Production and Consumption at the Hillfort site of Mont Dardon, France: An Archeobotanical Analysis

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ABSTRACT

**AMANDA TICKNER: Consumption and Production at the Hillfort Site of Mont Dardon: An Archeobotanical Analysis
(under the direction of C.M. Scarry)**

There have been few archeobotanical studies conducted in the region of Burgundy, France and few archeobotanical studies from hillforts in Europe. This dissertation presents an analysis of archeobotanical remains from a hillfort site, Mont Dardon, located in Burgundy, France (the commune of Uxeau). The analysis was conducted on materials from the earliest Hallstatt period, the beginning of the La Tène 1 and and the final La Tène periods of the Iron Age. Producer/consumer models, as well as those of labor and tribute are discussed in relationship to the data. Cultural continuity is indicated in the data via the lack of processing remains from all time periods, and this point is then related to the models of production and consumption. Changes in response to shifts in climate are also identified in this analysis, via weed seeds and shifts in crops grown.

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INTRODUCTION

Mont Dardon in the Arroux river valley of Burgundy has been a significant place for ritual and defensive purposes for over 2000 years-- from the Bronze Age continuing into the present. Five years of excavations (1975-1979) at Mont Dardon revealed evidence for habitation activities spanning the Iron Age, from the Hallstatt period through the early medieval period (radio carbon dates indicate a range of occupation/activity from ca. 1200 BC to AD 1400;Green, et al. 1987). In the course of the excavation archeobotanical samples were taken and these samples provide that data I discuss in this dissertation.

Very few sites in the Burgundy region have had systematic archeobotanical analyses applied. Furthermore, excavations of hillfort sites across Europe have not generally been extensive (Ralston 2006). Hence research in these areas is of some significance and will serve as an enduring dataset for others to use in the future.

Theoretical orientation

The theoretical orientation that guides my research is historical ecology. Historical ecologists use all relevant data available to address the changing relationships between humans and their biome through time (Crumley 1994, 2007). The work of historical ecology is, then, inherently interdisciplinary (Balee 1998, 2006;Crumley 1994, 2007). Historical ecology rejects explanations of human behavior based on adaptation alone (Balee 1998, 2006). Instead of an adaptationist approach, historical ecology takes a mutual transformation perspective on human and environment relationships (Balee 1998, 2006;Crumley 1994, 2007). This approach allows a non-deterministic understanding of human-environment relations and a view that defies the traditional “nature/culture” dichotomy. The dissolution of the nature/culture dichotomy may appear to some to be circular and irresolvable (Ellen 1996), however, it is possible to resolve this opposition rather tangibly, in the form of landscapes.

Landscapes are the major concern of historical ecology (Balee 2000;Crumley 1994, 2007).   Landscapes represent the intersection of the biosphere and human activity materially and can be studied as a tangible result of the human culture/biome relationship; “The landscape is where people and the environment can be seen as a totality— that is, as a multiscalar, diachronic, and holistic unit of study and analysis” (Balee 2006 p. 2). In spite of its focus on landscapes, historical ecology’s approach to landscapes differs from that of landscape ecology, due to the explicit inclusion of human activities/agency and from that of human geography, due to the insistence on the need for a long term perspective (this approach bears some similarities to the annales school of history, with its long duree;Braudel 1980;Balee 1998, 2006).

In the case of this work, historical ecology will not serve as a hypothesis to be tested or as an explanation for the patterns within the data in and of itself. Rather it will provide a useful framework that informs my outlook on the data and its setting. This can be viewed as “cosmological approach” or a “lens” whereby the theoretical perspective provides a set of understandings rather than an explicit set of principals to be proven or operationalized. The reason it is important to point out that this is the perspective taken is that in some instances in this archeobotanical analysis either the environment or culture could be seen as determining agrarian practice exclusively. It is important to disavow determinism; historical ecology is powerful because it does so by encompassing both biological and cultural influences in a synergistic, dynamic fashion.

Additionally this analysis complements historical ecology in its subject matter and methods. “Each major environment of the earth has a unique and often complex human history embedded in the local and regional landscape. Understanding the human role in the creation and maintenance of this uniqueness is a central goal of historical ecology.“ (Balee 2006 pg. 6). This dissertation contributes to this understanding of the unique Burgundian agrarian past and thus is connected to the goals of historical ecology.

Summary of Chapters

The first three chapters provide background information relevant to the dataset. Chapter 1 is a general chapter that summarizes both palynological data and archeobotanical data from across Europe. These descriptions provide general patterns of land use and crops cultivated across Europe during the period of Dardon’s occupation. Also, the studies summarized show patterns that can be compared to the archeobotanical remains found at Mont Dardon.

Chapter 2 provides regional archeological background and a summary of the excavations at Dardon. This information is important for contextualizing and understanding the source of the samples.

Chapter 3 gives basic environmental information on the landscape surrounding Dardon. Information on climate, soils, and flora will further contextualize the dataset and will give a basis for discussion of the agrarian landscape as it relates to the crops and weeds represented in the samples.

An analysis of the samples is presented in Chapter 4. Summaries of methods, species found and their changes over time, patterns of consumption/production based on common models, speculation regarding agrarian practices of seasonal planting and maslins, as well as environmental influences on agrarian practice will all be discussed in the course of this chapter.

