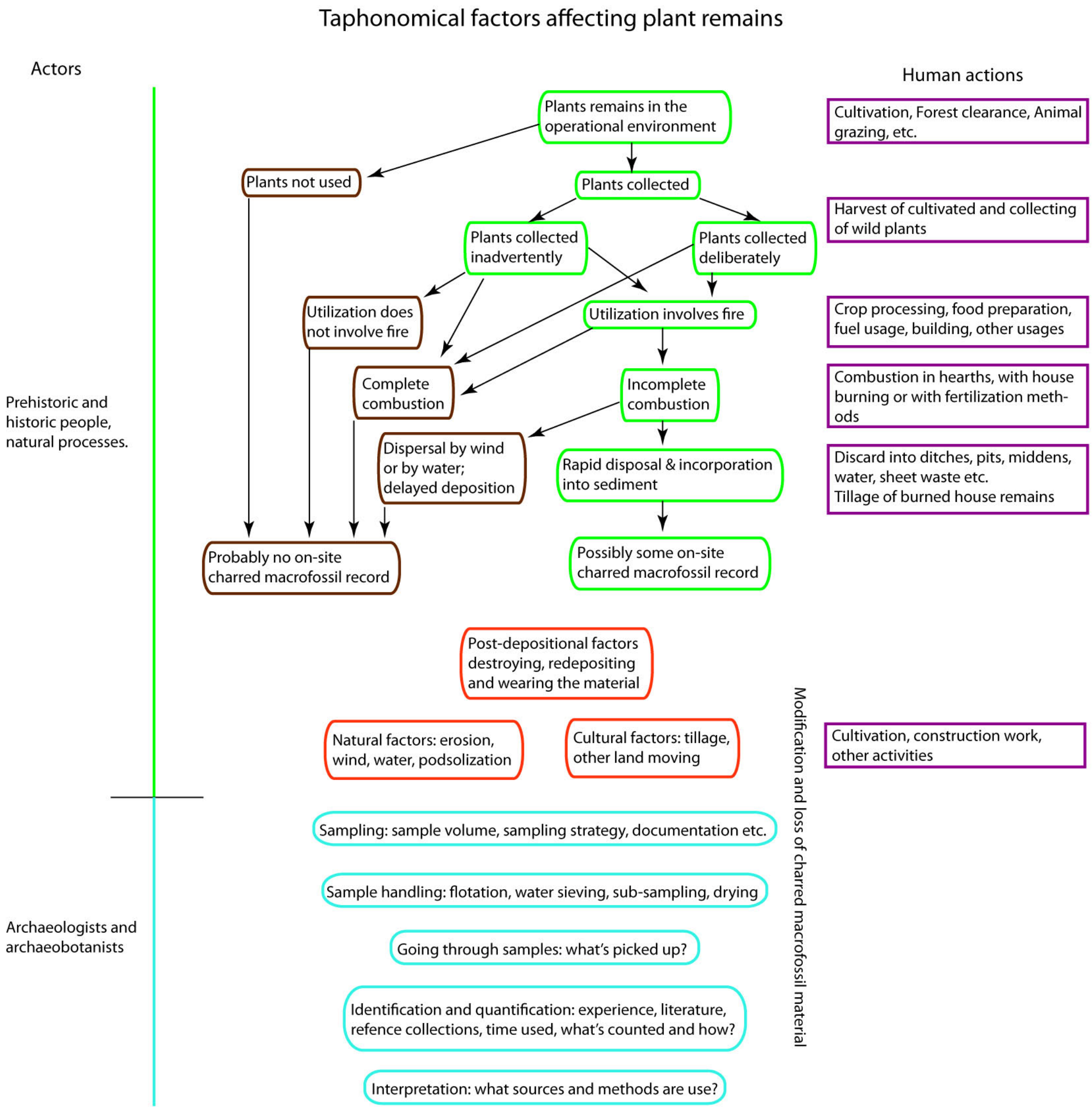

Figure 1: Taphonomic factors affecting plant remains. Based partly on Dincauze (2000:fig. 13.1) and O'Connor & Evans (2005:fig. 11.2). The formation processes of the archaeological material in Orijärvi site are discussed in detail by Mönkkönen (2008). Drawn by author.

It is important to understand that the different environmental archaeological methods give answers to the questions of different temporal and spatial scale (see Dincauze 2000:24–26). In Orijärvi, the archaeobotanical analysis provides site and context level environmental information, which is combined with the region and locality level environmental information received with pollen analysis (Alenius et al. 2007), and the information gained by osteological analyses, artefacts and study of the prehistoric fields. Pollen analyses can characterize vegetation and human activities over long periods of time (Alenius 2007:7). In Orijärvi, the material studied in the pollen analysis spans through the whole Holocene (Alenius et al. 2007), whereas the charred seeds approximately date to the period between 600–1600 AD. Material found in a site gives information about the site itself and the off-site areas the material came from (O'Connor & Evans 2005:72). This means that the biological remains found in an archaeological site can derive both from the site itself and areas surrounding it. By studying the living requirements for different biota, it is possible to gain information of the human activity areas or site catchment (ibid.). The charred plant material is interesting, because it has been most probably taken to the site by people. The taphonomic factors affecting plant remains are outlined in figure 1. The column on the left shows human actors "using" the site and later the ones who study it. The column in the middle shows how plant remains could end up from growing up in the operational environment of the people to the report or article written by the archaeobotanist. The column on the right shows some possible human actions which could have caused the plant material to end up in the charred plant assemblage.

For the plants to be collected by humans they must exist in the operational environment. The plants that are growing in certain time and space can be studied by pollen analysis and to some extent by seeds. By studying the prehistoric spread of certain plant species and comparing them with charred seeds found in archaeobotanical samples, some aspects of import can be studied. If the archaeobotanical assemblage contains plant taxa, which has not been growing on the site or even in close proximity, it then should be inferred that somehow these plants have been imported to the site. (O'Connor & Evans 1999:137–139.) I think that the Roman Iron Age grape vine seeds found in SW-Finland (Aalto 1997:59), must be examples of plant import.

The plant taxa can give insight to the size and spread of the operational environment. If the charred seeds are of species growing on specific habitats, it can be deduced that the operational environment entailed these habitats (O'Connor & Evans 1999:137–139). This could happen for example when marine species are found in inland sites. When drawing the conclusions of the habitat of certain taxa it is important to be able to identify the plants to the species level. This is possible for charred seeds, but it can be difficult as seeds tend to get mutilated when they get charred (Renfrew 1973:9–14). It should also be assumed here that people have modified their operational environment by various activities. Clearing the forest promoted the growth of light demanding plant species. Introduction of fire during the clearance promoted plant species which have seeds that germinate only when they have been heated enough. Cultivation created new environments for weeds and plant species living in the fringes of the fields. Animal grazing changed the habitats considerably, since they chose what species to eat and what not and their droppings changed the soil conditions by adding more nutrients to the ground promoting certain plant species.

It is notable that almost all the plants that end up in the charred macrofossil record derive from plant remains that have been collected. These plants can be cultivated or they can grow in the wild. It should be noted here that these wild plants often thrive in man made habitats. (O'Connor & Evans 1999:137–139.) One example is raspberry, which is often found in archaeological assemblages. It thrives on stony and cleared areas and on soils rich in nitrogen (Hämet-Ahti et al. 1998:243). These kinds of habitats are often created by man. The plant is wild per se, but its habitat is often man-made, which means that the plant is a cultural plant. It is possible that plant remains end up in the material in other ways than collecting such as the clearance of the forests or burning of the houses, but still the majority of the preserved plant remains have been collected. Because the material ends up into the charred seed assemblage mainly by collecting, it is quite obvious that the charred plant material does not represent the whole natural vegetation of the site (O'Connor & Evans 1999:137–139.).

If all plant material represents material which is collected we must raise the question why this material has been collected. Plants can be classified firstly to ones collected deliberately and those collected inadvertently (ibid.). The plants collected deliberately can be further classified into cultivated cereals and fibre plants, fodder, wild plants with nutritional value, plants for fuel, plants for building material and plants collected for other purposes. The plants collected inadvertently consist of weeds of different kind. Weeds can also be collected, which have been proved by weed seeds found in the intestines of bog bogies and large assemblages of weed seeds (Behre 2008). Weeds can be classified by the plants they thrive with, type of cultivation, soil conditions and crop processing methods. The classification is partly overlapping and must be considered individually, with every archaeobotanical assemblage.

Figure 2 is a model of how and what plant species end up in the charred assemblages of Iron Age houses. The collected plants from fields and other areas are processed in various ways before they are used (Hillman 1984). Proportion of the cereal material such as straws and husks are given to animals in the barn. The material found in dwellings consists mostly of cultivated plants and weeds (Engelmark & Viklund 1991:37). Hay for the animals is collected from meadow and wetland areas and it can be seen in the plant taxa found in barns (ibid.). Sometimes the functional division of Iron Age houses can be inferred with the help of archaeobotanical material (e.g. Viklund 1998). Archaeobotanical assemblages can occasionally be classified according to their crop processing stages (Hillman 1984, Van der Veer 2007), but this requires well preserved material.

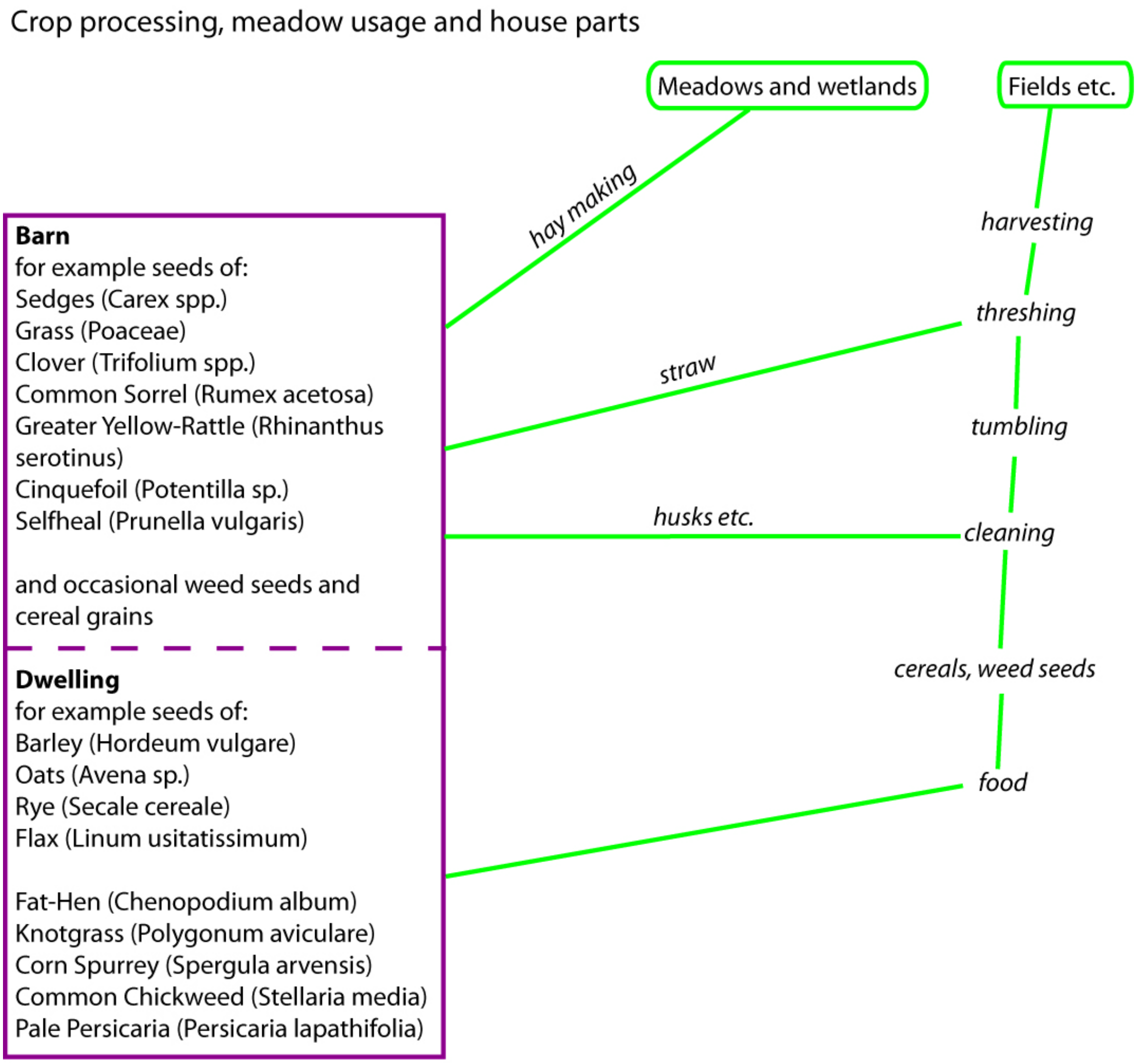

Figure 2: Crop processing, meadow usage and house parts. Barn and dwelling are situated in the different ends of an Iron Age house, but these could also be two separate houses. Based on Engelmark & Viklund (1991:37). Redrawn by author.

If we now consider that the plant material has been collected and then ended up in the Iron Age house or other structure, it now needs fire in order to get carbonized and to preserve. Van der Veer (2007:979) has suggested that there are five different modes of carbonization: 1) plants used as fuel, 2) foods (especially cereal grains and pulses) accidentally burned during food preparation, 3) stored foods destroyed by fire in accidents, 4) plants destroyed during the cleaning of grain storage pits using fire and 5) diseased or infested crop seeds that needed to be destroyed. Other possible way for the plants to get charred is when cultivated fields are burned in order to fertilize them or when forests are cleared with fire.

In the charred material some type of remains are preserved more often, such as cereal grains, cereal chaff and sometimes pulses and wild plants. Fruits, condiments, vegetables and oil-rich seeds are preserved less often. There are also exceptions in this pattern. Plant species used as fuel and plants which require heat for preparing (baking, cooking, roasting) tend to get charred more often. This is why only one part of the plant material is represented in charred assemblages. (Van der Veer 2007:977–978.)

As mentioned before the charring occurs only in places poor with oxygen and hot enough to make the plant material charred. Hearths seem to be the most common places where charring occurs. One problem with hearths is that plants can combust completely, because the heat is too intense or the combustion may happen in an oxygen rich environment. It is also possible that houses or other places where the plant utilization takes place have been burned. This was found during the excavations in an Iron Age farmstead in Gene in Norrland, Sweden in the 1970s (Ramqvist 1983).

Then one should consider how the material is incorporated into the sediment. It is important that plant remains do not get dispersed by wind or water, because then they will not be found in the charred assemblage. To be incorporated in the sediment, charred plant remains can be cleaned from hearths and deposited in rubbish pits, ditches or spread around so that not all charred plant material is found in the hearths (Branch et al. 2005:98, 104). One could also think the charred plant material is incorporated into the sediment by ploughing plant remains that have already been charred. This could happen when the burned house remains have been ploughed to a field. Other possibility could be that ashes from the hearths have been spread on the fields with fertilization. The clearance of trees and other vegetation in the places of the fields can also leave archaeobotanical traces such as charcoal and other plant parts.

The charred seeds are not secure even after they have been incorporated into the sediment. Formation processes keep on affecting the material as it is moved by natural and cultural factors. In Orijärvi, tillage has been an important factor that has been moving and wearing the plant material. Wind and water erosion have strongly affected the plants when they have been lying in the fields with no protective vegetation. Ditches and a well have been studied in Orijärvi and there the charred seeds have most probably been transported there with water. Most probably one could also find charred material in the sediment of the lake, where it would have ended up with the streams.

3.3 Manuring the fields

Manuring has most probably had many effects for the archaeobotanical material. First it changes the plant taxa, then it can add charred material into the fields and if the wandering field system has been used it can also transport the material. Manuring could be done at least with **animal manure**, **household waste**, **sods** and with the method of **'wandering' fields**. Hulled barley responses well to manuring (Welinder 1998:194) and manuring gives an opportunity to cultivate in less fertile grounds (Groenman-Van Waateringe 1979:140–141) and it can be seen in the archaeobotanical material with the presence of plant species thriving in phosphate rich habitats (Pedersen & Widgren 1998:141).

For a very long time the most important way of manuring has been to spread **animal manure** to the fields. The introduction of animal manure usage can be attached to the introduction of byres, because the manure could be collected when keeping the cattle inside. However, the connection between these two is not absolute. (Pedersen & Widgren 1998:255.) **Household waste** has also been spread to the fields (Groenman-Van Waateringe 1979:58). It is possible that domestic rubbish has been mixed with animal manure before it is taken into the fields (Evans 2003:124–125). This mixture could contain ceramics, bones, manure, ashes from hearths etc., so this could be one reason why ceramics are found in the fields in Orijärvi.

The fields could have been also manured with **sods** from the surroundings of the field with the method called ger. *plaggenwirtschaft*. Material could have been taken from the surrounding heaths, peats, meadows, pastures, water meadows, salt marshes, waysides, ditch banks, field edges and all kinds of soils (Groenman-Van Waateringe 1979:57–59). In NW Germany this type of manuring is connected with winter rye cultivation and the weeds prevailing in this type of agriculture have been *Centaurea cyanus*, *Fallopia* *convolvulus*, *Scleranthus annuus*, *Spergula arvensis* etc. This type of manuring increases the organic matter in the cultivated soils, which has most probably also happened in Orijärvi. It led to large deforestation, caused by the need for more heathlands. (Behre & Jacomet 1991:94–95.) The increase of heathlands around Orijärvi can be seen in the occurrence of *Calluna* in the pollen analysis from 500 BC onwards continuing until modern times (Alenius et al. 2007:178), which could have been caused by deforestation. A charred layer of sod and brown organic matter was present especially in the east side of Kihlinkuja field (R123) and this was interpreted as being from the introduction phase of the field (Mikkola 2006:17–18). So it could also be possible that sods have been used to manure fields in Orijärvi.

During the Early Iron Age in the Swedish areas of Småland, Västergötland and Gotland field areas were so large, that all these could not have been cultivated at the same time. For the lack of manure people have had to leave the fields for fallow after only a few harvests. Because these fields have been moved often, they are called **'wandering' fields.** These kinds of fields may have been in use during almost the whole Iron Age. Also villages and farms have moved with the fields as people built new houses when they were moved to new areas. This kind of moving led to houses being eventually built at the places where the old fields and houses had previously been. The most intensively cultivated fields have been situated in the vicinity of the houses. Moving could have been beneficial for the fertilization of the land or it can be helpful to get rid of weeds and pests or to claim and clear new land. (Pedersen & Widgren 1998:277–281.) Erosion, changes in the water table level or change in the cultivation intensity could also have been reasons for moving (Göthberg 1995:102). On the other hand Richard Bradley (2003:18) suggests that moving could have been happened also on social basis, so that the sequence would reflect the life of the household as social unit and moving had happened for example when somebody had died.

In Linköping, many remains of three aisled houses with postholes were excavated. The postholes had dark cultural soil, but it was not present in the remaining parts of the houses. This was interpreted so that the rest of the house remains had been ploughed into the fields. (Elfstrand 2005:134.) The moving of the villages has happened in an area restricted by the resource territories. In Orijärvi, the possible extension of moving would have been restricted by the occurrence of suitable soils (Kirkinen 1996). The villages could move many times during their existence and in Denmark wandering villages have been found from the Pre-Roman Iron Age until 1000–1200 AD. It has been proved in many cases that the abandoned villages were taken into cultivation. Erosion could play an important role in the Iron Age agriculture, because the agricultural systems were not able to produce an adequate layer of organic matter to the fields. The situation was like this especially in the lighter soils. (Jensen 1982:200, 204–227 & literature cited.) In Orijärvi, the peak of loss on ignition (LOI) occurs during 700–800 AD, when the most organic material is flowing into the lake basin. LOI decreases sharply after 800 AD, which indicates that there is more inorganic material flowing into the lake at this time. (Alenius et al. 2007:177.) The rising of inorganic material could have been caused by extension of areas which have been prone to erosion. This could have been caused by extension of cultivated areas, ditch digging, collection of sods etc.

3.4 Sampling and sample processing

For the archaeobotanical analysis 354 archaeobotanical samples were taken during the excavations in 2000, 2002, 2003, 2005 and 2006. The samples were taken by archaeologists working at the excavations. The amount and volume of samples has varied during years from 1 deciliter to 2 liters. The samples were taken from various contexts: plough zone layers, postholes, hearths, grave-like structures, ditches, pits and a well. The majority of samples have been taken from plough zone layers and not all contexts have been sampled. Samples taken from the plough zone are relatively problematic, because the nature and formation of the plough zone layer. Pearsall advises not to sample plough zones at all, because of their clear disturbance (Pearsall 1989:96), but I am not sure whether she means modern plough zones or buried archaeological plough zones. In every case the plough zones are mixed contexts, which pose challenges and problems for the interpretation of the archaeobotanical material.

The sampling locations have been documented by their X- and Y-coordinates, altitude above sea level, structure and excavation level. The documentation has not been totally congruent, but it still is a good base for the interpretation of the archaeobotanical material.

When considering the sampling now, I see some obvious problems. Still the whole issue of sampling in archaeobotany is quite complicated and every archaeological site has its own challenges regarding sampling. Excavation staff did not have environmental archaeological training, so it is understandable that the sampling has not been done in the best possible manner.