The conclusion considers potential for future research using this dataset, including further site-oriented questions and well as regional comparisons based on excavations and analysis that have not yet been completed.

CHAPTER 1
EUROPEAN PALYNOLOGICAL AND ARCHEOBOTANICAL STUDIES

Introduction

This chapter provides a background survey of pre-historic/historic agrarian land use and arable agricultural practices in Europe based on archeobotanical studies. Palynological and macrobotanical studies are summarized to provide an overview of trends and patterns in agriculture from the Iron Age through the medieval period for Britain, France and Northern Europe (Germany and countries in proximity to Germany).

Before presenting summaries and discussions of archeobotanical studies, I will give a brief summary of important trends and a chronology for the period under consideration. This discussion of chronology and setting is brief, but provides some context for the archeobotanical discussion.

I summarize several palynological studies that illustrate general patterns of land clearance and land use from each of the regions under consideration (Britain, France and Northern Europe) during the Iron Age and Roman periods. The general pattern I have noted in these studies is the expansion of land clearance during the Iron Age and either contraction or continuation during the Roman period. These studies show the trends in specific regions, and with a high level of detail. This means that they can illustrate patterns, but not necessarily prove that they existed everywhere and under every circumstance; a general pattern may exist but it is often superseded by regional variation. Because the area under consideration in this chapter is so large, small-scale variation cannot be considered in full. Rather, a few examples will serve to show possible trends.

Macrobotanical studies will provide more detailed evidence for species used and trends over time based on information from archeological contexts. In the macrobotanical section I will discuss the nature of macrobotanical evidence, by presenting information on crop remains, processing remains, and weed seeds. Following this, I will summarize macrobotanical studies in order to identify trends and patterns in the species used in arable agricultural activities. The studies I summarize in the macrobotanical section represent the geographic regions and the time periods of the Iron Age through the Medieval Period. Studies were chosen to cover the entire period, and to give examples of both "compilation" studies where multiple sites are considered and compared, and studies of single, particular sites. Different geographic regions have different numbers of available studies and the need for full coverage of the long time period under consideration influenced selection of studies summarized.

After observing trends in land use and arable agriculture found in the palynological and macrobotanical studies, I will conclude with a predictive section stating the possible contents of the macrobotanical remains found at Mont Dardon based on the trends I have highlighted from the studies discussed. This section provides a basis for looking for patterns related to wider European practice in the data from Mont Dardon.

Archeobotany also includes the methodology of phytolith analysis. Phytoliths are microscopic silica or calcium bodies found in the structural cells of plants. These phytoliths are collected from soil samples in which the soil is chemically dissolved and analyzed under a high power microscope. Phytolith studies are relatively new compared to palynology and macrobotanical studies and unfortunately the systematics for identifying phytoliths and issues of taphonomy have not yet been achieved in a fully complete and functional fashion (Piperno 2006). In Europe, this task of establishing systematics is especially difficult as the majority of cultivated plants come from the same botanical family, *Poaceae*, and thus produce very similar and somewhat indistinct phytoliths (Piperno 2006). This makes phytolith analysis somewhat more difficult than in the tropics, where commonly cultivated species produce more distinct phytoliths. In addition, preservation conditions in the tropics make phytolith analysis a more attractive method for agrarian practice reconstruction (Piperno 2006). This is not to say that phytolith studies do not exist in Europe, but that they are somewhat limited in their scope and are generally in methodological infancy, so to speak. To find phytolith studies across the time period and geographic range under consideration here is currently impossible and they will not be considered here.

Chronology and context: A brief summary of 2,000 years of European pre/history

Table 1 summarizes periods for several regions and provides background for the contextual discussion of European prehistory.

The Iron Age is the last truly "prehistoric" period of Europe, as the following period, the Gallo-Roman (Roman) has abundant classical references providing the written component. "Celtic" and Iron Age are often synonymous terms when referring to the culture of Iron Age Europe. Oftentimes the designation "Celtic" is based on contemporary linguistic affiliation, which places the range across Ireland, Britain, and Brittany only. However, in the context of the discipline of archeology the designation is based on archeological evidence, which widens the geographic range across which “Celtic” can be applied to central Europe, Iberia, Britain and Ireland.

Table 1: Summary of European chronology

		Dardon Area C	*Central and Northern France*	*Central Europe*	*Britain*	*Southern and Central Germany*
1400						
1300	Late MA				Medieval	Luxembourg
1200						Hohenstaufen
1100	High MA		Capetian	Holy Roman Empire 962-1806	Norman	Salian
1000						Ottonian
900						
800			Carolingian	Carolingian	Anglo-Saxon	Carolingian
700	Early Middle Ages					
600						
500		Zone 4	Merovingian	Merovingian	Saxon	Merovingian
400						
300						Migration
200			Roman	Roman	Roman	
100	Roman					Roman
0			Roman Conquest	D3	Late Iron Age	La Téne D3/Roman
100			Final La Téne	D2 La Téne D1		La Téne D2 La Téne D1
200		Zone 3	Middle La Téne	La Téne C2 La Téne C1	Middle Iron Age	La Téne C2 La Téne C1
300	La Téne		III II	La Téne B2		La Téne B2 La Téne B1
400			Early La Téne I	La Téne B1 La Téne A		La Téne A
500		Zone 2	Hallstatt II b Hallstatt IIa	D3 D2	Early Iron Age	Hallstatt D1-D3
600	Hallstatt			Hallstatt D1	Early Iron Age/Llyn Fawr	
700			Hallstatt 1	Hallstatt C	Ewart Park/Carps Tongue	Hallstatt C1-C2
800				B3	Ewart Park/Blackmore	
900		Zone 1		B2	Wilburton	Urnfeld: Hallstatt B
1000	Urnfeld period (Late Bronze Age)		Bronze Age	Hallstatt B1	Penard II	
1100				A2		Urnfeld: Hallstatt A
1200				Hallstatt A1	Penard I	
1300				Bronze D		Bronze Age

Many authors, such as Barry Cunliffe (1999;2005), John Collis (2003), Miranda Greene (1995), and Simon James (2005) have provided excellent detailed summaries for these time periods.

Prior to the Iron Age, the Neolithic, in which agriculture truly developed and the subsequent Bronze Age, in which metal working and political organization expanded, set the stage for the Iron Age and represented, in some ways, more radical transformations of culture than the Iron Age period. The Iron Age is predominantly characterized by development of new metal working techniques, specifically (and rather obviously, given its name) the creation of iron implements. This new innovation allowed for some expansion of arable agrarian activity and some expanded social differentiation and political organization.

The Iron Age is typically divided into two time periods, the Hallstatt and the La Tène. The exact dates on these time periods vary across the continent and within Britain (see the “comparison of chronologies” figure for precise dates).

The Hallstatt period is named after the salt mining village site of Hallstatt, located in Austria. Generally, with some regional variation, this period covers approximately 800-500 BC High status graves associated with hilltop settlements frequently characterize the late Hallstatt period in central Europe. A famous example of a Hallstatt grave site is found at the site of Vix, located in France (excavated by R. Joffroy in 1953) and this grave in some ways typifies the burial pattern of the period (if a bit dramatically). The excavation at Vix revealed an enormous bronze krater standing 1.64 meters high, the largest krater that has been found from this time period. There was also a finely wrought bronze vessel used for wine mixing of a size probably indicating it was used in feasting activities. Mediterranean imports were also present in the burial. More typical of the Hallstatt burial type was the ornate wagon on which the Vix princess was placed. Hallstatt burials typically contain horse related items, including wagons, wagon wheels, and horse tackle (bits, bridles, etc.). These burials also indicate a possible “princely class” (although it is worth noting that settlement patterns do not necessarily reflect this elite group).

The La Tène period is named after the lakeside site of La Tène, located in Switzerland, excavated in 1857. La Tène is also the name of the swirling art style that commonly features animal and plant themes that characterizes the period. Generally this period extends from the end of the Hallstatt (approximately 450 BC) to the Roman period (which begins at different times throughout Europe, but generally in the first century BC). Some scholars place the division between Hallstatt and La Tène somewhat earlier, at 650 BC There is no distinctive break (in the form of a new technology, for example, as is the case between the Bronze and Iron Ages) between the Hallstatt and La Tène periods, and hence the exact termination of one and the beginning of the other can be somewhat contentious. It is during the La Tène that hillfort use reappears and these sites are often referred to as oppida. Oppida (a name first given by Cesar) are large fortified settlements and are essentially large hillforts.   All oppida are fortified in some way, usually over 200 acres large and housed at least several hundred people (Cunliffe 1997;Wells 1984). The size and density of populations is a new development in the late La Tène period, nothing similar had existed previously.   Trading with the Mediterranean region also expands during this time period.

By 100 AD all territories in consideration in this chapter, Britain, France and portions of Germany/Northern Europe (with the exception of the north above the Rhine) were under Roman influence and rule, with the Gaulish (French) territories having been brought thoroughly into the fold by 0 AD The Roman period is characterized by the spread of

Roman culture, termed “Romanization.” The concept of Romanization implies that the Romans essentially transformed native Celts into “Proto-Romans.” Without getting into too much detail, this concept is now frequently considered to be somewhat simplistic. This is not to say that the Romans didn’t influence their territories, but there was considerable native involvement in the response to Roman culture and Roman rule. The Roman strategy readily used and integrated indigenous elites into the maintenance of empire. For example, for the first half of Cesar’s conquests in Gaul (modern France) during the last century BC, the Aedui polity was initially a Roman ally, but they changed their position by the end of the campaign. This willing affiliation of the Aedui with Cesar serves to illustrate that some Gaulish elites were attempting to take advantage of the Roman conquest. In addition to political agency, indigenous cultural agency was being exhibited as well. One example (relatively local to Mont Dardon) of indigenous culture persistence was that the inhabitants of Augustadunum continued to use indigenous ceramic styles for some time after their move to the city rather than assimilating Roman styles (Bon 1999). Also, there is considerable “hybridity” in religious iconography, with mixtures of Roman and Celtic gods occurring (Cunliffe 1997). None of this underestimates the influence of the Romans, however. The Roman armies alone had significant impacts on economic activity, as they would have needed provisioning and would have presumably influenced local production (Wells 1984).