Samples have been flotated by using a saturated saltwater method. In this method salt is added to water until it is saturated with salt. The soil samples are then poured into buckets where saltwater is then poured. This mixture of saltwater and soil is then stirred for awhile and after waiting for ca. half an hour the floating organic material is poured through a sieve. In this study a sieves of 0,125 and 0,25 mm mesh sizes were used. After the flotation the samples were kept wet and in saltwater. The flotation work was done partly during the excavations (Vanhanen undated) and partly during post excavation work at the National Board of Antiquities.

After the flotation process plant material was picked out from the samples by using a stereo microscope. This was done partly in National Board of Antiquities (NBA) and partly at the University of Helsinki, Department of Archaeology. The work was made partly by the author and partly by M.A. Tanja Tenhunen from the NBA. The samples were weighed wet to gain an estimation of the amount of organic material. The identification of the plant material consisting mostly of seeds was done by me and FM Tanja Tenhunen from the National Board of Antiquities, with the aid of literature (Cappers et al. 2006) and a small reference collection. Doc. Terttu Lempiäinen from the University of Turku helped with identification.

Because of the lack of a proper reference collection and experience I wanted to re-identify the material during my stay in Umeå with the help of doc. Karin Viklund, prof. emeritus Roger Engelmark and the reference collection in the Miljöarkeologiska Laboratoriet. This made the identification of the plant material more detailed and new plant species were also identified.

The plant material, which consists mostly of seeds, was identified to the species level when it has been possible. This has not been done with sedges and small grass seeds, because it was considered too time consuming. This would also be interesting and it can possibly be done in the future. Quite much time was used to distinguish between hulled and naked barley, because it was considered relevant for the study. Fragmentation of cereal grains was also noted to have the possiblity to study the effects of the ploughing for the plant material.

Especially the identification of charred cereal grains can be quite challenging and I think it is important to get taught by an experienced archaeobotanist. I think I have learned really much when I have had the chance to study and discuss the identification with persons mentioned above.

4 Mikkeli Orijärvi Kihlinpelto site

The Mikkeli Orijärvi Kihlinpelto site (for location of Mikkeli see fig. 3) was originally discovered by amateur archaeologists. They thought that the place would have been topographically suitable for Iron Age settlement and found also dark mullein (*Verbascum nigrum*) growing in the farmyard. The plant has been found growing near many Iron Age settlements. One Ottonian silver coin was found during a fieldwalking session in 1998. The coin was a part of a silver hoard consisting of over 140 coins. Other finds consisted of bronze ornaments, iron artefacts, glass-paste beads and two mill stone fragments. Most common finds were pottery, daub and loom weights made from clay. The excavations continued in the years 1999, 2002, 2003, 2005 and 2006. During the excavations over 260 features and structures and 5 ancient fields were studied. (Mikkola et al. in press; Alenius et al. 2007; Mikkola 2001a.) The excavations have been exceptionally large-scale in Finnish archaeology.

The dating of Orijärvi material is based on numismatic dating, artefact dating, radiocarbon dating and stratigraphy. The first three are discussed here. The pollen analysis has been dated with paleomagnetic method (Alenius et al. 2007).

The Viking Age silver coin hoard found at Orijärvi consisted of 123 whole and 21 fragmented coins (Mikkola et al. in press). The *terminus post quem* of the hoard is 1014 AD, which means that the youngest coins are made in this year. There are similar hoards found in Tavastia and this could be an indication of contacts with the area. (Mikkola & Talvio 2000:135.) Coin finds in Finland are much more numerous during the Viking Age than the preceding periods, but there are much fewer finds than in Sweden or Russia (Talvio 2002:8). All the coins have been found in the modern field layer. (Mönkkönen 2008:58, map appendix IV & literature cited.)

Figure 3: Southern Finland during the Late Iron Age (800–1150/1300 AD). Areas shaded with red are interpreted having permanent settlement based on grave finds. Mikkeli is situated in between Tavastia and Karelia and it is considered being a part of the Eastern Finnish area. The graves on Åland are of a Swedish type. Triangle: grave. Blue triangle: Scandinavian grave. Diamond: uncertain grave. Dot: artifact. Blue dot: Scandinavian artifact. Star: hoard. (Map based on Huurre 1992 & Talvio 2002:16 and redrawn by author.)

Laboratory number	Material dated	Sample number & year	Context	Field phase	from	to	charred plant material found
HelA-592	Barley (*Hordeum vulgare*)	41 (2000)	R84	P5	596	862	Hordeum vulgare 1 (dated)
HelA-596	Club Wheat (*Triticum compactum*)	123 (2000)	R23	P2	638	965	Triticum aestivum s.l. 1 (dated), Cerealia frag. 2
HelA-594	Barley (*Hordeum vulgare*)	104 (2000)	R23	P2	681	971	Hordeum vulgare 1 (dated), Cerealia frag. 1
HelA-593	Barley (*Hordeum vulgare*)	68 (2000)	R23	P2	686	970	Hordeum vulgare 1 (dated)
HelA-1412	pottery residue	-	R23	P3	694	894	-
HelA-1428	Barley (*Hordeum vulgare*)	6 (2006)	R264	P3	780	978	Hordeum vulgare 1 (dated), Vicia sp. 1
HelA-1413	pottery residue	-	R209	P2	782	989	-
HelA-1411	piece of a leather belt	-	PM	PM	833	1014	-
HelA-1427	Barley (*Hordeum vulgare*)	18 (2005)	R123	P4A	887	1014	Hordeum vulgare var. vulgare 4, Hordeum vulgare 9 (1 dated) Cerealia 3, Fragaria vesca 1, Bromus secalinus 1, Carex sp. 1, Poaceae 1, Picea abies (needle) 6, stalk 1
HelA-1447	Rye (*Secale cereale*)	82 (2002)	R84	P5	892	1015	Secale cereale 1 (dated), Cerealia frag. 1, stalk 1
HelA-1431	Barley (*Hordeum vulgare*)	45 (2006)	R23	P3	895	1023	Hordeum vulgare 3 (1 dated), Triticum aestivum s.l. 1, Cerealia 2, Chenopodium album 3
HelA-1448	Barley (*Hordeum vulgare*)	28 (2006)	R23	P3	896	1025	Hordeum vulgare 1 (dated), Picea abies (needle) 14
HelA-1410	burned bone	-	R85/134	-	896	1025	[1]Hordeum vulgare 2, Cerealia 2, Chenopodium album 2, Picea abies (needle) 1
HelA-1426	Barley (*Hordeum vulgare*)	81 (2002)	R84	P5	898	1117	Hordeum vulgare 3 (1 dated), Cerealia 3, Persicaria lapathifolia 1, Galium spurium 1, Chenopodium album 1, Vicia sp. 1,
HelA-1429	Rye (*Secale cereale*)	25 (2006)	R23	P2	999	1159	Hordeum vulgare 3 (1 dated), Cerealia 7, Chenopodium album 3, Galium spurium 1, Chenopodium polyspermum 1, Persicaria foliosa 1, Vicia sp. 2, Poaceae 1,
HelA-773	tree remains (cf. *Betula* sp.)	-	R210	-	1021	1173	[2]Hordeum vulgare var. vulgare 4, Hordeum vulgare 1, Secale cereale 1, Cerealia 1, Galium spurium 1, Polygonaceae 1, Arrhenatherum elatius var. bulbosum (tuber) 1
HelA-595	Barley (*Hordeum vulgare*)	112 (2000)	R23	-	1267	1401	Hordeum vulgare 1 (dated), Cerealia frag. 1
HelA-1430	Barley (*Hordeum vulgare*)	12 (2005)	R264	-	1438	1619	Hordeum vulgare 1 (dated), Linum usitatissimum 1, Cerealia 6, Chenopodium album 1

Dates will be published in: Mikkola et al. In press. All dates in AD.
All dates presented here are calibrated using Oxcal 4.1 and with 95,4 % probability.
[1]Dating was from a hearth and not from exactly same place as the macrofossil sample.
[2]Dating is from the wooden remains of the well, so the plant remains are deposited after the well has been built.

Figure 4: Radiocarbon dated material, their contexts, calibrated datings and charred plant material found in the dated samples.

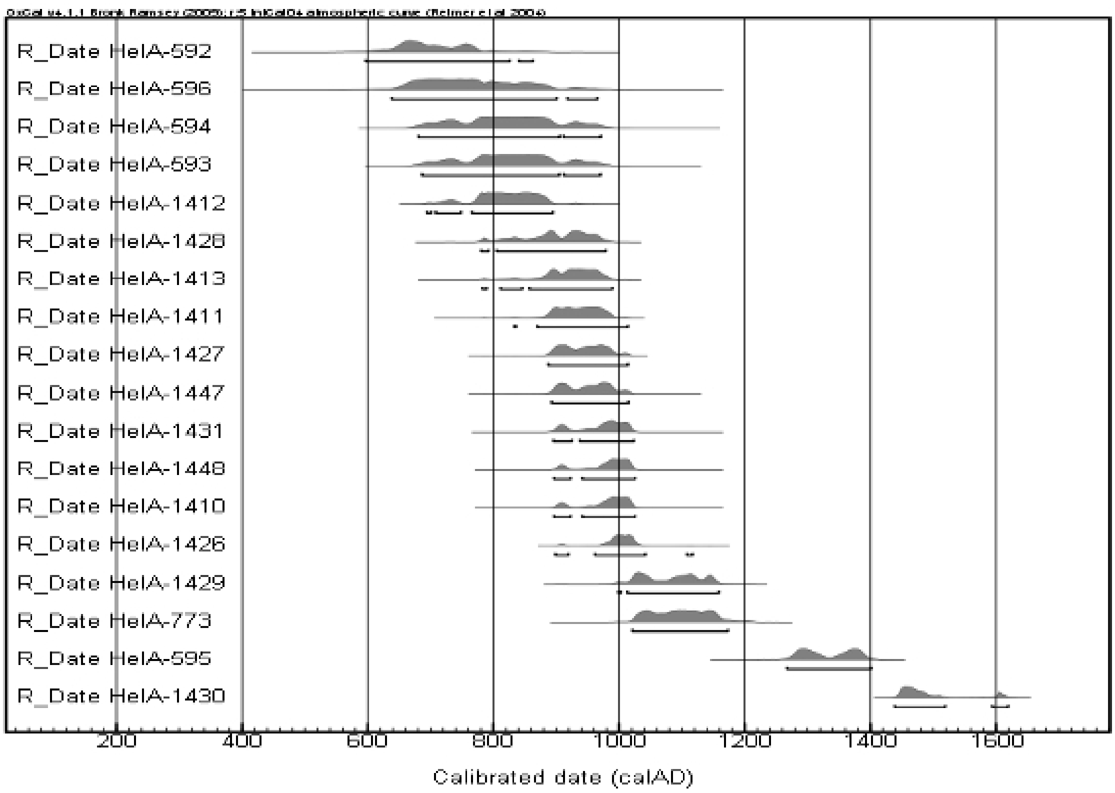

Figure 5: Radiocarbon dates calibrated with Oxcal 4.1.

18 radiocarbon datings were made from the material (see figs. 4 & 5). These are made mostly from cereal grains and they range from the Merovingian Period to the historical times (ca. 600–1600 AD). Radiocarbon datings are partly published in Alenius et al. (2007) and the rest will be published in Mikkola et al. in press. Only two datigs range to the Middle Ages and the majority of the datings are from the Viking Age. The occupation seems to be continuous from the Merovingian Period until the beginning of the Crusade Period. Two possible hiatuses date to ca. 1200 AD and 1400 AD, but these can be caused by the sampling strategies and material chosen for the datings.

4.1 Situation and environment

Orijärvi is situated in east Finland ca. 4 km WSW from Mikkeli railway station. The old Kihli house is built on a sort of a terrace formation with a hollow in the middle (for location of the site see figs. 6 and 8). Fields dip mostly south towards Orijärvi lake and west towards Rantakylä with the mean slope of less than 5 %. The fertile supra-aquatic areas are situated in the elevations higher than ca. 105 m.a.s.l. The fields are situated at ca. 102 to 103 m.a.s.l. so they have situated on the sub-aquatic area. The bedrock in Orijärvi area consists mostly of mica-gneiss with some granodiorite. There are also some alkaline stones, for example amphibolites and gabbros, which evidence soil fertility. The sediment of the fields is mostly fine sand and silt. The soils are the remains of ancient shore formation built up after the last Ice Age. In some places, there are also coarse sand and light grey clayey lenses. Sand and silt layers are 3 to 11 m deep. Very few stones were situated on the fossil fields, and the stony area started after the fossil fields in the north. The fields consisted of 30 to 40 cm deep cultivation layer consisting of humus and in the southern parts mixed with clay. (Mikkola 2005:3, 7–8; 2007:50.) Fossil podsol horisont was situated below the fields, which indicates that the fields have been formed in concave depressions (Mönkkönen 2008:41–43).

Tuija Kirkinen (1994, 1996) has studied the locations of Iron Age settlement in South Savo using GIS-modelling using environmental archaeological, archaeological and geological data. She has proposed that the rarity of the fine grained sediments and water supplies suitable for Iron Age settlement and agriculture sets limits to the possible places for settlement in South Savo area. The sediment around Mikkeli area is mostly moraine, which is formed as low ridges and drumlins. The city of Mikkeli is situated on a S–N running sandy heath ridge. Fine grained sediments are also found sometimes between moraine ridges, so that these areas can be suitable for cultivation. The Iron Age settlement sites tend to have been situated in the vicinity of water systems, but not exactly at the shore as during the Stone Age. Almost all Iron Age sites in the Mikkeli area are situated in the sub-aquatic areas. The supra-aquatic areas consist much of moraine and they are considered to be suitable for slash-and-burn agriculture.

Figure 6: The Orijärvi site and surroundings with the pollen coring location (Alenius et al. 2007:172).

A well found during the excavations has most probably secured the water supply for the people and cattle living in Orijärvi. Wood remains found in the bottom of the well have been radiocarbon dated to 1020–1190 AD. (Mikkola 2005:53.)

The Kihlinpelto site is situated approximately 250 NNW from the shore of the Orijärvi lake. Here the fine sand and silt has been suitable for agriculture with simple ard (cf. fig. 7). The south side of the hill must have been a warm and dry place for the fields and the alkaline stones have improved the soil fertility.

Figure 7: A model for Iron Age settlement in Pörnullbacken in Southern Ostrobothnia. The horizontal elevations are emphasized. The model shows the most important areas for Iron Age cultivation and pasturing. The system could have been similar in Orijärvi. Map based on Engelmark (1991:95).

4.2 Iron Age in Mikkeli area

The datings of the end of the Viking Age and Crusade Period are different in Karelia and Western Finland. Mikkeli lies between these two areas and there was cultural interaction between the both areas. The following Iron Age chronology for Karelia for the Viking Age and Crusade Period will be used in this study, because Mikkeli is traditionally considered to be a part of the eastern area (Uino 2003b:292).

Merovingian Period 600–800 AD
Viking Age 800–1100 AD
Crusade Period 1100–1300 AD

The area of Mikkeli is considered to be an important centre of South-Savo area during the Iron Age (Kivikoski 1961:214; Lehtosalo-Hilander 1988:190–224; Huurre 1979:171). The majority of the Iron Age finds date to the Viking Age and Crusade Period, but there is also some remains dating to the Merovingian Period (Kirkinen 1996:21). Cremation and inhumation cemeteries, 4 hillforts and some settlements have been found in the area (for all the sites see figs. 8 and 9).

The interpretation as an important centre during Iron Age has been mostly based on the rich cemeteries found in Mikkeli (Lehtosalo-Hilander 1988:171). The best known of these are Latokallio, Kyyhkylä, Tuukkala and Visulahti. A flat ground cremation burial and some settlement remains have been excavated in Latokallio (no. 7), where the graves are dated to the period between 900 and 1100 AD. The site of Kyyhkylä (no. 9) consists of cairns and settlements. These date from the Merovingian Period until to the 12th century. The Tuukkala (no. 6) cemetery is the largest and best known in Mikkeli. The first excavations in Tuukkala have been conducted already in the end of the 19th century. The burials were mostly inhumations, but there are also some cremations. Some settlement areas have also been found near Tuukkala, but these have not been fully excavated. The Tuukkala cemetery dates from 11th century to the beginning of 13th century. The Visulahti cemetery consists of inhumation and cremation burials and these date to 12th and 13th centuries. (Nousiainen & Lehtinen 1994.)

The burial nearest to Kihlinpelto is Mäntyranta (no. 3), which is situated ca 1 km south from Orijärvi Kihlinpelto. Here a Viking Age spearhead and axe dating to the 11th century were found. These finds had been in fire, so the burial has most probably been a cremation. Nearby Mäntyranta is the burial of Ketunniemi (no. 26) situated ca 1,4 km SSW from Kihlinpelto. Another burial close by Kihlinpelto is Rantala (no. 2) situated ca 1,5 km NW from Kihlinpelto. Here a spearhead and an axe dating to the 11th century were found, these had not been in fire, which suggests that the burial had been an inhumation. (Nousiainen & Lehtinen 1994.)

The importance of Mikkeli is proposed to be due that it is situated in a junction of important water and land routes (Kirkinen 1996:25–26 & literature cited). The flora in the areas settled during the Late Iron Age consists of demanding plant species, which indicate soil fertility (Taavitsainen 1987:220). Huurre (1979:171) proposes that the prosperity has probably not been only due to the agriculture, but the water and land routes have been more important. The situation of Mikkeli between Tavastia and Karelia, must have been also important (see fig. 3, p. 34). Artefact types deriving from the area of Tavastia are commonly earlier though settlement excavations and pollen analyses indicate that there also has been people before this (Lehtosalo-Hilander 1994:26–27). Many artefacts originating from Ladoga area date to 12^{th} and 13^{th} centuries and strong influences from Karelians date to the Crusade Period (Lehtinen 1994:64). The origin of the settlement in Savo area has been discussed a lot and I will not discuss this more in this study.

Figure 8: Mikkeli Orijärvi and nearby archaeological sites dating to the Iron Age. Map based on Nousiainen & Lehtinen (1994:12), with new sites added. Orijärvi is marked with red dot, number 31.

The site of Orijärvi is situated in Mikkeli, which has been a central area during the Late Iron Age and lies in between the permanently settled areas of Tavastia and Karelia. The site of Orijärvi is situated near a lake on a southward sloping hill with light soils, which could have been easy to plough with a simple ard. There are many Iron Age burials and some dwelling sites in the proximity of Orijärvi which date from the Merovingian Period to the Crusade Period. Radiocarbon datings from the site range from ca. 600 AD until 1600 AD and a Viking Age silver hoard has been found in the fields. Many settlement finds have been found in the fields, which are remarkable discoveries, because no previous prehistoric fields had been found in Savo area before Orijärvi.

no.	Site	Type of site	Subtype & finds	Dating
1	Tyynelä	cemetery	cremation	Viking Age
2	Rantala	cemetery?	inhumation, spearhead & axe	11th century AD
3	Mäntyranta	cemetery	cremation, spearhead & axe	11th century AD
4	Vatilan linnavuori	hillfort	knife, axe, fire striking Iron	Iron Age
5	Valkola	settlement	spearhead, knife blade etc.	Iron Age
6	Tuukkala	cemetery	inhumation & cremation	1000-1200 AD
7	Latokallio	cemetery	cremation	900-1100 AD
7	Moisionpelto	settlement & cemetery?	hearths, graves?	Iron Age/Middle Age
8	Konnunsuo 2	settlement	ceramics, Slag, flint, quartz	Iron Age
9	Kyyhkylä	cemetery, cairns	cremation, spearheads, oval brooches	600 AD-Middle Age
10	Otrala	hillfort		Undated
11	Sairila	hillfort		Middle Age?
12	Kivisakasti	cemetery	oval brooches	Crusade Period & Middle Age
13	Närepelto	cemetery	inhumation	Viking Age
14	Visulahti cemetery	cemetery	inhumation & cremation	1100-1200 AD
14	Visulahti 1	find	buckle	ca. 1000 AD
14	Visulahti 2	find	jewellery	Iron Age
15	Katajalahti	cemetery/settlement?	bronze ring, ceramics, burned bone etc.	Crusade Period
16	Visulahti	cup marked stone		Iron Age?
17	Kröpi	cemetery	inhumation	Undated
18	Lampila 6	find	glass bead	Iron Age
18	Lampila 7	find	glass bead	Iron Age
19	Juoneennurmi	cairns	crucifix-pendant	Undated
20	Alaranta 1	cemetery	cremation, arrow head, jewellery, scales	Viking Age-Middle Age
20	Alaranta 2	cairns		Iron Age
21	Aittosaari	find	jewellery	Iron Age
22	Kenkäveronniemi	settlement	oval brooches	Iron Age
23	Rokkala	find	brooch	Iron Age
24	Ravirata	find	jewellery	Iron Age
25	Nikara 1	find	fire striking Iron	Iron Age
25	Nikara 2	find	oval brooch	Iron Age
26	Ketunniemi	cemetery?	cremation?, spearhead	Viking Age-Crusade Period
27	Silvasti A	find, cemetery?	buckle	Iron Age
28	Annilantie	settlement	postholes, ceramics etc.	Iron Age
29/30	Lenius	cairns	pendant, oval brooch, bones	Iron Age
31	Orijärvi Kihlinpelto	settlement & fields	postholes, hearths, well, etc.	Iron Age
32	Porrassalmenpelto	cairns & settlement	weapons, jewellery, bone artifacts, bronze casting	Merovingian Period-Middle Age
33	Vuolinko	find	glass bead etc.	Iron Age & Middle Age
34	Paimenpolku 2	find	spearhead	Viking Age
35	Vanha-Kyyhkylä	settlement & Grave?	hearth, burned clay	Iron Age
36	Niemenmäki	find	arrowhead of iron	Iron Age

Figure 9: Archaeological sites dating to the Iron Age from Mikkeli. Based on Poutiainen (1994), Schulz (1994), Nousiainen & Lehtinen (1994) and the Registry of Ancient Monuments.