Oppida/hillforts during the Roman period were generally abandoned in favor of Roman built/organized cities. For example, in the case of Bibracte, an oppida located in the Morvan mountains of France, the Romans encouraged (somewhat forcibly) the relocation of its inhabitants to Augustadunum (now the city of Autun) which was a Roman ruled town (Cunliffe 1997;Bon 1999). Roman towns were characterized by gridded streets and generally had sanitation infrastructure, temples, bath houses and other amenities associated with Mediterranean culture (Wells 1984;Burnham 1995). In addition to Roman cities, villas were important to the process of Romanization. Villas were large household compounds built in a similar fashion to one another, generally rectangular buildings with courtyards, mosaics, and under floor heating. These villas may have been important agrarian economic centers of production, elite status symbols, or both (Wells 1984;Burnham 1995).

The period of 250-700 AD was a tumultuous period within Europe. At time of the fall of the Roman Empire, there were Germanic migrations southward, subsequent warfare, and an expansion of Christianity. The Roman frontier was essentially abandoned in 260 AD and following that local Roman representatives struggled to maintain their elite political status without the support of Rome. In most cases, Roman influence collapsed under the advancing Northern migrations, Rome's internal problems and possibly a change in European climate. Rome was sacked in 410 by the Visigoths, led by war leader/king Alaric, after many years of raiding in Italy. The sacking of Rome is not significant in and of itself; Rome persisted after its sacking. But the sacking was emblematic of the large extent of raids and migrations taking place at the time. The sacking of Rome generally marks the end of the Roman period and the beginning of the Medieval period in most chronologies.

The Medieval period is generally divided into designations ofEarly, High or Middle, and Late and further subdivided by royal dynastic designations. During the Early Medieval period the infrastructure (and in general, urbanism) of the Roman period fell away due to the lack of an organized tax base and government to support it. The rule of the time was "feudal" (this term is in quotes because it is somewhat problematic, but for this general summary, sufficient). In a feudal governed society, lineages of charismatic/inherited leaders (lords, kings, bishops etc.) exchanged land for tribute (usually in the form of agrarian products) from vassals. This arrangement emphasized agrarian production, and as such the economy did not much diversify (i.e. become mercantile) until the very Late Medieval period. In spite of the decrease in centralized infrastructure, the Medieval period is highly notable for the expansion of agrarian technology. Examples of these improvements include: heavier wheeled plows, nailed iron horse shoes, an increase in water mills for grinding grain, saw and cloth-fulling mills, rotation field systems (as opposed to their scattered and less certain presence in earlier periods), and artesian wells. The expansion of technological innovation is somewhat in contrast to the Roman period. During the Roman period the majority of technological improvement was in the form of improved distribution and centralized infrastructure (such as aqueducts and roads) as opposed to farming technologies. This is in part perhaps because the Roman's use of slaves mitigated the need for improved productivity.

In general, my discussion will not parse out specific phases within the Iron Age or Gallo-Roman periods (due to their variation across the wide ranging regions under consideration) but will be more generalized (i.e. discussions will fall under the headings of "Iron Age" and "Gallo-Roman") with specific examples, such as evidence from sites, being ascribed specific dates or date ranges. This emphasis on specific dates rather than a concern for specific classification within chronologies follows the majority of archeobotanical and other authors. The majority of archeobotanical studies treat the time periods very generally using designations of "Late" or "Early" rather than more specific definitions. Peter Fowler's approach to agrarian activity sums up this approach, as he states: "My aim is to try to look at agrarian history, consciously seeking neutrality in terms of periodisation and cultural ascription" (2002 pxii). The time periods designated in the Mont Dardon excavation themselves are unique so this attitude makes even more sense in the context of my study.

Palynological studies from the Iron Age and Gallo-Roman Periods

In the earliest period of European agriculture, the Neolithic, it is assumed that the implements available would make working heavy soils prohibitively difficult. But by the Iron Age it is assumed that most arable land could potentially be in use and frequently was, given the effectiveness of iron plows. Certain land types, such as swamps and poor soils were likely not targets of cultivation, but much of the rest of the landscape was certainly valued and used. Rates and changes in proportions of pollen reflecting worked land versus forest can serve as evidence for changes in the intensity of farming activity. The general pattern (with significant regional variation) is that of slowly expanding land clearance from the Neolithic through the Bronze Age with rapid expansion during the Iron Age and maintenance of that expanded clearance during the Roman Period. After the Roman period in the early Dark Ages there is typically a decline in cleared land or persistence of clearance, with maintenance of land use continuing to the extent of the present day.

Evidence for land clearance (and to a lesser extent, use) is most effectively provided by palynology. Palynological data can provide an overview of regional landscape composition and indicate changes in overall land cover. Palynology is in some ways more useful than macro-remains in landscape modeling as it can provide a larger range of aggregate information. Macro-botanical data are more targeted and site specific (which itself can be a useful factor in landscape reconstruction, see Ponel and Matterne (2000) for discussion). Due to the long-range travel of much pollen, pollen can provide a wider ranging and more aggregating source of information suited to discussing land clearance. Typically land clearance events are spotted by looking at the proportions of grass to tree pollen and shifts thereof that show changes in forest to open land proportions. While pollen can provide evidence for land clearance that points to agrarian activity, it does not necessarily point to the nature of that agrarian activity. Some forest removal was for arable (usually cereal) agriculture and some was for pasture and the two co-varied over time. It is difficult with current methodologies in palynology to characterize agrarian activity in a region based solely on pollen; however, evidence such as increases in cereal pollen and pollen from common pasture species such as heather may point to arable versus pastoral agrarian activity.

Having discussed the general nature of palynological data, I will now turn to summaries of palynological studies that illustrate the general trend of the expansion of land clearance during the Iron Age and either contraction or continuation during the Roman period, bearing in mind there are always exceptions to these trends and regional variation cannot be fully encompassed in such a broad geographic survey.

Palynological studies from Britain

An example of a palynology study not directly associated with specific archeological sites but demonstrating regional variation and patterns in land use during the Iron Age and Romano-British periods is the study of 3 pollen cores near the Anotonine Wall, in Scotland, by Lisa Bumayne-Peaty (1998). Her study of column samples taken from 3 mires/bogs (Letham Moss, Stirlingshire, Blairbech Bog, Dumbartonshire and Fannyside Muir, Cumbernauld) shows patterns of clearance in the region. Throughout the Neolithic and Bronze Ages there is evidence for modest clearance which Bumayne-Peaty says is typical in comparison with other Scottish studies. However, the pollen remains show substantial landscape clearance during the Iron Age, with a marked decrease in tree pollen and a rise in pollen from trees that prefer a more open landscape. At the Letham Moss and Blairbech Bog sites tree pollen decreased in the early Iron Age (radio-carbon dates place the change at 200 and 225 BC, respectively). At Fannyside Muir the expansion in land clearance occurred in the late Iron Age (385 BC). Clearance during the Iron Age (especially in the case of Blairbech Bog, where there is an oppida 8 km to the south) may be related to expanded settlement in the region during the Iron Age. Activity during the Romano-British period indicated by pollen remains shows some variation, with two sites showing continuity or modest expansion of clearance, and one site (Blairbech Bog) showing reforestation. At Letham Moss, preexisting clearance continued with some increases in cereal pollen during the first part of the Roman occupation (which began in the region 79 AD) until Roman abandonment about 300 AD. Fannyside Muir shows a similar pattern. Blairbech Bog shows forest regeneration, and hence agricultural abandonment. Bumayne-Peaty speculates that this is due to regional populations abandoning the region in advance of the Roman front. She states that soil exhaustion does not seem to be a factor in the decline or maintenance of agricultural activity across the region. During post Roman times, beginning approximately 400 AD with the abandonment of the Roman built Antonine wall, there was forest regeneration, which continued until monastic times.

Another study of the Peak District (Northern England) conducted by Deborah J. Long also shows strong evidence for an expansion of land clearance in the Iron Age (1998). In contrast with the Bumayne-Peaty study, the pollen sources for this study are closely associated with a farmstead site and its associated field boundaries. The palynological remains used for this study have a chronology that begins at 2000 BC and ranges through the 1st millennium BC. At 2000 BC there is the beginnings of evidence for arable activity within the pollen core in the form of expanded grass species pollen. A major arboreal decline began at the radiocarbon-dated period of 373 BC (the La Tène period). The open environment persists subsequent to this period. Evidence for human activity extends through the 1st millennium BC. However, evidence for the expansion of arable agriculture does not continue through the arboreal decline beginning at 373 BC. This may be due to the fact that clearance could be associated with pastures; however, there is little heath or other pollen associated with pastures in the cores to provide evidence for pastures. Long proposes that the reason for the decline in both evidence for human activity and forests is actually the abandonment of field systems and associated forest management or possibly climate change (specifically increased wetness and lower temperatures associated with the period just prior to the arboreal decline).

Sylvia Pelgar discusses land use around and in the town of Diss, in Norfolk Co. eastern England for a period of 7,000 years based on 95 pollen samples taken from cores pulled from the lake of Diss Mere, which the town of Diss borders (1993). The lake serves as a highly localized catchment of pollen and it is assumed that pollen found in the cores reflects pollen transported into the lake by local water runoff. During the Neolithic and Bronze Age there was some forest clearance associated with early agriculture, however, the town itself had not yet formed. *Tilia* sp. (lime) and *Ulmus* sp. (elm) declines were recorded during these periods. *Ilex aquifolium* (English holly) pollen also expands in the late Bronze Age, which may indicate expanded local grazing, as this tree species is grazing resistant. Ruderals also expand their presence in the Bronze Age, and *Hordeum* sp. (barley) pollen also spikes and reaches a peak in the sequence. However, the largest indicated land clearance is associated with the early Iron Age, and it is during this period Pelgar characterizes the land clearance as “complete” (p. 47). The cleared land never returns to full forestation following the early Iron Age and clearance is seen to have been maintained. Grassland taxa pollen expands its presence, indicating wet pastures. The early Iron Age clearance is connected with “changes in technology” (pg 1) according to Pelgar (though she doesn’t really elaborate on this hypothesis). Cereal pollen does not expand in conjunction with the decrease in forest related pollen and thus the author states that the Iron Age/Roman clearance is at least initially connected to expanded pastoral activity rather than arable agriculture. During the later Roman period and early Medieval period, certain forest types (pine and beech) show modest expansion. Pollen richness overall is very high, indicating a very diverse landscape. Charcoal also expands in the column, indicating strong human activity. There is also an increase in sand in the column, perhaps indicating stronger erosion surrounding the lake. Pollen of *Seacle* sp. (rye) expands during the late Roman/early Medieval period and the expansion of ruderals associated with arable agriculture (such as *Plantago lanceolata*) indicates that there may be a conversion of pastures to arable agriculture. In the later medieval period, pollen from weeds associated with fallow fields expands, perhaps indicating new field rotation practices. Also in the later medieval period pollen from *Rosaceae* family is more present than in other periods, which may indicate hedgerow development.