5 Research history of Iron Age subsistence strategies in Mikkeli

In this chapter I will discuss the published archaeological texts handling agriculture in the Mikkeli area during the period between 600 and 1300 AD. All material does not derive from Mikkeli, but by presenting other studies made in the rest of Finland I try to shed light on the larger scale agricultural developments. The first archaeological studies regarding the agriculture have been concentrating in the evidence gained by artefacts found during archaeological excavations. Later the osteological, pollen analytical and archaeobotanical studies have been introduced, giving more detailed insights to the agricultural developments. Prerequisites for agriculture have been studied according to the soil types and elevations. The archaeological inference is based also partly on historical data. As Savo has been an area of large-scale slash-and-burn agriculture during the later historical periods, this form of agricutulture is also considered to be important during prehistoric periods. There is no evidence of the Medieval slash-and-burn agriculture and the first historical pieces of evidence on agriculture are taxation records dating to 1510, which show that over 90 % of taxes in Savo have been gathered as cereal crops, but also hunting and fishing have had a minor role (Pirinen 1988:357, 372). The finds of prehistoric fields have contributed into the studies on prehistoric agriculture as they are concrete remains, which clearly indicate field cultivation. Slash-and-burn agriculture is considered the oldest type of agriculture in Savo and the whole of Finland (Huurre 2003:38) and this is probably based on historical evidence.

The evidence of prehistoric agriculture in Mikkeli spread in different sources. As there is so few settlement excavations, the scarcity of the evidence obvious. Different authors have discussed the subsistence and society of the Iron Age. As not too much is written on Mikkeli, material from other places in Finland is taken into account.

J.P. Taavitsainen (1987) states that permanent Iron Age settlement in Savo and other marginal areas has been preceded by slash-and-burn cultivation of plots in the wilderness and hunting. This is based on the finds of axes and strike-a-lights and pollen analyses showing cultivation outside of the permanent settlement area during the Iron Age. However, he suggests that graves and cemeteries in Savo have been situated in areas, which have been agricultural and have had permanent settlement.

Tuija Kirkinen (1996:51, 1994:21) states that the subsistence in the Mikkeli area during the Late Iron Age has consisted of slash-and-burn agriculture, cattle keeping, hunting and fishing. This is based on the archaeological material, pollen analyses and osteological material. She also thinks that the settlement has been permanent during the Iron Age.

Matti Huurre (2003:65–66) states that the settlement concentrations found also in Savo have represented strong peasant society with their slash-and-burn cultivation and permanent fields, with the continuous cultivation from 1000 AD onwards. He considers that agriculture outside the central areas has only had a minor role supporting the subsistence gained from wilderness areas.

Esa Mikkola (2005:49) consideres that the economic basis of Iron Age communities have been cereal cultivation, which has been compensated with cattle keeping, hunting, fishing and gathering. He (2009:41–42) states that the onset of the cultivation of elongated type fields found in Orijärvi and Rapola has started during the Merovingian Period. He also points out that it is extremely difficult to find remains of slash-and-burn agriculture with archaeological methods and proposes that field cultivation could have been the first cultivation method in Orijärvi.

Karin Viklund and Roger Engelmark (2002:14) have proposed that hulled barley has been the dominant crop since the Early Iron Age and in this form of cultivation manuring has been practised, which has required stabling of animals. Much of the fodder for animals has been gained from the shore meadows in the vicinity of the settlement. They have suggested also that during this phase of agriculture only spring sown crops have been cultivated and this method has been replaced by crop rotation during the Viking Age and the Early Middle Ages.

According to Lehtosalo-Hilander (1984:311) during the Merovingian Period people have moved from single households into villages and at the same time there has been a big rise in the population and the cultivated area, but still all the clearing of the land would have happened in the previously settled areas. Quoting Scandinavian research, the Middle Iron Age is considered to be a period of developing agriculture as the tillage implements have been improving at that time. This has been made possible by making bigger sickles and scythes and attaching iron blades into ploughs. Clayey areas, which are cultivated much nowadays, have not been that much in use. Though no prehistoric fields were found in the 1980s, it is suggested that the onset of field cultivation dates to the Merovingian Period in the Southwestern Finland and Eura-Köyliö area. This is based on the more sedentary settlement, which could also have been made possible by the different type of slash-and-burn cultivation. The more intensive field cultivation is suggested to date to the Viking Age and at this time more bones of domestic animals are found, which could indicate field manuring.

It seems to be clear that the society has been agricultural during the Late Iron Age at least in the main areas of the Iron Age settlement. Almost all writers seem also to think that hunting and perhaps also gathering have been part of the Late Iron Age subsistence. The finds of prehistoric fields have proved that there has been at least field cultivation during the Merovingian Period. This still does not rule out the possibility of slash-and-burn agriculture. I think it is difficult to infer the importance of the different sources of livelihoods.

5.1 Implements

The first evidence for subsistence activities have been gained by studying the agricultural implements. These have been mostly found in graves and more often in women's graves.

Ella Kivikoski (1961:193, 204, 241–242, 267) mentiones scythes, sickles, ards, scissors, flax brush, spindle whorls, hoes and snaffle bits, which all have been found in Finland in graves dating to the Iron Age. Sickle and scythe blades have been found from the Mikkeli Moisio cemetery (Lehtosalo-Hilander 1988:199).

Agricultural implements have also been found in Orijärvi. Some remains found in the plough zone are difficult to date as the object types can be long lasting and it is not sure how old the plough zone layers are. This material consists of: fragment of lyra-formed strike iron, fragment of a fishing spear, ice-horseshoe, fragments of knives and fragments of scythes. Many clay loom weights and a spindle whorl probably dating to the Crusade Period, were found. Two hand mill stone fragments were found in a well, which was dated to the end the Iron Age. (Mikkola 2005:53; Mikkola & Tenhunen 2003:56, 60, 66.)

Two wooden ardheads have been found in Finland: one from Karjaa and one from Perniö, which has been radiocarbon dated to circa 1290 AD (no uncalibrated date was mentioned in the article). The first iron shares, which could have been attached to the ards are dated to the Viking Age. These are found in Jomala, Lieto, Muhos, Saltvik and Vanaja. (Brady 1990.)

The most recent review of Finnish prehistoric agriculture is written by Matti Huurre (2003). In the chapter, also tools used for clearance – axes and fire stones or fire steels – are discussed as prerequisites for cultivation. A new type of socketed axe has replaced the old tube-formed axes approximately 800 AD onwards. These axes have been more effective for clearing. At the same time artefacts found outside permanently settled areas became more common. During the end of Iron Age or beginning of the Middle Ages a new type of ard was taken into use. This type of ard was especially good for the slash-and-burn cultivation. Ten hoes in Karelia and three in West Finland have been found dating to the Crusade Period. One small wooden rake has been found in Ylitornio, northern Finland. The rake has been found in a deep pit, which has been situated underneath a hearth dating to the 13th century. The first bill hooks used for leaf fodder collection date to the Roman Iron Age. The first shears date to the period after birth of Christ. Grinding stones have mostly been small cubic ones also during the Viking Age. First snaffle bits in Savo date to the Viking Age. (Huurre 2003:40, 46–47, 53–55, 58–60.)

Tuija Kirkinen has gathered the information of archaeological finds connected with agriculture, hunting, fishing and trade in South Savo area. Many finds relating to agriculture have been found in Moisio Latokallio cemetery and these are: a scythe, a sickle, a bit and an ice-horseshoe. Bits have been found also in Visulahti and Kyyhkylä cemeteries. Arrowheads have been found in Moisio Latokallio, Tuukkala, Visulahti and Vanha-Kyyhkylä. An arrow used for squirrel hunting has been found in Kyyhkylä cemetery. A fishing spear has been found in Tuukkala. Coins relating to trade activities have been found in Tuukkala, Visulahti and Kyyhkylänniemi Porrassalmen pelto (and Orijärvi). Scales also relating to trade have been found in Kyyhkylänniemi Porrassalmen pelto and Kyyhkylänniemi Vanha-Kyyhkylä. (Kirkinen 1996:22–23 & literature cited.) One spindle whorl made from clay was found in a pit in Latokallio, where a rope made possibly from hemp found in the pit was radiocarbon dated to 1450 AD (no uncalibrated date was mentioned in the article) (Schulz 1994:60).

The implements indicate that agriculture, hunting, and fishing have been sources of subsistence during the studied period. Sickles can have been used to reap the crops. Most probably scythes, found also in Orijärvi, have been used to scythe fodder for the animals, which then have been supplemented by leaf fodder cut with bill hooks. Scissors are most probably used for cutting wool from sheep and spindle whorls to make thread out of wool, flax, hemp or nettle fibers. Besides spindle whorls, loom weights also represent textile processing and these both have been found in Orijärvi. Flax brushes has been used in flax processing. The snaffles and other horse implements indicate that people had horses that time. Ards equipped with iron blades could have been used in heavier soils. Hand mill stones, found in Orijärvi represent crop processing activities.

5.2 Domestic and wild animals

Information on the animals used by the prehistoric societies is gained by studying bones found in the archaeological contexts i.e. refuse faunas. These finds are usually fragmentary and do not represent all animals used by the prehistoric societies. Osteological analyses are made from material deriving from graves and settlements. The material gained from graves can be different than the material found in settlements as these animals can have different meaning for the society as the animals which are found in the contemporaneous settlements. Some preliminary osteological studies have been conducted in Orijärvi, but the majority of the bone material has not been analysed (Mikkola 2001b:36–37).

The uncertain settlement found in Valkola has revealed bones of cattle, sheep/goat, pig, fowl, bear, squirrel, beaver, hare, reindeer, elk, and pike. It is not certain that these remains date to the Iron Age. A cairn in Kyyhkylä revealed horse, pig, cattle, sheep/goat, hen, reindeer, and bear bones. (Ukkonen 1996:83–89, Kirkinen 1996:23–24, 1994:21.) The cremation cemetery in Latokallio revealed bones of bear (Ukkonen 1996: 83–89). Excavations in Latokallio settlement site revelead many pits and fireplaces dating to the Late Iron Age and Middle Ages, which contained bones of horse, cattle, sheep/goat, pig, hen, cat, frog, rabbit, elk, squirrel and fish (Schulz 1994:60–61). A cattle skull has been found in a grave in Visulahti (Kivikoski 1961:271), but it has been interpreted as a deposit of refuse by J.P. Taavitsainen (Taavitsainen 1990).

Though no osteological analyses have been done in the site of Orijärvi, the evidence gained from contemporaneous sites in Mikkeli suggests that the domestic animals of the people living in Kihlinpelto could have cosisted of cattle, horse, sheep or goat, pig, hen, cat and most possibly also dog, though it has not been found in refuse faunas in Mikkeli area. The people have hunted various land animals and fish, but no Iron Age seal bones are found in Mikkeli. Maybe this is due to the studied settlement types.

5.3 Vegetation history and cultivated plants

According to previous pollen analyses, the onset of cultivation dates to the Merovingian Period in many locations in South Savo, in northern Lake Ladoga area and Valamo Island. Land use is intensified in East Finland during the period between 1000 and 1300 AD (Alenius 2007:12 & literature cited). Two pollen analyses are made in the Mikkeli area. Here the analysis from Kattilanlahti is reviewed shortly and the analysis from Orijärvi is gone through more thoroughly.

A pollen analysis has been made from Mikkeli Kattilanlahti, which lies approximately 3,7 km NEE from Orijärvi. The datings in this study have been done by using varve chronology and it is said to be quite uncertain in this case. *Cerealia* pollen occur continuosly from approximately 1280 AD and the first *Cerealia* and *Secale* pollen spores are bit earlier. (Simola et al. 1988:11, 22–23.)

Figure 10: The parts of the pollen analysis dating from 500 BC until the modern times (Alenius et al. 2007). Cropped by author.

The pollen analysis made from the sediments of Lake Orijärvi (fig. 10) have been dated with paleomagnetic dating. Pollen core of Orijärvi has been divided into subzones, where the important ones for this study are 4B and 4C, which date respectively 500 BC – 830 AD and 830–1300 AD. As in this paper the studied period dates between 600–1300 AD, it is the end of the pollen zone 4B and the whole 4C, which are relevant to this paper. (Alenius et al. 2007.)

Human impact becomes clear from 550 AD onwards when *Pteridium* pollen increases showing increasing light factors in the forests, *Alnus* pollen decreases and *Urtica* becomes more abundant associated with footpath and ruderal communities. First *Secale* pollen is dated to 615 AD. Quite much happen during the pollen zone 4C (830–1300 AD), when arboreal pollen starts to decrease and herb pollen starts to increase during the beginning of this zone. Poacea and *Salix* pollen both increase indicating fields. The sedimentation environment changes clearly, LOI decreases and pollen influx increases suggesting substantial terrestrial input from the inflows. The amount of *Nyphaea* pollen rises sharply 800–1000 AD, which is related to human presence in the lake vicinity. The LOI of Orijärvi has its maximum values between 700 and 800 AD, it then rapidly drops after that in about 300 years. This increase of mineral matter ending up in the lake is can also be caused by human presence in the lake vicinity. (ibid.)

Slash-and-burn cultivation is indicated by a clear increase in the fire regime 900 AD onwards, continuous *Secale* occurrence, *Rumex* and Poaceae pollen and *Pteridium* spores. The slash-and-burn cultivation is also shown by *Picea* pollen decrease from

1180 AD onwards. Pollen of *Humulus/Cannabis* is recorded continuously and *Cannabis* pollen increases 900 AD onwards. *Juniperus*, Poaceae, *Urtica*, *Humulus/Cannabis* type, Brassicaceae, *Rumex,* Ranunculaceae and *Potentilla* pollen all increase from 1090 AD onwards as also *Isoëtes* spores start to occur continuously. The amount of *Pinus*, *Betula* and *Alnus* increase. A marked intensification of agricultural activities is visible in the pollen data from about 1050 to 1080 AD. This shown by taxa commonly associated with local settlements and ruderal communities including cultivated *Humulus* and *Cannabis* together with *Plantago, Urtica,* Ranunculaceae and *Potentilla.* The increase of *Juniperus* reflects the growth of grazed meadows. Continuous *Hordeum* occurrence shows the presence of permanent fields 1220 AD onwards. (ibid.)

The pollen analysis of Orijärvi shows cultivation first from 550 AD onwards and the amount of human activities increase after that period. The pollen analysis shows both slash-and-burn cultivation and permanent field cultivation in the area. Agricultural activities seem to start in some places during the Migration Period and then intensify during the Late Iron Age.

The cultivated plants can be studied best by archaeobotanical analysis. Only one study dating to the studied period exists at the moment. A well preserved rye straw was found in a grave in Tuukkala Crusade Period cemetery, which had been excavated already in 1866. Here the plant material was mixed with the bronze spirals of the hemline of the apron (Lempiäinen 2002:162, 166). Other plant finds mentioned by archaeologists are the following: a rope made possibly from hemp in Latokallio, which was dated to 1450 AD (Schulz 1994:60) and fibres made of hemp and flax or nettle have been found in the graves in Mikkeli (Lehtosalo-Hilander 1994:32).

Due to the small number of material studied in Mikkeli, I will present a selection of published archaeobotanical records elsewhere from Finland to give an overview of the cultivated crops from the Merovingian Period until the Crusade Period/Middle Ages (fig. 11). Previous lists have been published by Terttu Lempiäinen (Häkkinen & Lempiäinen 1996), but this list did not contain quantities of the species and Marjatta Aalto (1997), where the recent sites are missing. The list should be quite complete, but some publications can be missing. Only material with charred seeds or impressions are presented as they are comparable with the material studied in Orijärvi and only the secure identifications of the crops are mentioned. Club wheat (*Triticum compactum*) and bread wheat (*T. aestivum)* are grouped as bread/club wheat (*T. aestivum* s.l.) because the difficulties of identifying the two varieties and the fact that they consist of same species. The *Avena* sp. can also represent wild oat (*Avena fatua*).

Commune	Site	Dating	**Find category**	**Preservation**	Avena sp.	Hordeum vulgare (hulled)	Hordeum vulgare (naked)	Hordeum vulgare	Secale cereale	Triticum aestivum s.l.	Triticum dicoccum	Arrhenatherum elatius var. bulbosum	Camelina sativa	Cannabis sativa	Linum usitatissimum	Pisum sativum	Vicia faba	Source
Maalahti	Kalaschabrännan	MP	cul	ch	3			42	5				2					Engelmark 1991
Hattula	Retulansaari, Tyrväntö	MP (700-800 AD)	gra	ch	23			205	39		1					16	1	Aalto 1997
Laitila	Vainionmäki	MP	gra	ch	12			27	5	5	5	5	5		16	3	3	Aalto 1996
Lieto	Pahamäki, Pahka	700-900 AD	str	ch	15			4605	1228	28						21		Onnela et al. 1996
Karjaa	Domargård 1	VA (900-1000 AD)	cul	ch	2			119	3	51								Aalto 1997 & literature cited
Hämeenlinna	Varikkoniemi	900-1300 AD	cul	ch	34			2249	150									Lempiäinen 1992
Lieto	Rähälä	calAD: 1161 ± 88	str	ch	1		4	52	2167									Lempiäinen 1996
Kokemäki	Ylistaro, Leikkimäki	calAD: 814 ± 113	gra	ch				3										Lempiäinen 1987
Paimio	Sievola	ca. 1000 AD	cul	ch&imp	1	12		35	82	7						1		Seppä-Heikka 1983
Sund	Kastelholms Kungsgård	LIA	fiel&cul	ch	5			118						3	1			Nuñez & Lempiäinen 1992
Valkeakoski	Rapola	PR-CP	fiel	ch	1			18	1	2								Vikkula et al. 1994
Maalahti	Pörnullbacken	ca. 300-1000 AD	cul	ch	7			656	2			2						Engelmark & Viklund 2002
Maalahti	Pörnullbacken	ca. 300-1000 AD	gra	ch	1			109				2						Engelmark & Viklund 2002
Huittinen	Loima	575-1000 AD		imp		2	1		1									Luoto & Seppä-Heikka 1985
Mikkeli	Orijärvi Kihlinnpelto	ca. 600-1600 AD	fiel&cul	ch	30	44	6	86	20	5		32		1	1			In this study.

PR: Pre-Roman Iron Age — ch: charred
MP: Merovingian Period — imp: imprint
LIA: Late Iron Age — cul: culture layers
VA: Viking Age — str: storage
CP: Crusade Period — gra: grave

Figure 11. Published finds of charred cereals, pulses, fibre/oil plants and bulbous oat-grass (*Arrhenatherum elatius* var. *bulbosum*) in Finland from the Merovingian Period to the Crusade Period.

As seen in the figure 11 barley (*Hordeum vulgare*) has clearly been the most abundant cultivated crop during the studied period. Rye (*Secale cereale*) has been the second most important crop. Oat is found in almost all sites, but in minor proportions. Bread/club wheat has been found is lesser amount of sites and it is abundant only in Domargård. Emmer wheat (*Triticum dicoccum*) is the least important crop, as it has been found only in two sites. Hulled barley (*H. vulgare* var. *vulgare*) seems to be the dominant crop, though the variety is mentioned only in few cases. In the case of Pahamäki it is mentioned that grains resemble mainly four rowed hulled barley, but it is possible that there exists remains of naked barley.

Other cultivated species are represented in minor proportions. These include gold-of-pleasure (*Camelina sativa*), hemp (*Cannabis sativa*), flax (*Linum usitatissimum*), pea (*Pisum sativum*), and horse bean (*Vicia faba*). In addition to these also finds of hazel nuts, bog myrtle, henbane, juniper, and damson/bullace have been found during the period 500–1000 AD (Häkkinen & Lempiäinen 1996:151). As bulbous oat-grass (*Arrhenatherum elatius* var. *bulbosum*) has been found in Orijärvi, the other finds of it are also mentioned in the list. The list presented here does not include all plants collected from the wild. These, especially raspberry are found often during archaeobotanical analyses.

Rye cultivation has started in Finland first time in the Early Iron Age, but the importance grew during the Viking Age. The first occurrences of rye dating approximately 100 BC – 100 AD are interpreted as weed rye. The occurrence of rye in graves from the Late Iron Age is interpreted as the sign for the introduction of a new, most probably highly valued, cereal. (Lempiäinen 2006:36; 2002.)

A list of Finnish heathen gods discussed by Huurre (1979:206-207) is written approximately in the middle of 16th century and it contains references to crops and cultivation methods. Crops mentioned in the list are: rye, barley, oats, pea, bean, turnip, cabbage, flax, and hemp. In the list there is also a god which is devoted to slash-and-burn plots and fields. All but turnip and cabbage are also found in macrofossil analyses, because these plants are collected before they make bloom and produce seeds, therefore the seeds or pollen of these plants have only slight possibilities to be preserved. It should be noted that the historical sources get more common during the 16th century and other historical material can also be used during this period.

Hulled barley has been the most important crop during the studied period. In addition four other cereal crops have been cultivated and rye has been the most important of these. Cultivated pulses are represented by pea and horse bean. The cultivated fibre and oil plants have been hemp, flax, and gold-of-pleasure. Various wild plants have also been collected from the surroundings of the settlements.

5.4 Prehistoric fields

In North Europe the first visible remains of agriculture are dated to the the late Bronze Age. Many types of remains from agricultural activities derive from this period. The first small rectangular fields from Gotland are dated to 8th century BC. Fields dated to this same period are found also from Estonia, Denmark, north Germany, Netherlands and Norway. (Pedersen & Widgren 1998:241.) Field systems resembling Celtic fields in Estonia have been dated to the Early Bronze Age. Though there is evidence of Late Neolithic and Early Bronze Age agriculture in Finland, the first prehistoric fields containing ard marks all seem to date to the Late Iron Age. In Finland and Åland about 10–15 these kinds of fossil fields have been found, Orijärvi being one of them. (Asplund 2008:284, 292–295 & literature cited.) The prehistoric fields in Finland have been usually situated on light soils: silts, clays and sands (Huurre 2003:40).

Prehistoric ard marks have been found underneath houses, graves and modern fields. Fossil fields are identified by the ard marks which are formed when the ard cuts the subsoil and the agricultural soil drops into these furrows. These kinds of fields which are ploughed with an ard are often rectangular or square shaped, because they have to be ploughed in two directions to form a criss-cross pattern. Ards can also be used to plough terrace-fields, irregular shaped fields and elongated fields. The fields tend to become concave because the soil loosens when it is taken to the sides of the field. This way banks are formed at the field edges and the field itself becomes concave. Bowl form is also caused partly by wind erosion. (Pedersen & Widgren 1998:340–342.) Mönkkönen (2008:41–43) has studied the fields in Orijärvi and he has noted that the situation has been different as the fields have been concave already when they have been taken into cultivation. This is supported by the notion that the old podsol horizon is visible below the fossil fields.

The fields of Orijärvi seem to belong to the same type of fields, which are common also in other parts of North Europe. The morphology and different structures in Orijärvi should still be studied more carefully to ascertain this. I think that it may be due to the prevailing research situation that no Bronze Age fields have been found yet from Finland, though they are found in the surrounding areas and cereal pollen and grains are already found dating to the Bronze Age in Finland. Of course it is possible that the early cultivation did not leave so much visible remains, but I still think that these should be searched.

5.5 Summary of Iron Age subsistence strategies in Mikkeli area

The archaeological and environmental data give quite much insights to the agriculture during the studied period. As macrofossils have been analysed in Mikkeli only once before Orijärvi, this material gives valuable insights to the plant usage in this area. The Iron Age subsistence in Mikkeli area has been diverse and it seems to have been consisting of cultivation, animal husbandry, hunting, fishing, and gathering. In the current state of research it is difficult or even impossible to evaluate the importance of these different strategies and it should also be noted that these strategies are interconnected and should be studied together. Also the restrictions of the different methods makes it difficult to estimate the importance of these different strategies. I think it would be more important to try to find out the chronology of the land usage, the level of technology and what plant and animal resources have been used. The fossil field finds prove that the agriculture has been at least partly permanent. In my opinion the proposed slash-and-burn agriculture and hunting in the wilderness areas still need further studies.

6 Results of the archaeobotanical analysis

The plant macrofossil analysis of Orijärvi obtained a great amount of charred plant material. Over 2300 plant parts were picked out and identified (see fig 12). Identified plant material, which was mostly seeds, consisted of 50 different taxons. Almost all plant species are related to agricultural activities. See appendix 2 for the list of all studied samples. Here the plant finds are first discussed for the whole site and regarding the different aspects relating to each taxon.

Mikkeli Orijärvi charred plant macrofossils

Cereals

Hordeum vulgare var. vulgare	44
Hordeum vulgare var. nudum	6
Hordeum vulgare	86
Avena sp.	30
Secale cereale	20
Triticum aestivum s.l.	5
Cerealia	183
sum	**374**

Fibre plants

Cannabis sativa	1
Linum usitatissimum	1
sum	**2**

Collected plants

Rubus idaeus	20
Fragaria vesca	5
Arctostaphylos uva-ursi	3
Juniperus communis	3
cf. Arctostaphylos uva-ursi (leaf)	1
sum	**32**

Arable weeds

Chenopodium album	62
Spergula arvensis	22
Galium spurium	18
Stellaria media	9
Galeopsis sp.	8
Bromus secalinus	8
Persicaria lapathifolia	7
Viola arvensis/tricolor	6
Vicia cf. Tetrasperma	6
Chenopodium polyspermum	2
Fallopia convolvulus	2
Polygonum aviculare	1
Scleranthus annuus	1
sum	**152**

Meadow and wetland vegetation

Carex sp.	82
Ranunculus acris	25
Rumex acetosa	4
Ranunculus sp.	3
Stellaria graminea	2
Lathyrus pratensis	1
Persicaria foliosa	1
Prunella vulgaris	1
Rumex acetosella	1
Rhinanthus sp.	1
sum	**121**

Other plants

Poaceae	77
Vicia sp.	71
Trifolium sp.	5
Galium sp.	4
Cyperaceae	3
Polygonaceae	3
Fabaceae	2
Polygonum sp.	2
Caryophyllaceae	1
cf. Epilobium sp.	1
Picea abies	1
Potentilla sp.	1
sum	**171**

Other plant parts etc.

Picea abies (needle fragment)	1392
stalk	38
Arrhenatherum elatius var. bulbosum (tuber)	32
Claviceps purpurea	8

Figure 12: The whole charred plant material from Mikkeli Orijärvi.

6.1 Cultivated cereals

Altogether 375 cereal grains were found. Most numerous was barley with 136 grains, second was oat with 30 grains, then came rye with 20 grains and least numerous was wheat with 5 grains (fig.13). 183 grains were identified as *Cerealia* due to their bad condition.

Barley was the most common cereal found from Orijärvi with its 136 grains accounting for 71 % of the cereals identified to species level. It was possible to identify between hulled and naked barley in 50 cases. This was often difficult, because many hulled grains resembled naked grains, probably because these had been charred when they have moist. The amount of Hulled barley was 88 %.

Barley thrives best, when the growing season is long and cool. The rainfall should be moderate, not excessive. Best soils for it are well drained deep loams and it produces low yields on sandy soils. It grows best in loose soils rich with chalk, with a lot of organic matter, with a lot of nutrients. Barley tolerates alkaline soil and is sensitive to acidity. (Renfrew 1973:80–81; Osvald 1959:112–113.)

Oat can not be identified to the species level in Orijärvi material, so it can be either cultivated or wild. Oat was second most numerous cereal with 30 grains accounting for 16 % of the cereals identified to species level.

Oat grows best in cool temperatures with much rainfall, because the plant requires a lot of water to develop, but can manage with less sunshine. It is less sensitive to soil acidity than barley and wheat and it can grow almost on every kind of soil, which is not too dry for it. On light soils it is sensitive for alkaline, but on heavier soils it can tolerate some alkaline. Excessive nitrogen and moisture may cause it to lodge. It does not require as much nutrients as the other cereals. (Renfrew 1973:98; Osvald 1959:131.)

Figure 13: Cereals: Hulled barley, naked barley, oat, rye and bread/club wheat. Scale 1mm. Pictures by author.

Rye was the third most numerous cereal accounting for 10 % of the cereals identified to the species levels with its 20 grains. It can not be identified morphologically what was the type, where it was grown and was it sown in the spring or autumn, but the arable weed flora can help in to get ideas about this subject.

Rye can be grown in cool climates and poor soils and it does not tolerate extreme heat. It is more tolerant for different soil conditions than other cereals mentioned here and it sprouts and grows faster than wheat in cool climate. It grows well on quite dry sandy soils, but can also grow on clay soils, humid sod soil and as first crop on moor soil. It requires quite a lot of manure to grow well. (Renfrew 1973:85; Osvald 1959:97)

Bread/club wheat (*Triticum aestivum* s.l.) was the least numerous cereal with 5 grains accounting for 3 % of the cereals identified to the species level. According to Jacomet et al. (2006:25) there are quite many problems in the distinguishing between club wheat and bread wheat. Naked wheats can be still measured and so classified to short stubby- (former *T. vulgare* type), long slim- (former *T. aestivum* type) and intermediate type grains. Three of the grains could be measured for their length and breadth. These grains were 2,6–3,3 mm long and 1,8–2,3 mm wide, so they are very small if compared to the characteristic measurements of length 3,4–7,0 mm and breadth of 2,2–4,7 mm (Jacomet et a. 2006:24). The length divided with breadth (L/B) ratio of the grains measured was 1,37–1,72, as the short stubby type is somewhere below 1,5 and long slim type above 1,5 (ibid). When considering these measurements, I think it is better to call the grains found bread/club wheat (*T. aestivum* s.l.). Two measured club wheats found from the ancient field of Rapola had the lengths of 4,0 & 3,5 mm and their L/B was 1,38 and 1,13 (Vikkula et al. 1994:53), so they were somewhat bigger and more short and stubby. Altogether there was three finds of wheat, two of these being club wheat and one was possible bread wheat (ibid. App. I) these account for 12 % of the 25 cereal grains identified to the species level in Rapola.

Wheat requires quite high mean winter temperatures. It grows best when it rains a lot in the spring and only little during autumn. It requires quite much for the soil. Best soils for wheat are well drained clay loams, which hold together and keep moisture. Sandy soils do not suit well for it, especially if they are acid. It grows poorly if pH is under 5,5. It requires chalk in the soil and it extracts a lot of nutrients from the soil and requires a lot of nitrogen, which can be introduced to the field with the help of manure. (Renfrew 1973:65–66; Osvald 1959:79–80.)

Figure 14: Rye ear with ergot infestation (picture from Jonsell & Tunón 2005:210). A charred piece of ergot found in Orijärvi (Picture by author), scale 1mm.

The finds of ergot (fig. 14) are most probably connected with the cereals cultivated in Orijärvi due to the size of ergot. There was altogether 8 pieces of ergot, which constitute 2 % of the cereal material. Ergot is a parasitic fungi growing most commonly on rye, but it can grow also on wheat, barley and about 40 other grass species. Ergot has various toxic substances and it causes a disease called ergotism, which affects the nervous system and can cause death. Ergot follows with the cereal harvest and can get mixed with cereals during threshing. It is common when the amounts of rainfall are high and it has been especially common with rye cultivated with slash-and-burn agriculture. During the Middle Ages in Finland, the proportions of ergot grains in flour, especially after rainy summers, could have been even 6-10 %. (Jonsell & Tunón: 2005:210 & literature cited; Cantell & Saarnio 1936:22-24.)

6.2 Fibre plants

Plants below are classified as fibre plants though they have also other usages discussed below. Fibre plants are often underrepresented in charred plant macrofossil assemblages (Märkle & Rösch 2008). One reason for this could be that there has been a small amount of seeds of these plants and they were not easily lost, due to their importance.

Figure 15: Hemp, flax, bulbous oat-grass, and raspberry. Scale 1mm. Pictures by author.

One seed of hemp was found (fig. 15). This amount is quite small compared to the amount of archaeobotanical samples studied in Orijärvi. Although hemp seeds are rarely found in archaeobotanical samples, they have a good chance of getting charred and it is suggested that they are underrepresented in the archaeobotanical material for some other reasons (Märkle & Rösch 2008:258, 261–262 & literature cited). Hemp seeds could have been used as food and it has been traditional in Savo area to prepare a dish called fi. *apposet*, which has been done by roasting hemp seeds in a cauldron and then grinding them and mixing them with salt and buckwheat or rye flour (Kaukonen 1946:116). The hemp seed could have been charred during the food preparation.

Hemp pollen is on the other hand found often in palynological analyses, because the stalks have to be retted in water to separate the hemp phloem fibres. Hemp retting has been done in lakes, ponds or mud pits (Kaukonen 1946:116). Hemp fibres can be used for ropes, nets, textiles and warp threads. Viking Age hemp textiles have been found in Norway and Denmark. According to pollen analyses made in Sweden, there is a strong upswing in hemp cultivation during 600–1000 AD. (Pedersen & Widgren 1998:381–

382.) Textiles made of hemp and rope possibly made of hemp have been found in Mikkeli (Schulz 1994; Lehtosalo-Hilander 1994).

In the palynological analysis of Orijärvi *Cannabis/Humulus* type pollen is recorded first in the pollen assemblage zone dated to 830–1300 AD. *Cannabis* pollen increase from 900 AD onwards and *Humulus/Cannabis* type increase clearly from 1090 AD onwards. (Alenius et al. 2007:179–180.) The pollen could derive from the retting of the hemp fibers. Retting methods could be a reason why only one hemp seed has been found and at the same time *Cannabis* and *Cannabis/Humulus* type pollen is clearly represented. *C. sativa* pollen is light so it gets transported easily by wind, so it could have been transported to Orijärvi in that manner also from the places where it has been cultivated (Engelmark 2009, pers. comm). Hemp cultivation has always been done in heavy manured fields (Grotenfelt 1899:360–361). Hemp seeds have also been found in the Late Iron Age house in Kastelholms Kungsgård (Nuñez & Lempiäinen 1992; fig. 11, p. 50).

One seed of flax was found (fig. 15). The surface of the seed was damaged, but the form of the seed was preserved. Flax seeds are quite rarely found in archaeobotanical samples and it is poorly charred when it is burned in oxidative conditions, but good when burned in reducing conditions (Märkle & Rösch 2008:258, 262 & literature cited). Flax has been cultivated most probably because oil can be made from its seeds. It is also possible that flax fibers have been used to produce textiles (Viklund 2000:121). The first signs of flax used in textiles from Sweden come from 200 AD and it becomes more common from 600 AD onwards. Flax has to be retted in the same way as hemp to separate the phloem fibres, which results in a lot of pollen in the palynological analyses. (Pedersen & Widgren 1998:381–382.) Flax seeds have been found in two other sites in Finland during the studied period (fig. 11) and fibers made of flax have been found in Iron Age graves in Mikkeli (Lehtosalo-Hilander 1994).

Flax seeds have been used as food in Finland during the historical times. Porridge has been cooked from the seeds to make a medicine for humans and animals to cure abscesses and stomach diseases. There has also been bread called fi. *Suistamolainen*, which was made from grinded flax seeds and used as a pie crust. (Kaukonen 1946:91 & literature cited.) There are no finds of *Linum* pollen in the palynological analysis made from Orijärvi (Alenius et al. 2007). I think it could be possible that flax been cultivated for oil and food purposes and therefore no pollen has been found, which would have derived from retting. Another option is that flax could have been retted in the small pond approximately 550 metres NW from Orijärvi. Traditionally in Savo area it has been common to ret in sheltered lake or pond sides (Kaukonen 1946:98). It could be quite interesting to study whether *Linum* pollen could be found in this pond. One other reason for the absence of *Linum* pollen could also be that its pollen spores drop to the ground and are not spread with the wind (Engelmark 2009: pers. comm).

6.3 Collected plants

This group of plant remains consists of natural vegetation which has been collected by humans for different purposes. All plants here can be collected for nutritional purposes, but they could have been used for other purposes also.

There were 32 pieces of charred bulbous oat-grass (*Arrhenatherum elatius* var. *bulbosum*) stem tubers (fig. 15). These represent the type of oat-grass, which has tuberous swellings at the base of the stem ie. bulbous oat-grass. Tubers of this plant can be eaten and it might have been cultivated. (Engelmark 1984:88–91; Welinder 1998:75.) Bulbous oat-grass has been found various Iron Age settlement sites and graves and it is suggested that it could have been part of some grave ritual. Charred remains of the plant has been found at least in Nordic Countries, central Europe and England. (Cooremans 2008; Preiss et al. 2005; Engelmark & Viklund 2002; Welinder 1998; Aalto 1996; Gustafsson 1995; Engelmark 1984.) In Finland bulbous oat-grass has been found in two other contemporary sites (fig. 11). The plant thrives on fresh meadows which are rich in light, moderately acid soils rich in nitrogen suitable for grazing, but also in other types of soils (Ekstam & Forshed 1992:80).

Raspberry (*Rubus idaeus*) was the second most common collected wild plant with its 20 seeds found (see picture 15). One proof of raspberry consumption was found in Lappeenranta in east Finland, where the uncharred seeds found in a grave inside the corpses stomach have been radiocarbon dated to the Middle Ages (1480–1670 AD) (Lempiäinen 2008:99). The plant thrives in open places rich in nitrogen (Hämet-Ahti et al. 1998:243) and also places which have been burned previously.

Five seeds of wild strawberry (*Fragaria vesca*) were found. This plant has most probably been used for food. This plant thrives on dry, open grasslands, moderate with nitrogen and most suitable for grazing (Ekstam & Forshed 1992:81).

Four bearberry (*Arctostaphylos uva-ursi*) seeds were found and the plant has probably used for food. It thrives in dry moors, and other dry places with sand or gravel (Hämet-Ahti et al. 1998:210).

Three seeds of juniper (*Juniperus communis*) were found. It thrives on fresh meadows, rich with light and little nitrogen, where grazing is common (Ekstam & Forshed 1992:81). The plant is not eaten by cattle and that is why it gets more common in the meadows.

6.4 Arable weeds

Thirteen plants which can be considered as arable weeds growing with various cultivated plants and in various growing conditions were found in the charred assemblage. These plants can give information about different aspects on cultivation: nature of tillage, manuring, spring- or autumn-sown crops and the natural soil conditions in the cultivated fields (Viklund 1998:130). Here these different aspects of these weeds are discussed. It should also be considered that various weed species could have been collected during prehistoric periods (see. Behre 2008).

Chenopodium album (fig. 16) was by far the most common weed in the material, with 62 seeds found. It is an annual, erect plant, 20–90 cm high. It reproduces by seeds and produces an average of 3000 seeds per plant, but can produce even 20000 seeds per plant. Seeds germinate rapidly after overwintering in the field. It can grow on all types of soils, but it prefers loose damp soils, which are rich in nitrogen and heavily manured. It is a difficult weed in all kinds of arable crops and it extracts large quantities of nitrogen from the soil. Some seeds overwinter in the fields and some are collected with the crops. (Korsmo 1926:45–47.)

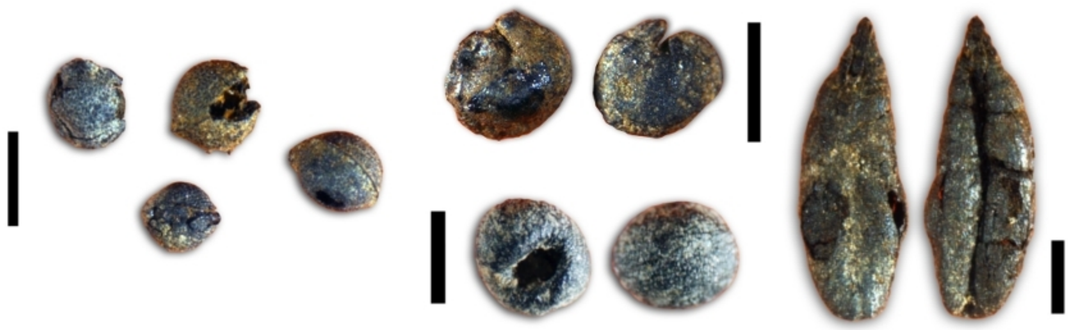

Figure 16: *Spergula arvensis*, *Chenopodium album*, *Galium spurium*, and *Bromus secalinus*. Scale 1mm. Pictures by author.

Spergula arvensis (fig. 16) was the second most numerous weed with 22 seeds. It is an annual, ascending or erect plant growing up to 15–40 cm high. It reproduces by seeds and produces an average 3200 of seeds per plant, which germinate fast after overwintering in the soil. It prefers somewhat acid, lime-deficient particularly lighter soils, but grows also on heavier soils. It grows as a weed in all kinds of arable crops and can be spread with animal manure. (Korsmo 1926:71–73.)

Galium spurium (fig. 16) was the third most numerous weed with 18 seeds. This plant thrives on nutrient-rich, manured fields, probably on clayey and loamy soils and the subspecies *spurium*, which is 50–100 cm high annual plant has been common on flax fields (Svensson et al. 1993:70). It is not possible to identify the different subspecies from charred archaeobotanical material.

There were 9 *Stellaria media* seeds found. It is a winter annual, decumbent or erect plant growing up 20–60 cm high. It reproduces by seeds and produces on average 15000 seeds per plant. It grows on all types of soil, particularly on humid climate. Grows as weed in all kinds of arable crops, but also can be a weed in meadows and pastures. It extracts a lot of nutrients from the soil. (Korsmo 1926:105–107.)

There were 8 *Galeopsis* sp. seeds found from the material. There is 4 *Galeopsis* species living nowadays in Finland. These all can grow as arable weeds (Hämet-Ahti et al. 1998:358–359).

There were 8 *Bromus secalinus* (fig. 16) seeds found from the material. It is at the moment an endangered plant, but earlier it has been a difficult arable weed. It is an annual plant and prefers heavier soil, but it can also grow well on lighter soils, that are deficient in lime (Korsmo 1926:138–140.) It is also thought that it thrives on wet fields, but this may be caused also by the fact that wet fields are more open giving it more living space (Svensson et al. 1993:47).

B. secalinus grows well during years with a lot of rainfall, when rye does not grow well and so it has secured some food for people even when no rye harvest was gained (Svensson & Wigren-Svensson 2003:230 & literature cited). It thrives best with winter cereals, especially rye, but also with oat. It ripens at the same time as the winter cereals are harvested. This way it is collected with the crops and it gets mixed with husks, litter and straws. It can be easily mixed with the cereals, hence to its similar size. It is thereafter introduced to the fields with impure seed corn and animal dung. This plant can be connected to the introduction of rye cultivation and three-field rotation system (Viklund 1998:137 & literature cited). It is also suggested that *B. secalinus* has been cultivated during the early phases of agriculture in Sweden (Welinder 1998:73). It could have been used to produce home brew or fodder (Svensson et al. 1993:47).