Palynological studies from France

The paleoenvironmental study of the Carquefou site in the Massif Amorican, France (near the city of Nantes, on a tributary of the Loire) conducted by Anne-Laure Cyprien and Lionel Visset (2001) shows patterns of land clearance from the Bronze Age (2028 BC) to the Middle Ages (1181 AD). Palynological samples were taken from both the small La Tène site of “Le Clouet” and nearby (within 50 m) bogs. Their samples show the very consistent presence of *Alnus* sp. (alder) pollen, which is probably due to the damp conditions of the site favoring the species. Though at times the *Alnus* sp. pollen disappears from the record and is replaced with water species pollen, and it is proposed that at those times the water level surrounding the site and within the bog rose, which is the case at the beginning of the sequence and at its end. The stand of alder was also significantly reduced during the beginning of the Iron Age when the settlement was active, and was cleared to make way for pasture and hemp cultivation (given the expansion of meadow plants in general and hemp pollen associated with the site- but not the bog- samples). During the Gallo-Roman period pollen shows continuation of clearance, with the appearance of *Calluna* sp. (heather) pollen, which is a species that shows up in developed meadow vegetation, in conjunction with the continued presence of cereal pollen. At the end of the Gallo-Roman period there is evidence for desertion of the land, as tree pollen expands. After a period of abandonment, at the beginning of the early Middle Ages there is a renewal of agrarian activity, with the return of meadow and cereal pollen.

A study of a bog in close proximity to the Carquefou site study is the Longné study, conduced by Delphine Barbler and Lionel Visset (1997). This study cored a variety of spots within the 120-hectare bog of Logné in the mountains of the Massif-Americon in Western France. The results of this study parallel those of the Carquefou site. The chronology of the core covers the Neolithic through the Gallo-Roman period. Evidence for human activity during the Neolithic was quite limited. During the Bronze Age, cereal pollen and the pollen of ruderals appear in the column. Alder pollen also decreases in this period, to be replaced by trees preferring a more open environment (such as willows). During the beginning of the Iron Age, there is some evidence for woodland regeneration, in the form of a rebound in prominence of alder. During the later Iron Age clearance continued, and during the Gallo-Roman period there was a sharp drop in alder and an expansion of weed species of open environments. By the Middle Ages, heather communities appear to have developed, which is a sign of open environment communities of long duration (perhaps related to pastures used over a long period).

Another study from France (which includes geoarcheological analysis) is the article "Multi-disciplinary approach to changes in agro-pastoral activities since the Sub-Boreal in the surroundings of "narse d'Espinasse" (within the French Massif Central) authored by Y. Miras et al. (2004). This marshland is located in central France, in the Auvergne region near the town of Randanne. The pollen for this study came from a marsh not specifically associated with a particular archeological site. The study demonstrates a long chronology of land use in the region, beginning with the Neolithic and leaving off with the High Middle Ages (16th century). Neolithic sites are rare within the region, and in fact extensive human activity is only documented beginning in the Gallo-Roman period for the vicinity. The first serious indication of major land clearance comes from the period of transition from the Neolithic to the Bronze Age (2000 BC). Prior to that, cereal pollen was present, however, in spite of an increase in sedge community pollen, the authors of the study stress that the majority of this pollen can be explained by typical succession activity, rather than by anthropogenic related land clearance. The geomorphology component of the study also shows a spike in "erosive events" at the beginning of the Bronze Age. The first major forest clearance of the region (marked by a major shift in the ratio of tree to field species pollen) occurred in the early La Tène. From the La Tène onwards there is no indication that there were any significant reforestation events; agricultural activity and open spaces were maintained. During the time of the La Tène to Gallo-Roman transition there was a marked decrease in fir pollen (fir is an excellent building material) and geomorphology indicates the potential for burning as a "land improvement" strategy. The only possible significant decline in agriculture was indicated for the time period of the late Dark Ages (800-900 AD) as shown by a decrease in cereal pollen and erosive activities.