There were 8 *Persicaria lapathifolia* seeds found. It is an annual, erect plant growing up to 30–100 cm high. It reproduces by seeds and produces 800–850 seeds per plant, which germinate best after overwintering in the soil. It prefers nutrient-rich, loose, slightly acid, humic and sandy loams. Grows as a weed in all kinds of arable soils, especially wet habitats. (Korsmo 1926:40.)

There were 6 *Viola arvensis/tricolor* seeds found. These species resemble each other quite much. *Viola tricolor* is an annual, biennial or perennial, ascending or erect plant growing up to 15–35 cm. It reproduces by seeds and produces on average 2500 seeds per plant. It prefers light acid to neutral soils. It is a weed in all kinds of arable crops, often spreading with animal manure. *Viola arvensis* is a more common weed. (Korsmo 1926:127–129.)

There were 6 *Vicia* cf. *tetrasperma* seeds found. It is an annual 20–60 cm high plant thriving on rocks, dry meadows and sometimes fields (Hämet-Ahti et al. 1998:277).

There were 2 *Chenopodium polyspermum* seeds found. It is an annual, initially procumbent, later erect plant growing up to 20–60 cm high. It reproduces by seeds and produces on average 4000 seeds per plant, which germinate best after overwintering in the soil. It prefers well-aerated, moist, slightly acid to alkaline and nitrogen-rich soils. It grows as weed in all types of crops, especially horticultural crops. (Korsmo 1926:47-49.)

There were 2 *Fallopia convolvulus* seeds found. It is an annual, twining or creeping plant growing up to 100 cm. It reproduces by seeds and produces 140–200 seeds per plant, which germinate best when overwintering in the soil. It prefers nutrient rich, light, and moderately acid loams. It grows as a weed in all types of crops, especially spring cereals. (Korsmo 1926:42-43.)

There was 1 *Polygonum aviculare* seed found. It is an annual, procumbent or ascending plant growing up to 5–60 cm high. It reproduces by seeds and produces 125–500 seeds per plant, which germinate best after overwintering in the soil. It prefers humic and sandy loams rich in nitrogen, but its requirements are extremely modest and it can grow on the least fertile of the soils. It grows as a weed in all kinds of arable crops. (Korsmo 1926:40-42.)

There was 1 *Scleranthus annuus* seed found. There are two variants of this plants, where the other one is more a weed and the other one thriving on rocks and burned areas (Hämet-Ahti et al. 1998:115). Both require a lot of light and acid soil with moderate amount of nitrogen (Ekstam & Forshed 1992:50).

6.5 Meadow and wetland plants

There was a great deal of plants found, which thrive on meadows and wetlands. The most numerous of these plants were the *Carex* spp. (fig. 17) with 82 nutlets found. There is near hundred sedge species growing in various habitats in Finland nowadays. The most common habitats for sedges are wetlands and meadows. (Hämet-Ahti et al. 1998.) Many types of sedge have been used as animal fodder and they could also have been grazed by different animals.

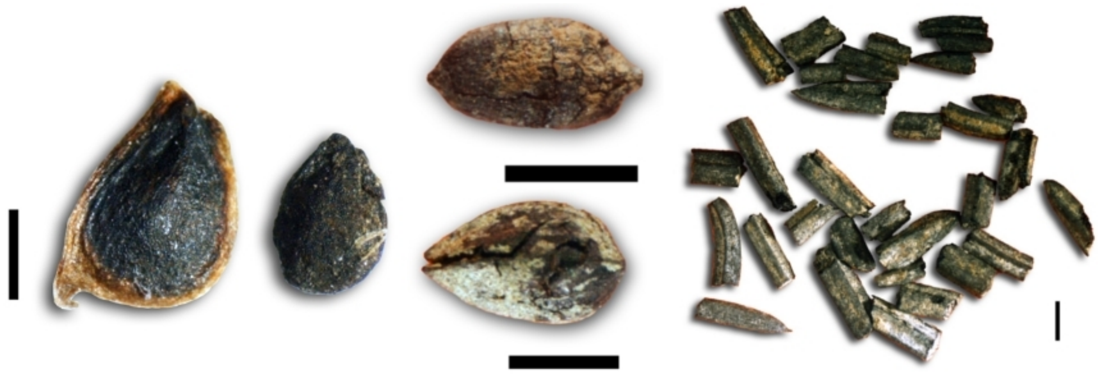

Figure 17: Modern and charred meadow buttercup, 2 sedges, and spruce needles. Scale 1mm. Pictures by author.

Second most numerous plant was meadow buttercup (*Ranunculus acris*) with 25 seeds (fig. 17). It thrives on meadows, roadsides etc. (Hämet-Ahti et al. 1998:77–78). The meadows suitable for it are rich with light, fresh, nitrogen-rich, which are more suitable for grazing (Ekstam & Forshed 1992:70), but the plant is not eaten by animals and so it is selectively promoted by grazing. The seeds have sort of a hook, which can attach the fur of the animals when they are grazing (see fig. 18). In this way it could be interpreted as remains of grazing and not collection of fodder.

Figure 18: Dispersal of some seeds with the help of cattle. Charred seeds of meadow buttercup (smörblomma) were found in Orijärvi. Picture from Ekstam & Forshed (2000:159).

Four seeds of *Rumex acetosa* were found. It thrives on meadows, roadsides etc. (Hämet-Ahti et al. 1998:152). The meadows suitable for it are rich in light, fresh (Ekstam & Forshed 1992:81), have low pH and are low with nutrients. It is common in wet meadows and older pastures (Korsmo 1926:235).

There were 2 seeds of *Stellaria graminea* found. It thrives on meadows, roadsides etc. (Hämet-Ahti et al. 1998:107). The meadows suitable for it are rich with light, fresh, intermediate with nitrogen and more suitable for grazing (Ekstam & Forshed 1992:81).

There was 1 seed of each of the following plant found from the material:

*Lathyrus pratensi*s thrives on meadows, roadsides etc. (Hämet-Ahti et al. 1998:281). The meadows suitable for it are rich with light, fresh, quite acid, soil with some nitrogen and are suitable for hay making (Ekstam & Forshed 1992:80).

Persicaria foliosa thrives on flooding and decomposing muddy watersides etc. (Hämet-Ahti et al. 1998:141).

Prunella vulgaris thrives on meadows, roadsides, pastures etc. (Hämet-Ahti et al. 1998:365). The meadows suitable for it are half-shadowed, fresh, quite acid, nitrogen-rich soils and are suitable for grazing (Ekstam & Forshed 1992:82).

There are four *Rhinanthus* species in Finland. In this material it is most probably *R. minor* or *R. seronitus,* which both are weedy species also thriving on meadows (Hämet-Ahti et al. 1998:392–393).

Rumex acetosella thrives on meadows, fields etc. (Hämet-Ahti et al. 1998:153). The meadows suitable for it are rich in light, dry, acid, low with nitrogen and suitable for grazing (Ekstam & Forshed 1992:63).

6.6 Other plants

There were some other plants found, of which many could not be identified to the species level, so their living habitats etc. are not discussed here. It could be considered that the 77 grass (*Poaceae*) seeds can represent some remains of meadow or wetland vegetation and could be connected with grazing or fodder collection. It is also possible that the gras seeds were remains of arable weeds. The 71 vetch (*Vicia* sp.) seeds could be the remains of some arable weed or plant growing on meadows.

Spruce (*Picea abies*) is a common plant that thrives in fresh moors, grove-like forests etc. (Hämet-Ahti et al. 1998:59). There were 1392 spruce needle fragments and 1 spruce seed found from the material. The needles or branches could have been used as building material, as a manure additive or fuel. One option is that spruce forest had been burned to clear the area. This does not rule out that there would have also different tree species growing, because no charcoal analysis have been conducted.

7 Charred plant remains in the features

Here the different fields and structures are described and then the charred plant material found in them is presented. The information about the structures is based on excavation reports and articles written on the subject. They are described in with varying detail regarding to the information available. The material from Karilantie and Peltorannantie field units are compared with the structures adjacent to them and then the material of these two field units is compared. The seed material is viewed in percentage amounts when the sum of seeds is considered large enough. Tubers of bulbous oat-grass, ergot and spruce needles are not counted on the percentage amounts due to them being different type of plant material. It should be also considered that the formation processes of the different structures varies quite considerably.

Five fields dating to the Iron Age and Middle age have been found in Orijärvi (see fig. 19). These fields form two separate complexes and each field has at least two phases of use marked with p1, p2, p3, p4 and p5. These different cultivation layers have been 5 to 25 cm thick. Almost three hundred structures of different kinds have been found. One interesting structure is a well, which is radiocarbon dated to the Crusade Period and is the oldest dated structure of this type found in Finland. Ten ditches have been found in connection to the fields. All the fields seem to have been elongated and approximately rectangular. The fields consist of two larger units. The fields have formed a unified unit during the Late Iron Age or Middle Age. Peltorannantie unit has been a unified unit from the Crusade Period or Early Middle Ages. The areas of the different fields should be considered as estimations. It is suggested that fields have been founded in moist depressions, where it would have been necessary to drain them with the help of ditches. (Mikkola 2007:32; Mikkola et al. in press)

Figure 19: Fields found in Orijärvi (Alenius et al. 2007:172).

7.1 Fields

Karilantie field unit, situated in the east, consisted of Karilantie field (R84), Kihlinkuja field (R123) and field R209. The western Peltorannantie field unit consisted of Peltorannantie field (R23) and field R264.

Karilantie field (R84) was an approximately 14 m wide and 57–58 m long field. The whole area of the field has been approximately 850–1000 m² and during the oldest phase it has been approximately 220m². The fossil field layer was concave and approximately 80 cm thick in the middle of the field. A ditch was running in the middle of this field. Ard marks were found in every documentation level, but only few were found in the lowermost level of the field where a lot of daub and pottery shards were found. There were many hearths and ditches found in the field and these are interpreted so that they have been in use when the field was fallow. A large pit-hearth was found in the middle of the field and a piece of burned bone found there was dated to the Viking

Age. Radiocarbon dating from the field layers range from the Merovingian Period to the Viking Age. (Mikkola 2005:54–55; Mikkola et al. in press.)

Kihlinkuja field (R123), was an approximately 7–10 m wide and 55 m long field. The whole area of the field was ca. 400 m² and cultivation phase R123/p3 has been ca. 220 m² and R123/p4 ca. 120 m². The fossil field layer was approximately 30–50 cm thick. Two ditches were found in this field: one in the middle and one in the side of the field. There is a Viking Age radiocarbon dating from the field. (Mikkola 2005:55; Mikkola et al. in press.)

Field R209 was an approximately 28 m long and 5–8 m wide field. The maximum area of field has been 200 m². The field had two cultivation phases. Bronze pendands dating to the Crusade Period were found in both two overlaying cultivation phases R84/p3 and R209/p1. There is a Viking Age radiocarbon dating from the underlying cultivation phase R209/p2. (Mikkola 2005:56; Mikkola et al. in press.)

Peltorannantie field (R23) was an at least 6 m wide field, with an unknown length and area. This field had at least three, maybe four phases of usage. The find material consisted of pieces of pottery, pieces of bronze jewellery, silver coin fragment and clay daub. This field was not fully excavated. There are radiocarbon dated cereal grains and pottery residues which date from the Merovingian Period to the Middle Ages from this field. (Mikkola 2007:22; Mikkola et al. in press.)

Field R264 was a ca. 7 m wide and 30 m long field. The area of the field has been ca. 150 m². The fossil field layer has been ca. 40 cm thick and the uppermost preserved cultivation layer had been ca. 20 cm thick. This field had a ditch running through the middle of the field. There was a cultivation layer which seems to have been hoed, not ploughed. Finds consisted of pieces of pottery, glass beads and bronze jewellery. There are two radiocarbon datings from this field ranging from the Viking Age to the Middle Ages. (Mikkola 2007:22; Mikkola et al. in press.)

	Karilant	Peltorannant		Karilant	Peltorannant
cereals			**meadow & wetland vegetation**		
Hordeum vulgare var. vulgare	30	4	Carex sp.	61	7
Hordeum vulgare var. nudum	2	2	Ranunculus acris	17	1
Hordeum vulgare	43	33	Rumex acetosa	4	
Secale cereale	8	5	Persicaria foliosa		1
Avena sp.	5	8	Stellaria graminea	1	
Triticum aestivum s.l.		4	**meadow & wetland vegetation**	**83**	**9**
Cerealia	73	73			
cereals	**161**	**129**	**other plants**		
			Poaceae	59	6
fibre plants			Vicia sp.	48	14
Linum usitatissimum		1	Trifolium sp.	4	1
			Cyperaceae	2	1
collected plants			Ranunculus sp.	2	1
Rubus idaeus	16		Fabaceae	2	
Fragaria vesca	4		Galium sp.	2	
Juniperus communis	2	1	Polygonaceae	2	
Arctostaphylos uva-ursi		2	Caryophyllaceae	1	
collected plants	**22**	**3**	cf. Epilobium sp.	1	
			Picea abies	1	
arable weeds			Polygonum sp.	1	
Chenopodium album	34	15	Potentilla sp.	1	
Galium spurium	14	1	Rhinanthus sp.	1	
Spergula arvensis	17	3	**other plants**	**127**	**23**
Stellaria media	8	1			
Bromus secalinus	3	4	**other plant parts**		
Persicaria lapathifolia	4	1	Picea abies (needle fragment)	921	171
Viola arvensis/tricolor	4	1	stalk fragment	32	
Vicia cf. Tetrasperma	5		Arrhenatherum elatius var. Bulbosum (tuber)	29	
Galeopsis sp.	5		Claviceps purpurea	3	2
Chenopodium polyspermum		2			
Scleranthus annuus	1				
arable weeds	**95**	**34**			

Figure 20: Charred plant remains from Karilantie and Peltorannantie field units.

The largest amount of charred plant material was found in Karilantie field unit (fig. 20). This was most probably due to the fact that there were most samples taken from this unit. Altogether 1473 identified plant remains came from this unit. 488 of these were seeds or other propagules, 921 spruce needle fragments, 32 stalk fragments, 29 bulbous oat-grass tubers and 3 pieces of ergot. The percentage amount of different plant groups were the following: cereals 33 %, collected plants 5 %, field weeds 20 %, meadow & wetland vegetation 17 % and other plants 26 %.

Quite much charred plant material was found in Peltorannantie field unit (fig. 20). In total 363 identified plant remains derive from this unit. 193 of these were seeds or other propagules, 171 spruce needle fragments and 2 pieces of ergot. The percentage amount of different plant groups were following: cereals 67 %, fibre plants 1 %, collected plants 2 %, field weeds 15 %, meadow & wetland vegetation 5 % and other plants 12 %.

7.2 Hearths

There were 5 hearths or hearth-like structures adjacent to Karilantie field unit (R84), which contained charred plant material.

R101 was a hearth-like structure in the Karilantie field (R84). There was a lot of badly burned clay around this structure and it possibly derives from the historical period. (Mikkola 2003:31.)

R129 was an elongated hearth formed of small burned stones in the Karilantie field (R84). It had a big stone in the middle and it was below the ditch R115. There was black soil with charcoal around the hearth. (Mikkola 2003:16.)

R132 was a nearly rectangular hearth in Karilantie field (R84) measuring approximately 50 cm in breath and approximately 100 cm in length. It was placed in SW–NE direction. There were strongly burned stones found in the hearth. (Mikkola 2003:17–18.)

R134 was a large pit hearth found underneath the Karilantie field (R84). It is the same structure as the R85, so it is called **R85/R134**. It was approximately 50 cm deep and it was bowl formed and round. One radiocarbon dating (HelA-1410) from a bone from this hearth dates to the Viking Age/Crusade Period. (Mikkola 2003:14, 18.)

R265 was a hearth in the area of the Kihlinkuja field (R123). Stones had been partly crushed to pieces when they had been burned. There were also areas of red burned sand around the hearth. (Mikkola 2006:17-18.)

There were 38 charred seeds found from these hearths (fig. 21). They were 47 % cereals, 3 % fiber plants, 3 % collected plants, 18 % arable weeds, 21 % meadow &

wetland vegetation and 8 % other plants. The material was quite small for percentage counting.

R	101	129	132	134	265	R	101	129	132	134	265
Cereals						**Meadow and wetland vegetation**					
Hordeum vulgare var. vulgare		1				Carex sp. distigmaticea	1	1			1
Hordeum vulgare var. vulgare frag.		1				Carex sp. tristigmaticea	1		1		
Hordeum vulgare var. nudum		1				Ranunculus acris		1	1		
Hordeum vulgare		1		2		Stellaria graminea	1				
Secale cereale		1									
Avena sp.	1					**Other plants**					
Triticum aestivum s.l.	1					Galium sp.		1			
Cerealia				2		Poaceae	1		1		
Cerealia frag.		3	4								
						Other plant material					
Fibre plants						Claviceps purpurea			2		
Cannabis sativa		1				Picea abies (needle)				1	32
						stalk					5
Collected plants											
Rubus idaeus					1						
Arable weeds											
Chenopodium album		1	1	2							
Galium spurium			1								
Spergula arvensis			1								
Vicia cf. Tetrasperma	1										

Figure 21: Charred plant remains from the hearths.

The plant proportions are quite unevenly distributed among the different hearths. R129 has the most cereal grains. The only hemp seed was also found here. R101 has the only bread/club wheat and oat grains and it is said to be from the historical period. R132 has the only 2 pieces of ergot found in the hearths. There is 32 spruce needle fragments from the hearth R265 and 1 one from hearth R101.

7.4 Ditches and pits

There were five ditches which contained plant material and four of these were situated adjacent to the Karilantie field and one adjacent to Peltorannantie field unit.

R115 was a ditch in the Karilantie field R84. It ran through the whole field. It is considered to derive from the Iron Age. It had a flat bottom and it was approximately 40 cm wide, but at times even 100 cm. It was parallel to the longitudal axis of R84 from SSW to NNE. The ditch was stratigraphically younger than the well R210, which was dated to the Crusade Period. (Mikkola 2003:16; 2004:11, 14; Mikkola et al. in press.)

R124 was a curved possibly medieval ditch running in the east side of Kihlinkuja (R123) field. The ditch was approximately 30 m long and 50–80 cm wide. The finds from the ditch were mostly clay daub and burned clay. It was filled with brown cultural soil from the field. (Mikkola 2003:17; 2004:15; 2005:16.)

R125 was a ditch in the Kihlinkuja field (R123) running in NE–SW direction and it is older than R124. The ditch had a flat bottom and it was approximately 60 cm wide. It was filled with grey sand. (Mikkola 2003:17.)

R214 was a ditch or a ditch like formation in the Karilantie field (R84). It was filled with clay and sooty soil. There were some stones and a grey sand area with charcoal. (Mikkola 2006:17.)

Ditches, R	**115**	**124**	**125**	**214**	**269**
Cereals					
Hordeum vulgare var. vulgare					1
Hordeum vulgare var. nudum					1
cf. Hordeum vulgare	1				
cf. Hordeum vulgare frag.					1
Secale cereale	2				
Cerealia frag.					1
Collected plants					
cf. Arctostaphylos uva-ursi (leaf)					1
Fragaria vesca					1
Rubus idaeus			1	1	
Arable weeds					
Galeopsis sp.	1				
Galium spurium	1				
Chenopodium album	1				2
Persicaria lapathifolia	1		1		
Spergula arvensis			1		
Viola arvensis/tricolor		1			
Meadow and wetland vegetation					
Carex sp. distigmaticea	1				6
Lathyrus pratensis	1				
Ranunculus acris		1			
other plants					
Poaceae	2			1	
Vicia sp.					3
other plant parts					
Picea abies (needle)	46	3	57	7	142
Arrhenatherum elatius var. bulbosum (tuber)					1

Pits, R	**19**	**24**	**63**	**87**	**281**	**282**
Cereals						
Avena sp.		3				4
Avena sp. Frag.						5
cf. Avena sp. frag.						3
Secale cereale	1		1		1	
Hordeum vulgare var. vulgare						1
Hordeum vulgare						1
Cerealia	1					
Cerealia frag.						5
Collected plants						
Arctostaphylos uva-ursi						1
Arable weeds						
Chenopodium album						1
Fallopia convolvulus				1		1
Galeopsis sp.		1				
Meadow and wetland vegetation						
Ranunculus acris	1					
Rumex acetosella						1
Other plants						
Vicia sp.				2		
Other plant parts						
Claviceps purpurea						1
Picea abies (needle)					2	

Figure 22: Charred plant remains from ditches and pits.

R269 was a ditch running in N–S direction in the N-side of the field R264 and more parallel to the field, towards SSW, in the S-side of the field R264. It was stratigraphically situated underneath the field R264. The ditch was 50–60 cm wide and filled with a mixture of red burned sand, brown sand, grey sand and yellow-brown sand. There were charcoal particles, clay concentrations, pottery shards and daub. (Mikkola 2007:21–23.)

18 charred seeds were found in the ditches adjacent to Karilantie field unit (fig. 22). They were 17 % cereals, 11 % collected plants, 39 % arable weeds, 17 % meadow and wetland vegetation and 17 % other plants. 16 charred seeds were found in the ditch R269 adjacent to Peltorannantie field unit. The plants found consisted of 25 % cereals, 6 % collected plants, 13 % arable weeds, 38 % meadow and wetland vegetation and 19 % other plants. The amounts of seeds in the ditches are quite small for percentage counting.

R281 was a round shallow pit in the field R264. It was about 70 cm wide and the finds consisted of burned clay. The pit was filled with dark brown sand, charcoal, clay and burned stones. (Mikkola 2007:25.)

R282 was a round shallow pit in the field R264. It was approximately 60 cm wide. The pit was filled with dark brown sand, sooty soil, charcoal and fire cracked stones. (Mikkola 2007:25–26.)

R19 was an irregular-shaped rectangular pit with rounded edges measuring 3 x 2 m and being at deepest 80 cm. It was situated in the Peltorannantie field (R23). Structure was later than the field. It was interpreted as a possible storage or a cellar pit, which was filled with soil containing Iron Age and later finds. There were some stone constructions in the pit. Around the pit there were rows of small postholes in the edges. The finds consisted of burned clay, burned bone, flint, Iron Age ceramics, green bottle glass and a iron nail. (Mikkola 2001b:14–15.)

R24 was a possibly quite young oval pit which was situated in the Peltorannantie field (R23). It was a 2,5 metres long and at most 1,4 metres wide. The structure was about 60 cm deep. The finds consisted of burned clay, unburned bone, Iron Age ceramics, clay daub, burned clay, pieces of bronze, iron object, piece of knife made of iron and on top of the structure a piece faience pottery. In the structure there was a lens of clay and shredded wood and also a mole hole. There was also a stone construction with a lot of unburned wood running in S-N direction. (Mikkola 2001b:18–19.)

R63 was an oval pit filled with cultural soil most possibly dating to the Iron Age. It was running in S–N direction in the Peltorannantie field (R23). It was 90 cm long, 44 cm wide and ca. 15 cm deep. There was a round stripe of sooty soil in the pit. The finds consisted of thick piece of bronze sheet, a bottom piece of a ceramic vessel, clay daub and burned bone. (Mikkola 2001b:17.)

R87 was a round pit of cultural soil, which was approximately 30 cm deep. It was situated in the Peltorannantie field (R23). Finds consisted of burned clay, two pottery shards, clay daub and a piece of flint. (Mikkola 2001b:17–18.)

The pits contained some charred plant material. The charred plant material of pit R282 was clearly different and more numerous than the material in the other pits. It consisted of 12 oat grains which accounts for 40 % of all oat grains found from Orijärvi, so it would be significant to know the age of this pit, when evaluating the importance of oat in the charred plant assemblage. This pit varies quite much from the other contexts studied here with its plant species and that the plant material consists of 83 % of the cereals.

7.5 Well and postholes

There was a well **R210** found at Orijärvi and there was charred plant remains found there. The well was 1,5 m deep. There were remains of a wooden frame measuring 80x80 cm and being about 50 cm high in the bottom layers of the well. Timbers forming the frame have been approximately 10–15 cm thick. Dendrochronological dating of the wood remains in the well was tried, but it was unsuccessful, because the trees were not thick enough. There was different filling levels found in the well. The finds consist of two grinding stones, which derive from two different pairs. Other finds were Iron Age ceramics, iron slag, burned bone, clay slag, burned clay, piece of flint and a piece of clay daub. A piece of wood from the frame was dated to 1021–1173 AD. (Mikkola 2005:53, 2004:13–14.)

Well, R	**210**	**Postholes, R**	**106**	**107**	**135**	**139**	**140**
Cereals		**Cereals**					
Hordeum vulgare var. vulgare	4	Hordeum vulgare cf. var. vulgare frag.			1		
Hordeum vulgare	1	Hordeum vulgare frag.				1	
Secale cereale	1	Cerealia frag.		1	4		
Cerealia frag.	1	cf. Cerealia frag.				1	
Arable weeds		**Arable weeds**					
Galium spurium	1	Chenopodium album				1	
		Galeopsis sp.				1	
other plants							
Polygonaceae	1	**Meadow and wetland vegetation**					
		Ranunculus acris				1	
other plant parts							
Arrhenatherum elatius var. bulbosum (tuber)	1	**Other plants**					
		Poaceae	1	1		2	
		Polygonum sp.				1	
		Vicia sp.					1
		Other plant parts					
		Arrhenatherum elatius var. Bulbosum (tuber)				1	
		Picea abies (needle)				3	3

Figure 23: Charred plant remains from well and postholes.

There were 9 charred seeds and one tuber found from the filling of the well (fig. 23). The relative amount of cereals is much greater in the well than in the Karilantie field, but the plant species found in the well have also been found from the Karilantie field unit. The plant material in the well differed from Karilantie field unit as no charred remains of wetland or meadow vegetation was found in the well.

There were various postholes found from Orijärvi. Five of these are discussed here, because charred plant material was found in these.

R106 was a posthole most probably dating to recent times. **R107** and **R135** were postholes with stone settings. **R139** was a possible posthole with stone setting in the N-side of Karilantie field (R84). **R140** was a possible posthole with stone setting in the N-side of Karilantie field (R84). (Mikkola 2003:16, 20.)

There were altogether 17 charred seeds, 1 tuber and 6 needle fragments found in the postholes. 8 of these were cereal grains (fig. 23). Posthole R139 shows greatest variation in taxa and its plant composition is quite similar as in the Karilantie field unit. All the plants found from postholes are found also in the Karilantie field unit.

8 Discussion

8.1 What does the charred plant material represent?

The first question raised in the beginning of this paper was: “What kind of taphonomical processes have been affecting the archaeobotanical material and what does it represent?” This question will be discussed in this chapter by combining archaeobotanical theory, archaeological finds and charred plant material in Orijärvi.

As the conditions in Orijärvi are fully aeriated and humid, plant remains preserve only charred or mineralized. The charred material found in Orijärvi is discussed in this paper. The taphonomy of the charred seeds has been discussed in the chapter 4.3. For the allochtonous plant material to be preserved in the charred state it is necessary for it to be collected, because only rarely plants that are not collected are preserved in this manner (fig. 1). The collecting of plants could have been done by men or animals from the surroundings of the site. After the plant material has been collected and processed it must have got charred. According to Van der Veer (2007:979, see also Hillman 1984) this happens most often when: plants are used as fuel, food plants are burned during processing, stored foods are destroyed by fire in accidents, plants are destroyed during the cleaning of grain storage pits, and diseased or infested crop seeds that needed to be destroyed are burned. Material found in hearths has most probably been charred during the usage of the hearth. It is possible that spruce needles have been charred during clearance, but I think it is quite difficult to say how the charring has happened with the material found in the ancient fields of Orijärvi, but most probably it could be one or many of these reasons that have caused it. Finds of charred spruce needles in possible ard marks in SW Finland dating to the Viking Age have also been interpreted as remains of clearance burning (Roeck Hansen & Nissinaho 1995:28).

All plant material that could be identified to the species level in Orijärvi can be in some way connected to agricultural or other activities. The cereal, fibre, collected plants and fodder plants belong to the group of deliberately collected plants. Weeds are conventionally considered collected inadvertently, but in some cases they have also been collected deliberately (Behre 2008).

All plant species mentioned in the model of deposition of plants in Iron Age dwellings and barns (fig. 2) are found in the charred assemblage of Orijärvi (fig. 12). When considering this evidence one could conclude that the charred plant material can derive from houses. Bulbous oat-grass, which is often found in graves suggests the possibility that the material derives also from graves. Spruce needles could derive from houses, but it is also possible that they are results of clearance activities.

In the archaeological evidence settlement material is represented by postholes, hearths, clay daub, and clay slag and the absence of clear house remains in Orijärvi has been interpreted so that the destroyed settlements have been turned into cultivated fields (Mikkola 2006:27). The silver hoard is another line of evidence. In Gotland these hoards were often dug under the house floors during the Viking Age (Östergren 1989:235). Given the silver hoard had also been inside a house in Orijärvi, it could be another indication that there were houses in the original location of the silver hoard, as it was found dispersed in the fields (Mönkkönen 2008:57–62, Karttaliite [map appendix] IV). Both archaeological and archaeobotanical data is consistent as they both suggest that there has been settlements.

Many processes have affected the charred plant remains before they have ended up in their archaeological contexts. It is suggested that the houses fields have been moving, in the same manner as in Scandinvian settlements. This could be the reason why material from houses is found in the fields. This moving could have been useful for the manuring of the fields (Pedersen & Widgren 1998) or it could also be a social event (Bradley 2003). Ploughing seems to have played an important role in moving and wearing the plant remains as been proven with the archaeological finds (Mönkkönen 2008). Water and wind could have also moved the plant remains to the ditches and to the well and also on the fields. It should also be considered that the plant assemblage and the archaeological material, do not have to derive from a single dwelling or burial phase. The settlement could have been moving many times.

The material from postholes, hearths and other closed contexts are not as mixed as material from fields and thereby easier to date and securely attach to a context. The material found from the ditches and pits is challenging, because it is not certain where this material derives from.

Altogether, 32 pieces of charred bulbous oat-grass stem tubers were found in Orijärvi. The tubers of this plant are rich in starch, they are edible and it might have been cultivated (Engelmark 1984:88–91; Welinder 1998:75). Bulbous oat-grass is relevant here, because it is found often in Iron Age graves and ritual deposits in Scandinavia and Central Europe and it has been suggested that it could have been used in some grave ritual (e.g. Cooremans 2008; Preiss et al. 2005; Viklund 2002:200-201; Gustafsson 1995; Engelmark 1984). Bulbous oat-grass is also found from settlement sites, but in Sweden these date mostly to the Bronze Age (Gustafsson 1995:382). Artelius (1999 and literature cited) discusses that the plant has been found as grave and house offerings, and in refuse pits.

Two findings of the plant have been published in Finland. One was a Merovingian Period cemetery in Laitila Vainionmäki in SW Finland, where the bulbous oat-grass remains were found from a pit filled with charcoal and soot. The pit contained also numerous cereals, pulses, weeds and oil plants (Aalto 1996:177–178). It can be interpreted as being an offering pit and is the most remarkable Iron Age offering find containing charred plant material in Finland. Bulbous oat-grass has also been found in an Ostrobothnian Iron Age site Vöyri Pörnullbacken, where it was found both in houses and in graves (Engelmark & Viklund 2002:15).

Bulbous oat-grass does not grow in Finland at the moment, and it is difficult to say whether it grew in Orijärvi during the Iron Age. The findings of bulbous oat-grass are interesting and as they have been found only from the Karilantie field unit, the archaeological material should be studied in detail to find out if there is a same kind of distribution of grave goods. During the archaeological excavations some structures were found, which have been interpreted as being possible inhumation graves (Mikkola

2003:60–61). As the Orijärvi site has been settled at least from the Merovingian Period to the Middle Ages, it is most possible that the rituals and beliefs practiced have changed during this time. Hence, there have most probably been various types of graves in Orijärvi during the time period it was settled and these have been ploughed into the fields in the same way as the settlement sites have been ploughed.

8.2 The field units and structures compared

The second question raised in the beginning of this paper was: "How can the contexts be interpreted according to the archaeobotanical material and how do the contexts differ from each other?" I think this question has its problems when the taphonomical processes discussed in the previous chapter are taken into account.

The variation between the different plant groups is greater in the Karilantie field unit than in the Peltorannantie field unit. In the Karilantie unit, this is represented by the smaller relative amount of cereals and greater amount of the other types of plants. The cereals of the both fields are dominated by barley. The amount of rye is quite equal in both units. The relative amount of oat is a somewhat greater in the Peltorannantie unit and wheat is represented only in the Peltorannantie unit. Both fields contain a small amount of naked barley, but the majority is hulled barley. Both field units contained approximately the same amount of ergot. Flax was only found in the Peltorannantie unit.

Ergot and raspberry are only present in the Karilantie unit. Juniper was found in small amounts from both units and bearberry only in Peltorannantie unit. The weed flora seems to be more varied in the Karilantie unit, but this may also be caused by the greater amount of samples. *Chenopodium album* and *Spergula arvensis* are numerous weeds in both units. *Galium spurium* is much more numerous in Karilantie field and *Bromus secalinus* in the Peltorannantie unit.

The meadow and wetland vegetation is represented mostly by sedges in both fields units. In addition there is meadow buttercup in both field units and common sorrel in the Karilantie unit and *Persicaria foliosa* in the Peltorannantie unit. Both fields contained grass seeds, which could derive from meadows and wetlands and also spruce needle fragments.

All the species – except bread/club wheat and hemp – found from the hearths adjacent to the Karilantie field unit are also found in the samples taken from the fields. The plant types seem to be represented in similar proportions in both field unit and hearths, though the there is not too many seeds found from the hearths. The plant composition in the ditches is quite similar as it is in Karilantie field unit, in Peltorannantie field unit the proportion of cereals was much higher than in the ditches.

All the species, apart from meadow vetchling, found in the ditches adjacent to the Karilantie field unit, are also found in the samples taken from the field unit. Plant types seem to be represented in similar proportions in both, though there are not too many seeds found from the ditches. Also spruce needle fragments are numerous in both fields and ditches.

All the species – except bulbous oat-grass and raspberry – found in the ditches adjacent to the Peltorannatie field unit are also found in the samples taken from the fields. Plant types seem to have quite different proportions in the ditches than in the Peltorannantie field unit and it resembles more the plant proportions of the Karilantie field unit, though there is not too many plant remains found in the ditches. Spruce needle fragments are numerous in both fields and ditches, but it seems that the proportion in the ditches is greater than comparing the ditches and Karilantie field unit. All in all the differences between the ditch and the field are greater in Peltorannantie unit than in Karilantie unit.

As the plant material is quite similar in the contexts it is quite difficult to assess their function. Based on the similarities in the charred assemblages, it seems that the material in the ditches and in the well could derive from the fields. The most interesting find in this comparison is that bulbous oat-grass tubers are found only in the Karilantie field unit. These plant remains are often found from grave contexts and it could therefore be possible that also graves had been incorporated and ploughed as fields.

8.3 When were the different plants introduced in Orijärvi?

The third and last question raised in the beginning of this paper was: “What kind of knowledge does the charred plant material give about the subsistence and agricultural history in Orijärvi?” The question of agricultural history is mostly discussed in this chapter. Details of the agriculture and subsistence are elaborated in the next two chapters.

Radiocarbon dating is very important tool for getting information of the agricultural history, and especially AMS-dating of the cereal grains. I think that studying the material from Orijärvi has produced a multifaceted impression of the plant usage and agricultural practices. It has not been possible to see what plants have been cultivated in different field phases within this study, due to the taphonomy of the charred plant material. Still a preliminary chronology of the introduction of different species is suggested and compared with the results gained with pollen analysis.

The plant material dated with radiocarbon dating is compared with the results of the pollen analysis in the figure 24. The radiocarbon datings were presented in figures 4 & 6. The datings of the plants are based on dated cereal grains or plant remains found in samples, where grains or other material is dated. It should be taken into account that secure datings are gained only from the charred grains, which are actually AMS dated.

First occurences of cereals, fibre plants and weeds

Macrofossils	**dating**[1]	**Pollen**	**dating**[2]
barley (*Hordeum vulgare*)	596-862 AD	*Hordeum*	1220 AD
wheat (*Triticum aestivum* s.l.)	638-965 AD	*Triticum*	1300-1960 AD
vetch (*Vicia* sp.)	790-978 AD	-	-
hulled barley (*Hordeum vulgare* var. *vulgare)*	887-1014 AD	*Hordeum*	1220 AD
rye brome (*Bromus secalinus*)	887-1014 AD	-	-
rye (*Secale cereale*)	892-1015 AD	*Secale*	615 AD
fat-hen (*Chenopodium album*)	895-1023 AD	-	-
pale persicaria (*Persicaria lapathifolia*)	898-1117 AD	-	-
false cleaver (*Galium spurium*)	898-1117 AD	-	-
many-seeded goosefoot (*Chenopodium polyspermum*)	999-1159 AD	-	-
flax (*Linum usitatissimum*)	1438-1619 AD	-	-
hemp (*Cannabis sativa*)	Iron Age[3]	*Cannabis*	beginning of pollen subzone dated to 830-1300 AD
naked barley (*Hordeum vulgare* var. *nudum)*	Iron Age[3]	*Hordeum*	1220 AD
oat (*Avena* sp.)	Iron Age?	*Avena*	1300-1960 AD
-	-	*Fagopyrum*	1300-1960 AD

[1]Datings with years are based on radiocarbon datings and the rest is based on stratigraphical considerations.
[2]Datings are based on paleomagnetic datings (Alenius et al. 2007).
[3]These remains come from hearth R129, which is stratigraphically dated to the Iron Age (pers. comm. Mikkola).

Figure 24: First occurrences of selected plants in the macrofossil and pollen (Alenius et al. 2007) analyses.

Radiocarbon datings suggest that barley and wheat have been cultivated in Orijärvi during the Merovingian Period. The long time span between first AMS-dated charred barley grain (596–862 AD) and the first occurrence of barley pollen (ca. 1200 AD) is considerable as the distance between the fields and the pollen coring location is only ca 700 m (Alenius et al. 2007:182). In modern studies barley pollen has been poorly represented even in the close proximity of fields, because it is autogamous as rye is wind pollinated (Alenius 2007:20 & literature cited). Pollen analytical data also shows rye cultivation in the surroundings of Orijärvi since the beginning of the Merovingian Period, but the first AMS dated rye is from the Viking Age. Oat has also been an important cereal, but there is no radiocarbon dated Iron Age oat from Orijärvi. The discrepancies between barley, rye, wheat, and some other datings are most probably caused by differences in the spread of pollen and the distance of the coring position.

Hemp macrofossil date to the Iron Age according to stratigraphical observations and its first occurrences in the pollen analysis date to the Viking Age. Flax has been found in a sample dating to the Middle Age and it is not found from the pollen samples probably due to its poor dispersal by wind.

If taking into account the taphonomic processes in the both methods, these results complement each other and the results seem to be consistent. It should be kept in mind that pollen accumulates into the lake sediments by dispersal with wind and water, whereas charred macrofossil material represents mostly plants collected by man. It should be also noted that the absence of some plant species in the list of macrofossils is often caused by the sheer reason that there is no samples dated, where this species is present.

The previous archaeobotanical studies have given only limited information regarding the agricultural history in Mikkeli. Before the pollen analysis and the analysis of charred seeds in Mikkeli there was only one pollen analysis (Simola et al. 1988) indicating rye and *Cerealia* cultivation since the Crusade Period. Archaeobotanical remains of rye was also found in Tuukkala cemetery dating also to the Crusade Period (Lempiäinen 2002). Possible hemp remains dating to the Middle Ages (Schulz 1994) and fibres made of plant fibres dating to Iron Age had been found (Lehtosalo-Hilander 1994). So these studies of macrofossils and the pollen analysis have given a great wealth of new knowledge of the agricultural history in Finland and Mikkeli.

When the charred plant material found in Mikkeli (fig. 12) is compared with contemporaneous sites in Finland (fig. 11) the material is highly similar. The dominance of barley, mostly hulled barley is clear in almost all Finnish sites. Rye has also been an important crop and it is possible that the actual cultivation of rye starts during the Merovigian Period. Rye is most important crop in two sites, but mostly it has had a similar importance as in Orijärvi. Oat is found in many sites, but it is not clear that it is the cultivated oat or wild oat during this period. This question could be answered with some good preserved remains of oat, where the floret-bases would be preserved (Jacomet et. al 2006). Bread/club wheat has been found in small quantities in some of the other Finnish sites, though in Domargård it has been an important crop. Emmer wheat is the only cultivated cereal that has not been found in Orijärvi, but it has also been of minor importance elsewhere in Finland.

Other cultivated plants have not been found in as great numbers as the cereals in the Iron Age sites in Finland. Hemp and flax are also present in some coexistent sites. Gold-of-pleasure has been found in two other sites, but not in Orijärvi. Legumes have not been found in Orijärvi, though they could have been cultivated there. Pea and horse bean have been found in some sites. It is interesting that horse bean has only been found in grave contexts and this can have something to do with the processing methods of this plant, which maybe got charred when it was intentionally or accidentally burned as the processing of this crop was not connected with fire. One pea has been found in settlement context, but the other finds are storage and grave contexts, which could evidence accidental or intentional burning. This could imply that the processing of pea has differed from the processing of cereal crops as may be the case with horse bean. Bulbous oat-grass has been found in two other sites, where it has been found in grave contexts and in one site settlement context.

It should be taken into account that if some plants are missing from the charred assemblage, it does not mean that they could not have been cultivated. As there is many similarities in the charred assemblage in Orijärvi with the other Finnish sites, it is highly possible that also legumes and some other plants not found in the charred material could had also been cultivated in Orijärvi.

8.4 What kind of agricultural system there could have been in Orijärvi?

The whole macrofossil material can be seen as an accumulation of a long period of agricultural activities and settlement in Orijärvi from the Merovingian Period until to the Middle Ages and perhaps even later. Agricultural soils have had different qualities and the climate has been diverse. The soil requirements for selected weed species is presented in figure 25.