A landscape reconstruction study with a different methodology from palynology is the study by Phillipe Ponel et al.. entitled "La Tène and Gallo-Roman Natural Environments and Human Impact at the Touffrèville Rural Stettlement, Reconstructed from Coleoptera and Plant Macroremians (Calvados, France)" (2000). This is the first study in France to combine analysis of water-logged macro-remains with the remains of insects (namely beetles from the coleoptera order) in order to find signals of human activity. This is a more localized study than pollen studies typically are, because macro-plant remains and insects do not have the geographic range of most pollen. The study samples come from an archeological site, the Touffréville site situated in a valley with varying soil fertility within the Department of Calvados, Northern France. The site covers the late Hallstatt period to the 3rd century AD, with several Iron Age enclosures and a Gallo-Roman farm. There is evidence from the Gallo-Roman (1st century AD) period for several commercial kilns at the site. During the 3rd century, occupation at the site became much more minimal. The activity at the site is reflected in the ecological remains. During the Gallo-Roman period there is an expansion of weeds associated with agriculture; however, the authors note "there is nothing in the macrobotanical remains to indicate a flourishing agrarian economy" and they suspect that the kilns were probably supporting the community. During the phase of abandonment there is an abundance of water-loving insects rather than those species typically found in a domestic context, indicating disuse of the site. Forest cover in the region is presumed to have been consistently dense, based on “specific Coleopteran taxa,” furthering the hypothesis of limited agrarian activity associated with the site and potentially within the region. Other regional sites suggest this forest cover persisted well into the medieval period. This constant forest cover is somewhat different than the majority of other studies summarized here that typically indicate a period of deforestation at some point in the chronology.

Palynological studies from Germany

A long chronology of land use is presented in the study “Long-term human impact as registered in an upland pollen profile from the southern Black Forest, south-western Germany” by Manfred Rösch (2000). His study covers the pre-Neolithic through the late Medieval period. Samples were taken from a raised bog (named Steerenmoos) in the upper Rhine region of the Black Forest. The author characterizes the results of this study as demonstrating “typical” forest composition and landscape use for the region when compared with other studies. The first human activity represented in the profile comes from 5700-5600 BC when cereal pollen appears (this is also, the author notes, when the Linear-bandkeramik culture begins in the region). After this human presence is indicated, fir trees replaced the mixed oak forest, and there are decreases in several other species. However this is not seen to be indicative of major deforestation, but rather sporadic minor events. A period of burning is indicated in the early Neolithic. The presence of substantial amounts of *Plantago lanceolata* (ribwort plantain, a common field weed) pollen, is a good indicator of human land clearance activity. Increases in *Plantago lanceolata* pollen begin during the Bronze Age (approximately 2000 BC) and persists in all periods following the Bronze Age and indicates that forest grazing was likely common and maintained in post-Bronze Age periods. A strong decrease in common tree pollen that occurs at 1900-1700 BC in the early Bronze Age, along with the appearance of new types of cereal pollen, indicates forest clearance; this pattern continues into the Hallstatt period. During the La Tène period (400-300 BC) there is a dip in tree pollen once again. Human impact for the Roman period is not well recorded, but the author suggests that the decrease in fir pollen during the late La Tène (fir providing solid building wood) may be related to the expanding Roman influence. There is a strong indication, as evidenced by burning of the bog and a dip in the dominant forest pollen (fir and beech) that there was an abundance of human activity in the Carolingian period (8^{th} century AD). Following that disturbance, there is a strong disruption of bog growth lasting for a 1,000 years, reflective of strong human impact. An increase in *Pinea* sp. (pine) pollen during the last phase of the bog chronology is also probably related to human clearance activities. Rösch (2000; pg216) concludes his study by summarizing regional activity, “seasonal farming seems to have always been practiced from the Bronze Age onwards but permanent settlement and arable farming was probably scattered and limited in time and space.”

A palynological study by Susanne Jahns (2001) covers an area in the north-east of Germany (specifically the portion of the Mecklenburg Lake district called Uckermärkisches Hügelland or hill country). The samples for her study come from a mire and were collected in conjunction with an archeological project (the Römisch-Germanische Kommission). The area is home to many Neolithic sites, with fewer Bronze and Iron Age sites. Human impact within the pollen results is demonstrated by expanded cereal and pulse pollens and by weedy species (especially plantain). During the Neolithic there was steady human impact as evidenced by the pollen. At around 1100 BC there is a significant decline in beech pollen, probably a reflection of increasing arable agriculture, as beech typically grows on soils good for farming. In the early Iron Age there was a period of decreased impact and return of some early beech forests, Jahns points out that this is interesting, as it is in contrast to the archeology of the region showing continued activity from the Bronze to Iron Age. In the Iron Age and Roman periods evidence for further human activities on the landscape is minimal. Medieval period pollen results were not found in this study.

Two studies of landscape and subsistence which use rather unusual methodologies are "Evaluation of honey residues from Iron Age hill-top sites in south-western Germanyimplications for local and regional land use and vegetation dynamics" by Manfred Rösch (1999) and "Environmental reconstruction of a Roman Period settlement site in Uitgeest (the Netherlands), with special reference to coprophilous fungi" by Bas van Geel et al.. (2003). Both of these studies use pollen as part of their analysis, but they have unique pollen sources that reflect more local rather than large-scale activity.

In the case of the honey study, contents of 5 bronze vessels from Iron Age burial sites in southern Germany were analyzed for pollen contents. The burial sites are associated with fortified hilltop sites (Heuneburg, Hochdorf and Glauberg). That these vessels contained honey is indicated by the fact that the pollen found was non-wind blown, non-arboreal pollen. There is also beeswax associated with the vessel residue. Environmental data acquired from the honey residue indicates a high level of local biodiversity in flora (one of the vessels produced evidence of over 180 species). The pollen was organized according to ecological groups, which provided evidence for a wide variety of plant communities, arable fields on acidic soils, arable fields on basic soils (more common than acidic soils in the region), fertilized grasslands (indicating fallow land), ruderal communities, dry non-fertilized grasslands/dry forest margins (not commonly indicated by lake or bog pollen diagrams), flood plains containing wet grasslands (probably used as pastures), heath-land (indicating prolonged grazing), and reed swamp. Rösch (1999) summarizes these data, “In short, the assemblages appear to represent a well-developed agricultural landscape with rich ruderal communities presumably associated with settlement areas, well developed arable weed communities, pastures with scattered shrubs and trees, and a relatively high level of deforestation” (p 7). Rösch (1999) links this pattern to other studies that indicate high levels of forest clearance beginning in the La Tène period.