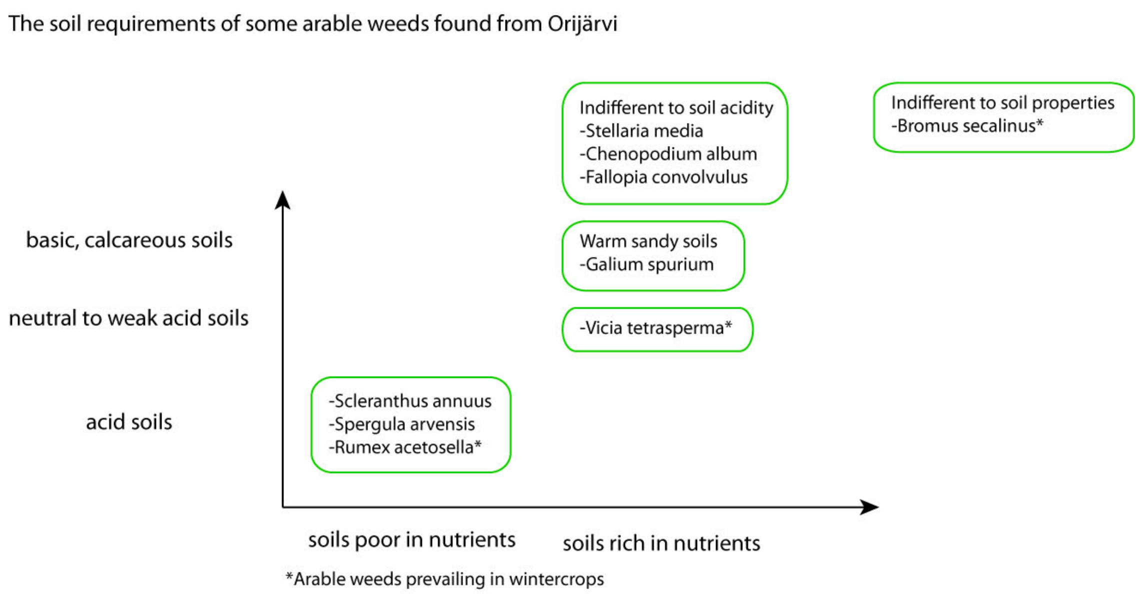

Figure 25: Soil requirements of selected arable weeds. Based on Engelmark & Viklund 2008.

During the whole period of use it seems that barley has been the most common cereal cultivated in Orijärvi and it is hulled barley which was the most common variety cultivated here, but even small amounts of naked barley were present. Rye, oat, and bread/club wheat have been cultivated in smaller proportions.

Galium spurium could well be growing on the same kind of soil as wheat, because both require warm, calcareous soil which is rich in nitrogen to grow well. Bedrock in Orijärvi is partly alkaline, which can promote the growth of wheat.

Barley grows also well on calcareous soils, but is more tolerant than wheat. It requires a lot of nutrients, so arable weeds requiring a lot of nutrients could have grown in the same places as barley. The species thriving in wet conditions are more likely to be grown in the same places as oat.

Oat can grow well also on acid soils if these are wet enough. This is why the arable weeds thriving in acid conditions could have been growing in same places as oat. *Persicaria lapathifolia* and *Stellaria media* are growing especially in wet conditions, where oat also thrives. The occurrence of ergot also indicates wet climate.

The occurrence of *Bromus secalinus* can be connected with the cultivation of rye. Both tolerate many kinds of soil properties. *B. secalinus* grows often with winter crops, so it could indicate some form of crop rotation. *Vicia tetrasperma* and *Rumex acetosella* can also indicate winter crops. *B. secalinus* could grow well when the climate was too wet for rye and thereby ascertain some sort of harvest.

Bulbous oat-grass, raspberry, wild strawberry, bearberry, and juniper represent the local flora which was collected. All the plants but bearberry thrive on meadows, so they could have been collected from the surrounding pastures.

The meadow and wetland vegetation most probably represents remains of collected fodder and animal grazing. Sedges are the most numerous, but it is not possible to say what kind meadows or wetlands these have been growing in. Other plants living in these environments can give an idea of the pastures and meadows that were used to feed the animals. The meadow vegetation found suggests that the meadows were open or in half shadow and rich or intermediate with nitrogen. Most plants thrive on meadows more suitable for grazing, but there is also species which thrive in meadows suitable for hay making.

The charred plant material also indicates manuring according to the abundance of arable weed species that thrive on nutrient rich soils. This does not show how this was done. The animal manure contains various seeds, but these have been uncharred and therefore not preserved. Household waste could be all sorts of different material deriving from houses and this could contain charred plant material. Manuring with sods would introduce various kinds of 'natural' plants to the fields, but this material would not be charred.

8.5 Subsistence in Mikkeli area during the Iron Age

The evidence gained from Orijärvi and other sites in Mikkeli suggest that the subsistence has based on cultivation, animal husbandry, hunting, fishing, and gathering. The evidence for these strategies has been gained from archaeological and environmental archaeological sources. The evidence in Orijärvi gives most information on plant usage, but there is also indirect evidence of animal husbandry. It can not be proven in this study that hunting or fishing has been done in Orijärvi, but this is suggested by other contemporary sites in Mikkeli.

The site of Orijärvi seems to have been suitable for various agricultural activities. The model shown in figure 7 seems to fit Orijärvi well. Clear evidence for the fields have been gained during the archaeological studies and the cultivation history has been dated with various methods. Animal grazing and meadow usage has been proposed with the finds of sedge, meadow buttercup and other plant species in the charred assemblage. Human presence in the lake vicinity during 800–1000 AD is indicated by the occurrence of *Nymphae* pollen and grazed meadows by *Juniperus* pollen since the 11th century (Alenius et al. 2007). Meadow usage is also prompted by the finds of scythes in Orijärvi, and leaf fodder collecting by the finds of bill hooks in other contemporary sites.

The osteological evidence in the Mikkeli consisting of cattle, horse, sheep or goat, pig, hen, and cat propose that there has been variety of animals in the farms. Various products have been gained from these animals, and the finds of scissors, spindle whorls, and loom weights indicate that secondary products of the animals have been used. Farmyard animals, especially cattle have provided with the valuable resource of manure and the usage of some kind of manure has been indicated by the finds of plant species thriving in nutrient-rich soils.

In addition to animal manure and wandering fields, also other types of manuring have probably been used. The usage of household waste is probable and also the use of sods. This is proposed by the increasing amount of *Calluna* pollen already since 500 BC (Alenius et al. 2007). More intense land usage is also shown by increasing erosion since 9th century (ibid.). The erosion could have been caused by ploughing, digging of ditches or animal herding. Also cultivation is intensified since the Viking Age (Alenius et al. 2007:180).

According to the pollen analysis, slash-and-burn cultivation is shown by *Picea* pollen decrease from 1180 AD onwards (Alenius et al. 2007). It can also be suggested that spruce forest has been burned in order to clear the land for other purposes. Finds of spruce needles in the field layers can be interpreted so that a forest containing spruce has been cleared away to start the field cultivation.

The subsistence in Mikkeli has been acquired from various sources during the studied period. This is also true when the first written evidence has been gained from Savo (Pirinen 1988). It is difficult to evaluate the importance of the various subsistence strategies. I think that it is more rewarding to understand the different processes connected with these strategies, than the amount of calories gained from various sources of food.

9 Conclusions

In this study the large charred plant material from Mikkeli Orijärvi has been studied. The charred material found in Orijärvi represents mostly collected plants, but the spruce needles can also be remains of clearance. In the Karilantie field unit there was material which was similar to the material commonly found from Iron Age dwellings, barns, and graves. In the Peltorannantie field unit the material was mostly resembling material from dwellings and the grave material was absent. According to this and the archaeological material it is suggested that settlements and graves have been ploughed as fields.

With the help of the radiocarbon datings, pollen analysis, and stratigraphical observations, a preliminary chronology for the introduction of certain plant species was proposed. In this chronology barley, rye, and bread/club wheat have been cultivated during the Merovingian Period onwards. Oat has been also probably cultivated at this time, but there is no radiocarbon dating for this. Hemp has been cultivated during the Iron Age, but flax has been probably taken into cultivation during the Middle Ages. The crops resemble material found in comtemporary Finnish sites, where the dominant cereal is barley (mostly hulled) and rye the second most important crop, with bread/club wheat and oat as minor crops.

Gathering of bulbous oat-grass, raspberry, bearberry, wild strawberry, and juniper indicate that collecting plants from the surroundings have also been part of the subsistence. Bulbous oat-grass tubers are interesting finds, because these are attached to graves in contemporaneous archaeological sites.

The weed flora and cereals indicate cultivation on different kinds of soils and climates during the long usage period of the Orijärvi site. The soils have varied from acid to calcareous, from clayey to sandy, from nutrient poor to nutrient rich and from damp soils to drier soils. Some of the weed species thrive in nutrient rich environments and thereby indicate manuring of the fields. Cultivation of winter crops is suggested by to the presence of *Bromus secalinus*. Animals have been grazing in the surrounding pastures and fodder has been collected for them.

The subsistence in Mikkeli area and most probably also in Orijärvi has been diverse. According to archaeological and environmental archaeological material the subsistence has consisted of agriculture, fishing, hunting, and gathering. The remains of gathered plants during the Iron Age in Mikkeli are first time discussed in this paper. Agriculture has consisted of cultivation of permanent fields, slash-and-burn agriculture, and animal husbandry. Secondary products of the animals have been used according to the archaeological finds. According to the weed flora the permanent fields have been manured. Manuring could have been done in several ways: animal manure, adding sods, wandering villages, and household waste. The clearence of the fields have been probably done with fire, proposed by the finds of spruce needles. The slash-and-burn agriculture is proposed by the pollen analysis from Orijärvi (Alenius et al. 2007), but the charred seed assemblage can not elucidate the type of agriculture more at the moment.

The people who lived in Orijärvi were interacting with their environment in various ways and were the main actors of the human ecological network. The charred plant material should be considered as the results of deliberate collection of chosen species and improving and promoting the living conditions of certain species. People have cleared areas suitable for cultivation, animals have grazed in the surroundings, leaf and hay fodder has been collected, timber has been cut, etc., which has changed the environment in various ways. The open areas have been good growing places for light demanding plants which have been collected for human and animal consumption and also for cultivation of cereals and fibre plants. The living environments of the cultivated plants have been further promoted by manuring, ploughing, digging ditches and probably introducing organic matter to the fields. Manuring has been most probably done also by taking dwelling places and possibly graves into cultivation. Maybe this has been a part of a system where the villages have been 'wandering'. Wandering could have been caused by people's intention to plough down old religion, culture or generations. Hence, the fields and houses can be seen as medias for socialization as can also the whole environment of Orijärvi. When considering all these factors, the environment in the surroundings of Orijärvi has by no means been 'natural', but instead strongly influenced by various cultural activities.

During the Late Iron Age people in Orijärvi have been a strong ecological factor, who have modified the various habitats. Their agricultural system has had the same basic components from the Merovingian Period until the Middle Ages. The cereal cultivation has been consisting of an interplay with various species with different requirements making the cultivation less sensible for fluctuations in the climate and thereby more resilient, this kind of means of living has been further supported by gathering of wild plants, and probably hunting and fishing. Food production has increased the complexity of the society and laid the basis for future developments in the society.

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Appendices

Appendix 1: Scientific, English, and Finnish names used in the paper

Scientific	**English**	**Finnish**
Alnus	alder	leppä
Arctostaphylos uva-ursi	bearberry	sianpuolukka
Arrhenatherum elatius var. *Bulbosum*	oat-grass	heinäkaura
Avena fatua	wild oat	hukkakaura
Avena sativa	cultivated oat	kaura
Avena sp.	oat	kaura
Betula	birch	koivu
Brassicaceae	mustard/cabbage family	ristikukkaiskasvit
Brassica rapa ssp. *rapa*	turnip	turnipsi, nauris
Bromus secalinus	rye brome	ruiskattara
Camelina sativa	gold-of-pleasure	ruistankio
Cannabis sativa	hemp	hamppu
Carex sp.	sedge	sara
Caryophyllaceae	pink/carnation family	kohokkikasvit
Centaurea cyanus	cornflower	ruiskaunokki
Cerealia	cereal	vilja
Chenopodium album	fat-hen	jauhosavikka
Chenopodium polyspermum	many-seeded goosefoot	hentosavikka
Claviceps purpurea	ergot	torajyvä
Corylus avellana	hazel	pähkinäpensas
Cyperaceae	sedge	sarakasvi
Epilobium sp.	willowherb	horsma
Fabaceae	legume family	hernekasvi
Fagopyrum tataricum	buckwheat	tattari
Fallopia convolvulus	black-bindweed	kiertotatar
Fragaria vesca	wild strawberry	ahomansikka
Galeopsis sp.	hemp-nettle	pillike
Galium sp.	bedstraw	matara
Galium spurium	false cleaver	peltomatara
Hordeum vulgare	barley	ohra
Hordeum vulgare var. *nudum*	naked barley	kuoreton ohra
Hordeum vulgare var. *vulgare*	hulled barley	kuorellinen ohra
Humulus	hop	humala
Hyoscyamus niger	henbane	hullukaali
Isoëtes	quillwort	lahnaruoho
Juniperus communis	common juniper	kataja
Lathyrus pratensis	meadow vetchling	niittynätkelmä
Linum usitatissimum	flax	pellava
Myrica gale	bog myrtle	suomyrtti
Nymphaea	-	lumme
Persicaria foliosa	-	lietetatar
Persicaria lapathifolia	pale persicaria	ukontatar
Picea abies	norway spruce	kuusi
Pisum sativum	pea	herne
Plantago	plantain	ratamo
Poaceae	grass	heinäkasvi
Polygonaceae	-	tatarkasvi
Polygonum aviculare	knotgrass	pihatatar
Polygonum sp.	-	tatar
Potentilla sp.	-	hanhikit
Prunella vulgaris	selfheal	niittyhumala
Prunus institia (Prunus domestica var. *institia)*	damson/bullace	kriikunapuu
Pteridium	bracken	sananjalka
Ranunculaceae	buttercup/crowfoot family	leinikkikasvit
Ranunculus acris	meadow buttercup	niittyleinikki
Ranunculus sp.	-	leinikki
Rhinanthus sp.	rattle	laukut
Rhinanthus minor	yellow rattle	pikkulaukku
Rhinanthus serotinus	-	isolaukku
Rubus idaeus	raspberry	vadelma
Rumex acetosa	common sorrel	niittysuolaheinä
Rumex acetosella	sheep's sorrel	ahosuolaheinä
Salix	-	paju
Scleranthus annuus	annual knawel	viherjäsenruoho
Secale cereale	rye	ruis
Spergula arvensis	corn spurrey	peltohatikka
Stellaria graminea	lesser stitchwort	heinätähtimö
Stellaria media	common chickweed	pihatähtimö
Trifolium sp.	clover	apilat
Triticum aestivum s.l.	bread/club wheat	leipä-/pölkkyvehnä
Triticum aestivum	bread wheat	leipävehnä
Triticum compactum	club wheat	pölkkyvehnä
Triticum dicoccum	emmer wheat	emmervehnä
Urtica	nettle	nokkonen
Verbascum nigrum	dark mullein	tummatulikukka
Vicia sp.	vetch	virnat
Vicia faba	horse bean	härkäpapu
Vicia tetrasperma	smooth tare	mäkivirvilä
Viola arvensis/tricolor	field/wild pansy	pelto-/keto-orvokki
Vitis vinifera	grape vine	viiniköynnös

Appendix 2: Samples with identified charred plant material with sample number, excavation year, structure number, and charred plant remains

nr.	year	R	Charred remains
2	2000	63	Secale cereale 1
3	2000	24	Avena sp. 2, Galeopsis sp. 1
14	2000	24	Avena sp. 1
18	2000	19	Cerealia 1
22	2000	19	Ranunculus acris 1
24	2000	19	Secale cereale 1
28	2000	84	Vicia sp. 1
40	2000	84	Chenopodium album 1
41	2000	84	Hordeum vulgare (dated) 1
42	2000	84	Cerealia frag. 1, Picea abies (needle) 1
50	2000	23	Hordeum vulgare frag. 1
59	2000	78	Cerealia frag. 2
61	2000	23	Hordeum vulgare frag. 1
64	2000	23	Avena sp. frag. 1
65	2000	23	Hordeum vulgare frag. 1, Cerealia 1
66	2000	23	Cerealia frag. 2
68	2000	23	Hordeum vulgare 1 (dated)
77	2000	87	Vicia sp. 1
90	2000	23	Avena sp. 1
100	2000	23	Hordeum vulgare cf. var. vulgare1
104	2000	23	Hordeum vulgare (dated) 1, Cerealia frag. 1
108	2000	23	Chenopodium album 1
112	2000	23	Hordeum vulgare (dated) 1, Cerealia frag. 1
113	2000	23	Hordeum vulgare cf. var. vulgare 1
115	2000	23	Cerealia frag. 1
116	2000	87	Vicia sp. 1
121	2000	87	Fallopia convolvulus 1
123	2000	23	Triticum aestivum s.l. (dated) 1, Cerealia frag. 2
1	2002	84	Poaceae 1, Cerealia frag. 1
2	2002	84	Scleranthus annuus 1
3	2002	84	Chenopodium album 1
4	2002	84	Claviceps purpurea 1, Poaceae 1, Spergula arvensis 1
5	2002	84	Carex sp. 2, Vicia sp. 1, Galeopsis sp. 1
6	2002	84	Secale cereale 1, Cerealia frag. 1
7	2002	84	Cerealia frag. 1, Ranunculus acris 1, Poaceae 1
8	2002	84	Rubus idaeus 1, Secale cereale frag. 1, indet. 1
9	2002	101	Stellaria graminea 1, Avena sp. 1, Vicia cf. tetrasperma 1, Triticum aestivum s.l. (3,3x2,3mm, L/B 1,43) 1, Carex distigmaticea 1, Carex tristigmaticeae 1, Poaceae 1
10	2002	107	Cerealia frag. 1, Poaceae 1
11	2002	106	Poaceae 1
12	2002	84	Cerealia frag. 1, Vicia sp. 1, Picea abies (needle) 2, stalk 1, Ranunculus acris 3
13	2002	84	Avena sp. 1, cf. Hordeum vulgare 1, Cerealia frag. 1, stalk 1, Galium spurium 1, Rhinanthus sp. 1
14	2002	84	stalk 1, Vicia cf. tetrasperma 1, Potentilla sp. 1
15	2002	84	stalk 1, Picea abies (needle) 1, Vicia cf. tetrasperma 1, Poaceae 1
16	2002	84	stalk 1, Picea abies (needle) 1, Carex sp. (tristigmaticeae) 1
17	2002	84	Viola arvensis/tricolor 1, Vicia sp. 1, Carex sp. (distigmaticeae) 1, Ranunculus acris 1
18	2002	84	Cerealia frag. 2, cf. Cerealia frag. 2, stalk 1, Vicia cf. Tetrasperma 1, Galium spurium 1, indet. 6
19	2002	84	Spergula arvensis 1, Rumex acetosa 1, Picea abies (needle) 1, Vicia sp. 2
20	2002	84	Hordeum vulgare var. vulgare 2, Secale cereale 1, Chenopodium album 4, Carex sp. (tristimaticeae) 1, Spergula arvensis 1, Ranunculus acris 2, Viola arvensis/tricolor 2, Ranunculus sp. 1, Galium sp. 1, Stellaria media 1, Poaceae 1

21	2002	84	Juniperus communis 2, Ranunculus acris 3, Carex sp. (tristigmaticeae) 1, Stellaria media 1, Galium spurium 1, Picea abies (needle) 1, Fabaceae 1, Poaceae 1
22	2002	84	Rubus idaeus 1, Vicia sp. 1, Hordeum vulgare var. vulgare 1, Hordeum vulgare cf. nudum 1, Hordeum vulgare frag. 1, Chenopodium album 1, Viola tricolor/arvensis 2
23	2002	84	Fragaria vesca 1, Picea abies (needle) 1, Ranunculus acris 1
24	2002	84	cf. Hordeum vulgare 2, Cerealia frag. 1, cf. Bromus sp. frag. 1, Chenopodium album 1, Vicia sp. 2, Picea abies (needle) 1, Poaceae 1
25	2002	84	Carex sp. (tristigmaticea) 3, Galium spurium 1, Vicia sp. 1, Stellaria graminea 1, Arrhenatherum elatius var. bulbosum 1, Cerealia 1
26	2002	84	Vicia sp. 2, Hordeum vulgare frag. 1
27	2002	84	Picea abies (needle) 3, Vicia sp. 1, Fabaceae 1, Cerealia 1
28	2002	84	Hordeum vulgare cf. var. nudum 1, Rubus idaeus 1, Chenopodium album 1, Picea abies (needle) 1, stalk 1, Ranunculus acris 3, Spergula arvensis 1, Vicia sp. 1, Carex sp. (tristigmaticea) 1, Carex distigmaticea 1
29	2002	84	Rumex acetosa 1, Poaceae 1, Cerealia 1
30	2002	84	Picea abies (needle) 1, Vicia sp.1, Poaceae 2
31	2002	84	Vicia sp. 1, Picea abies (needle) 1, stalk 2
32	2002	84	Picea abies (needle) 1, Vicia sp. 1, stalk 1, Galeopsis sp. 1
33	2002	84	stalk 1, Claviceps purpurea 1
34	2002	84	Rubus idaeus 1, Rumex acetosa 1
35	2002	84	Hordeum vulgare var. vulgare 1, Hordeum vulgare frag. 1, Secale cereale 1, Vicia sp. 1, Picea abies (needle) 1, Arrhenatherum elatius var. Bulbosum 1, indet. 3
36	2002	84	Hordeum vulgare var. vulgare 1, Cerealia 1, Galium spurium 1, Vicia sp. 1
37	2002	84	Secale cereale frag. 1, Hordeum vulgare frag. 1, Hordeum vulgare var. vulgare frag. 1, Hordeum vulgare var. vulgare 1, Picea abies (needle) 5, Rubus idaeus 1, Galium spurium 2, Trifolium sp. 1, Arrhenatherum elatius var. bulbosum 2
38	2002	84	Galium spurium 1, Vicia sp. 1, Arrhenatherum elatius var. bulbosum (frag.) 1
39	2002	84	Poaceae 1, Hordeum vulgare frag. 1, Cerealia frag. 1, stalk tms. 2, Carex sp. (distigmaticeae) 1, Caryophyllaceae 1, indet. 2
40	2002	84	Picea abies (needle) 9, Poaceae 1
41	2002	84	Picea abies (needle) 1, indet. 2, Polygonaceae 1, Cerealia frag. 2
42	2002	84	Spergula arvensis 1
43	2002	84	Ranunculus acris 1, Picea abies (needle) 3, Vicia sp. 1
44	2002	84	no identified charred remains
45	2002	84	Vicia sp. 1, Picea abies (needle) 2
46	2002	84	Vicia sp. 1, Polygonaceae 1,Galium spurium 1
47	2002	84	Vicia sp. 1, Picea abies (needle) 1, Cerealia 1, Galeopsis sp. 1, Cyperaceae 1
48	2002	84	Stellaria media 1, Picea abies (needle) 6
49	2002	84	Spergula arvensis 1, Secale cereale frag. 1, Hordeum vulgare var. vulgare frag. 1, Picea abies (needle) 3, Vicia sp. 1
50	2002	84	Avena sp. 1, Picea abies (needle) 4
51	2002	84	Picea abies (needle) 3, Cerealia frag. 2
52	2002	84	Picea abies (needle) 13, Carex sp. Tristigmaticea 1
53	2002	130	no identified charred remains
54	2002	129	Hordeum vulgare var. nudum 1, Secale cereale 1, Hordeum vulgare 1, Cerealia frag. 2, Galium sp. 1, Ranunculus acris 1, Chenopodium album 1
55	2002	84	Picea abies (needle) 3, Cerealia 1
56	2002	84	Picea abies (needle) 1, Chenopodium album 1
57	2002	84	Picea abies (needle) 3
58	2002	84	Persicaria lapathifolia 1, Chenopodium album 1, Picea abies (needle) 2, Hordeum vulgare var. vulgare 1, Secale cereale 1, Cerealia frag. 2, Arrheratherum elatius var. bulbosum 1, Poaceae 2, Vicia cf. tetrasperma 1
59	2002	84	Picea abies (needle) 33, Chenopodium album 1, Carex distigmaticeae (ovalis) 1, Stellaria media 1, Arrhenaterum elatius var. bulbosum 2
60	2002	84	Picea abies (needle) 14, Carex sp. (distimaticeae) 2, Ranunculus sp. 1, Cerealia 1, stalk 2, Vicia sp. 1
61	2002	84	Arrhenatherum elatius var. bulbosum 1, Carex distigmaticeae 2, Spergula arvensis 1, stalk 2, Picea abies (needle) 1
62	2002	84	Cerealia frag. 3, Cyperaceae 1, Picea abies (needle) 25
63	2002	84	Picea abies (needle) 26, Arrhenaterum elatius var. bulbosum 1, Poaceae 1
64	2002	84	Picea abies (needle) 16, Cerealia 1
65	2002	84	Chenopodium album 2, Carex distigmaticea 2, Carex tristigmaticeae 1, Poaceae 1, Picea abies (needle) 3, Arrhenaterium elatius var. bulbosum 2, cf. Hordeum vulgare 1, Cerealia frag. 1, cf. Epilobium sp. 1
66	2002	123	Hordeum vulgare frag. 1, Cerealia frag. 3, Poaceae 1, Picea abies (needle) 52, Rubus idaeus 4
67	2002	123	Picea abies (needle) 37, Rubus idaeus 1, stalk 2, Cerealia frag. 2
68	2002	123	Picea abies (needle) 44, Cerealia frag. 1, Rubus idaeus 1, Poaceae 2, Vicia sp. 1, indet. 3
69	2002	84	Carex distigmaticea 1
70	2002	115	Secale cereale 1, Persicaria lapathifolia 1, Picea abies (needle) 35, Chenopodium album 1, Lathyrus pratensis 1
71	2002	84	Spergula arvensis 1, Picea abies (needle) 1, Poaceae 2

72	2002	84	Hordeum vulgare var. vulgare 1
73	2002	84	Hordeum vulgare var. vulgare 1, Cerealia frag. 2, Chenopodium album 2, Stellaria media 2, Poaceae 2, Picea abies (needle) 19
74	2002	84	Avena sp. 1, Hordeum vulgare cf. var. vulgare frag. 1, Cerealia frag. 1, Ranunculus acris 1, Vicia sp. 3, Poaceae 1, Picea abies (needle) 30
75	2002	84	Hordeum vulgare var. vulgare 1, Hordeum vulgare 1, Spergula arvensis 1, Galium sp. 1, Fragaria vesca 1, Poaceae 1, Picea abies (needle) 5
76	2002	84	Picea abies (needle) 18, Chenopodium album 3, Spergula arvensis 2, Stellaria media 1, Trifolium sp. 1, Poaceae 13, Hordeum vulgare frag. 1, Vicia cf. tetrasperma 1
77	2002	84	Hordeum vulgare var. vulgare 1, Chenopodium album 1, Picea abies (needle) 1
78	2002	84	Poaceae 5, stalk 1
79	2002	84	Poaceae 3, Cerealia frag. 1
80	2002	132	Claviceps purpurea 2, Chenopodium album 1, Spergula arvensis 1, Galium spurium 1, Carex sp. tristigmaticeae 1, Ranunculus acris 1, Cerealia frag. 4, Poaceae 1
81	2002	84	Persicaria lapathifolia 1, Galium spurium 1, Chenopodium album 1, Vicia sp. 1, Hordeum vulgare (1 dated) 2, Hordeum vulgare frag. 1, Cerealia frag. 3
82	2002	84	Secale cereale 1 (dated), Cerealia frag. 1, stalk 1
84	2002	84	Galium spurium 1
85	2002	84	Vicia sp. 1, Picea abies (needle) 2, Chenopodium album 1, indet. 1
86	2002	134	Hordeum vulgare 2, Cerealia 2, Chenopodium album 2, Picea abies (needle) 1
87	2002	135	Hordeum vulgare cf. var. vulgare 1, Cerealia frag. 4
88	2002	84	Hordeum vulgare var. vulgare 1, Galium spurium 1, Poaceae 1, Vicia sp. 1
89	2002	84	Galeopsis sp. 1, Persicaria lapathifolia 1, Chenopodium album 1, Picea abies (needle) 3
90	2002	129	Hordeum vulgare var. vulgare 1, Hordeum vulgare var. vulgare frag. 1, Carex distigmaticea 1, Cerealia frag. 1, Cannabis sativa 1
91	2002	84	Carex distigmaticea 6, silmu 3, Chenopodium album 2, Picea abies (needle) 5, stalk 6, Poaceae 2, Arrhenatherum elatius var. bulbosum 3, indet. 4
92	2002	84	Picea abies (needle) 62, Carex distigmaticea 1, stalk 1, indet. 1
93	2002	84	Arrhenatherum elatius var. bulbosum 5, Galeopsis sp. 1, Carex distigmaticea 14, Rubus idaeus 1, Chenopodium album 1, Picea abies (needle) 24, Poaceae 2
94	2002	115	Picea abies (needle) 7, cf. Hordeum vulgare 1, Galeopsis sp. 1, Galium spurium 1
95	2002	139	Hordeum vulgare frag. 1, cf. Cerealia frag. 1, Arrhenatherum elatius var. bulbosum 1, Chenopodium album 1, Ranunculus acris 1, Galeopsis sp. 1, Picea abies (needle) 3, cf. Apiaceae 1, Poaceae 2, Polygonum sp. 1
96	2002	140	Picea abies (needle) 3, Vicia sp. 1
97	2002	84	Ranunculus acris 1, Vicia sp. (2 mm) 1, Trifolium sp. 1, Picea abies (needle) 27, Picea abies 1
98	2002	84	Arrhenatherum elatius var. bulbosum 4, Claviceps purpurea 1, Carex distigmaticeae 4, stalk 2, Picea abies (needle) 22
99	2002	123	Rubus idaeus 1, Vicia sp. 1, Picea abies 43
100	2002	84	Hordeum vulgare var. vulgare 1, Picea abies (needle) 11
101	2002	115	Secale cereale 1, Carex distigmaticeae 1, Picea abies (needle) 4, Poaceae 2
102	2002	125	Spergula arvensis 1, Picea abies (needle) 32, Persicaria lapathifolia 1
103	2002	84/123	stalk 1, Cerealia frag. 1
104	2002	123	Hordeum vulgare 1, Hordeum vulgare frag. 1, Cerealia frag. 4, Galium spurium 1, Vicia sp. 2
105	2002	123	Spergula arvensis 1, Picea abies (needle) 1, Hordeum vulgare 1, Poaceae 2, Vicia sp. 6, Polygonum sp. 1, Chenopodium album 2
107	2002	84	Hordeum vulgare 1
108	2002	84	Rubus idaeus 1, Carex sp. Tristigmaticea 1, Chenopodium album 1, Galium spurium 1, Vicia sp. 1, Cerealia frag. 3, Carex sp. distigmaticeae 2, cf. Asteraceae 1
109	2002	84	Chenopodium album 1, Picea abies (needle) 1, Ranunculus acris 1, Carex sp. distigmaticeae 2, Carex sp. Tristigmaticeae 1, Stellaria media 1, Poaceae 1, Hordeum vulgare var. vulgare 1, Cerealia frag. 2
110	2002	84	Rubus idaeus 2, Rumex acetosa 1, Ranunculus acris 1
2	2003	210	Hordeum vulgare var. vulgare 2
3	2003	210	Hordeum vulgare var. vulgare 1
5	2003	210	Secale cereale 1, Arrhenatherum elatius var. Bulbosum 1, Polygonaceae 1
6	2003	210	Hordeum vulgare var. vulgare 1
7	2003	210	Hordeum vulgare 1, Galium spurium 1, Cerealia frag. 1
9	2003	209	Picea abies (needle) 1
10	2003	209	Picea abies (needle) 3
11	2003	209	Picea abies (needle) 4, indet. 1
12	2003	209	Picea abies (needle) 7, Carex sp. 1
13	2003	209	Picea abies (needle) 2
14	2003	209	Picea abies (needle) 2
15	2003	209	Picea abies (needle) 10
16	2003	209	Picea abies (needle) 1, Arrhenatherum elatius var. bulbosum 1

17	2003	209	Picea abies (needle) 8
18	2003	209	Picea abies (needle) 12
19	2003	209	Picea abies (needle) 4
20	2003	209	Picea abies (needle) 16
21	2003	209	Picea abies (needle) 11
22	2003	209	Picea abies (needle) 5, stalk 1
23	2003	209	Picea abies (needle) 33, Carex distigmaticeae 1
24	2003	209	Vicia sp. 2, stalk 2, Picea abies (needle) 10, Carex distigmaticea sp. 1, Cerealia 1, Poaceae 1
25	2003	209	Hordeum vulgare frag. 1, Picea abies (needle) 30
26	2003	209	Picea abies (needle) 3
27	2003	209	Cerealia frag. 3, Hordeum vulgare 1, Poaceae 1, Picea abies (needle) 19
28	2003	209	Picea abies (needle) 4
29	2003	209	Hordeum vulgare var. vulgare 1, Carex sp. tristigmaticea 1, Picea abies (needle) 32
31	2003	209	Picea abies (needle) 3, Arrhenatherum elatius var. bulbosum 3
32	2003	209	Secale cereale 1, Hordeum vulgare 1, Trifolium sp. 1, Cerealia frag. 2, Picea abies (needle) 22, Spergula arvensis 1
33	2003	209	Hordeum vulgare frag. 1, Picea abies (needle) 4
34	2003	209	Arrhenatherum elatius var. Bulbosum 1, Picea abies (needle) 5
35	2003	84	no identified charred remains
36	2003	84	Picea abies (needle) 9
37	2003	84	Hordeum vulgare 1, Picea abies (needle) 6
1	2005	214	Poaceae 1, Picea abies (needle) 1
2	2005	124	Viola arvensis/tricolor 1, Ranunculus acris 1, Picea abies (needle) 3
3	2005	23	Chenopodium album 1, Poaceae 1, Picea abies (needle) 1, Hordeum vulgare 2, Secale cereale frag. 1,stalk 1
4	2005	264	Hordeum vulgare var. vulgare 2, Carex sp. distigmaticea 2
5	2005	123	Fragaria vesca 1, Hordeum vulgare var. vulgare 1, Hordeum vulgare var. vulgare frag. 1, Cerealia frag. 2, Picea abies (needle) 14
6	2005	265	Rubus idaeus 1, stalk 5, Carex sp. Distigmaticea 1, Picea abies (needle) 32
7	2005	214	Rubus idaeus 1, Picea abies (needle) 1
8	2005	214	Picea abies (needle) 2
9	2005	214	Picea abies (needle) 1
10	2005	214	Picea abies (needle) 2
11	2005	123	Hordeum vulgare var. vulgare 1, Poaceae (voisi tunnistaa) 1, Picea abies (needle) 11
12	2005	264	Cerealia frag. 6, Chenopodium album 1, Linum usitatissimum 1, Hordeum vulgare (dated) 1
13	2005	125	Picea abies (needle) 14
14	2005	125	Picea abies (needle) 5, Rubus idaeus 1
15	2005	125	Picea abies (needle) 6
16	2005	84	Chenopodium album 1, Vicia sp. (2mm, halkesi) 1, Cerealia frag. 1, Carex sp. tristigmaticea 1
17	2005	123	Hordeum vulgare var. vulgare 2, Hordeum vulgare 5, Hordeum vulgare frag. 1, Avena sp. 1, Avena sp. frag. 1, Cerealia frag. 7, Bromus secalinus 1, Picea abies (needle) 1, stalk 1, Carex distigmaticea 1, Chenopodium album 2, Vicia sp. 1, Spergula arvensis 4,
18	2005	123	Hordeum vulgare var. vulgare 4, Hordeum vulgare 4 (1 dated), Hordeum vulgare frag. 5, Cerealia frag. 3, Bromus secalinus 1, Poaceae 1, Picea abies (needle) 6, Fragaria vesca 1, Carex sp. tristigmaticea 1, stalk 1
19	2005	123	Carex distigmaticea 1, Persicaria lapathifolia 1, stalk 1, Chenopodium album 1, Hordeum vulgare var. vulgare 3, Hordeum vulgare var. vulgare frag. 1, Hordeum vulgare 1, Hordeum vulgare frag. 1, Cerealia frag. 1, Picea abies (needle) 3, Poaceae 1
20	2005	123	Picea abies (needle) 18
21	2005	123	Picea abies (needle) 1
22	2005	23	Hordeum vulgare var. nudum 1, Cerealia frag. 1
23	2005	23/264	Chenopodium album 1, Cerealia frag. 1, Vicia sp. 1, Poaceae 1, Polygonum aviculare 1
24	2005	264	Picea abies (needle) 1, Cerealia frag. 1
28	2005	261	Rubus idaeus 1, Picea abies (needle) 1, Hordeum vulgare var. vulgare 1, Bromus secalinus frag. 1
29	2005	23	cf. Hordeum vulgare frag. 1, Cerealia frag. 1, Picea abies (needle) 1
30	2005	23	Bromus secalinus frag. 2, cf. Hordeum vulgare frag. 2, Stellaria media 1
32	2005	23	Spergula arvensis 1, Arctostaphylos uva-ursi 1, Vicia sp. 1, Picea abies (needle) 4, cf. Hordeum vulgare frag. 1
33	2005	269	cf. Hordeum vulgare frag. 1
1	2006		Secale cereale frag. 1, Cerealia frag. 1

2	2006	281	Secale cereale 1, Picea abies (needle) 2
3	2006	282	Hordeum vulgare 1, Cerealia frag. 2, Claviceps purpurea 1, Avena sp. frag. 1, Chenopodium album 1
4	2006	264	cf. Hordeum vulgare frag. 1, Cerealia frag. 2, Vicia sp. 1, Picea abies (needle) 1, Poaceae 1, Trifolium sp. 1
5	2006	23	Avena sp. frag. 4, Cerealia frag. 1, Claviceps purpurea 1
6	2006	264	Vicia sp. 1, Hordeum vulgare (dated) 1
7	2006	282	Cerealia frag. 1
9	2006	264	Ranunculus sp. 1, Picea abies (needle) 1
10	2006	264	Spergula arvensis 1, Viola arvensis/tricolor 1, Carex sp. tristigmaticea 2, Chenopodium album 3, Picea abies (needle) 1, Cerealia frag. 16, Hordeum vulgare 1, Poaceae 1
11	2006	264	Juniperus communis 1, Ranunculus acris 1, Vicia sp. 3, Secale cereale 1, Hordeum vulgare var. nudum 1, Hordeum vulgare frag. 2, Cerealia frag. 4
12	2006	264?	Vicia sp. 2, Hordeum vulgare frag. 1, Cerealia frag. 2, Ranunculus acris 1, Poaceae 1, Galium sp. 1
13	2006	264	Picea abies (needle) 6
14	2006	264	Picea abies (needle) 4, Carex sp. Distigmaticea 1
15	2006	264	Picea abies (needle) 6, Carex sp. Distigmaticea 1
16	2006	269	Arrhenatherum elatius var. bulbosum 1, Carex sp. Distigmaticea 1, Picea abies (needle) 4
17	2006	269	Chenopodium album 2, cf. Apiaceae 1
18	2006	282	Hordeum vulgare var. vulgare 1, Avena sp. 4, Avena sp. Frag. 4, cf. Avena sp. frag. 3, Cerealia frag. 2, Fallopia convolvulus 1, Rumex acetosella 1
19	2006		Carex sp. tristigmaticea 1, Carex sp. distigmaticea 1, Picea abies (needle) 4, Cerealia frag. 6, Poaceae 1, Chenopodium album 1, Ranunculus acris 1
20	2006	269	Hordeum vulgare var. vulgare 1, Fragaria vesca 1, Carex sp. Distigmaticea 2, Picea abies (needle) 26
21	2006	269	Vicia sp. 1, stalk 2, Cerealia frag. 1, Carex sp. distigmaticea 1, Picea abies (needle) 9
22	2006	269	Vicia sp. 1, Carex sp. distigmaticea 1, Picea abies (needle) 28,
23	2006	23	Cerealia frag. 5, Chenopodium album 1, Poaceae 1
24	2006	23	Secale cereale 1, Secale cereale frag. 1, Hordeum vulgare 2, Hordeum vulgare frag. 2, Cerealia frag. 3, Bromus sp. frag. 1, Vicia sp. 1
25	2006	23	Chenopodium album 3, Galium spurium 1, Hordeum vulgare 3 (1 dated), Cerealia frag. 7, Persicaria foliosa 1, Vicia sp. 2, Poaceae 1, Chenopodium polyspermum 1
26	2006	23	Cerealia frag. 3, Bromus secalinus frag. 1, Vicia sp. 3
27	2006	269	Picea abies (needle) 12, Carex sp. distigmaticea 1
28	2006	23	Hordeum vulgare (dated) 1, Picea abies (needle) 14
29	2006	23	Hordeum vulgare 1, Picea abies (needle) 15
30	2006	23	Triticum aestivum s.l. (3,1x1,8 mm, L/B 1,72) 1, Picea abies (needle) 4
31	2006	269	Picea abies (needle) 23
32	2006	23	Picea abies (needle) 58, Cerealia frag. 1
33	2006	23	Arctostaphylos uva-ursi 1, Cerealia frag. 2, Cyperaceae 1, Picea abies (needle) 25
34	2006	269	cf. Arctostaphylos uva-ursi (leaf) 1, Picea abies (needle) 13, Vicia sp. (2mm) 1
35	2006	269	Hordeum vulgare var. nudum 1, indet. 3, Picea abies (needle) 27
36	2006	264	Persicaria lapathifolia 1, Cerealia 2
37	2006	264	Avena sp. frag. 1, Triticum aestivum s.l. frag. 1
38	2006	264	Chenopodium album 1, Poaceae 1
39	2006		Prunella vulgaris 1, Chenopodium album 2
40	2006	264	no identified charred remains
41	2006	264	Vicia sp. 1, Chenopodium album 1, Cerealia frag. 1, Picea abies (needle) 3
43	2006		Avena sp. 1, Cerealia frag. 1
44	2006	23	Spergula arvensis 1
45	2006	23	Hordeum vulgare (1 dated) 3, Chenopodium album 3, Cerealia frag. 2, Triticum aestivum s.l. (2,6x1,9mm, L/B 1,37)
46	2006	23	Cerealia frag. 1, Picea abies (needle) 6
47	2006	23	Hordeum vulgare 1, Hordeum vulgare frag. 1, Cerealia frag. 2, Vicia sp. 1, Carex sp. Tristigmaticea 1, Picea abies (needle) 1, Chenopodium polyspermum 1
48	2006	264	Hordeum vulgare 1, Cerealia frag. 1, Picea abies (needle) 1
49	2006	264	Cerealia 1, Picea abies (needle) 1
50	2006	264	Picea abies (needle) 18