“Environmental reconstruction of a Roman Period settlement site in Uitgeest (the Netherlands), with special reference to coprophilous fungi” by Bas van Geel et al.. (2003) presents an environmental reconstruction of the landscape surrounding the site of the title from the 1st century BC to the 3rd century AD based on pollen and fungal spores found in mammal dung. Remains at the site point to an economy primarily based on animal exploitation (animal bones are abundant and soils of the region are poor for arable agriculture). Coins found at the site indicate long distance trade and the animals produced at the site may have been associated with this trade. Pollen at the site indicates an open landscape surrounding the site. There is cereal pollen, but the study’s authors point out that this may not necessarily be related to the presence of arable fields, but rather the presence of threshing activity (pg 875). Fungal spores indicate a large amount of animal dung was present (and are an interesting indicator as they are strictly local in origin, as opposed to pollen). The authors suggest that these types of spores may be helpful in discussing animal usage when animal bones are not present, a new methodological technique. Organizing the pollen by plant communities indicates damp to wet meadows and ruderal sites, with some species favoring heavily trodden or grazed environments.

Conclusion: Land use from the Iron Age through the Medieval Period

As I stated in the introduction to this section, we must be careful not to over generalize regarding land use in Europe. Nonetheless, some general observations can be made with little hesitation. By the end of the Iron Age most land was under human impact or use in Europe and by the end of the Iron Age (or even from the Bronze Age, arguably) there were no "frontiers" or unexploited/unoccupied areas. While areas may have been deserted for a time, they would have been used or occupied for one purpose or another at some point.

Beyond the consistency of land use, the pattern that is demonstrated by these summaries is expanded land clearance in the Iron Age (prior to Roman contact) with various states of continuation of this land clearance and use in the following periods. Frequently there is some evidence of agrarian disruption at the end of the Roman period (see Bumayne-Peaty 1998). Nearly all the studies summarized support this pattern; however, it does not always hold as the study in NE Germany by Jahns (2001) demonstrates and it reiterates the cautionary note regarding over-generalization.

Most of the studies summarized do not provide explanations for expansions or contractions in land use. The general emphasis is on the presentation of data, not on its explication. But some general reasons given are: settlement expansion (reflecting a possible population increase), out migration (leading to changing patterns), climate change, and regional conditions (e.g., soil exhaustion leading to abandonment, though many authors also make a point of dismissing this option), and technological change (this is also favored by many of the macrobotanical studies which will be discussed in the following section).

The limitations of these palynological land use studies are varied, but two major problems are that the exact nature of agriculture (whether it is arable or animal based clearance, and the species used) cannot be easily determined and that there are non-anthropogenic reasons for forest decline, such as disease, (as may be the case in the *Ulmus* sp. (elm) decline of the Neolithic (Pelgar 1993). Macrobotanical studies can address these gaps to a certain extent by providing corroborating evidence for agrarian intensity and specificity with regards to landscape use.

Macrobotanical remains: crops, crop processing and weed ecology

In contrast to pollen, macrobotanical remains are site specific. Macrobotanical remains are the actual grains, seeds, and remains of processing such as chaff and glume bases of grain crops. Generally, these remains preserve by carbonization and are recovered by flotation of soil samples collected during archaeological excavation. Water logging and mineralization may also preserve macrobotanical remains. Macrobotanical remains can provide evidence of site activities, including crops used, crop processing techniques, the diet of the society from which they are found, and information about local weed ecology. Systematic collection of macrobotanical remains in Europe has only become common in the last 25 years. Macrobotanical collection has only become common in France and in the Mediterranean since the early 1990's (Matterne 2001). Despite of its relatively late growth in comparison to other archeological methods, there are many examples of archeobotanical analyses based on macrobotanical remains. After describing in general terms the different aspects of the macrobotanical remains (crops, crop processing remains and weed seeds), I briefly summarize some examples of macrobotanical remains found in sites in the regions under consideration (Britain, France, and Northern Europe). My objective in these summaries is to provide examples of trends in arable agriculture over the Iron Age through the Medieval Period.

Table 2 provides a summary of plants commonly cultivated during the Iron Age and beyond. By the time of the Iron Age most of the common crops of the pre-industrial era were available to farmers in most cases (but perhaps not all). However, there is patterning based on regional conditions, which will be mentioned in conjunction with the summaries of work across Europe. There are also changes in crops used over time. The changes that occur over time may be a result of changing conditions (such as climate change) and technologies/practices (for example, the practice of planting crops together in the same field as a maslin can influence crop choices). Also, some changes occurred due to new crops being available, especially during the Roman period, during which time some fruit and nut trees, spices, and vegetables were made available throughout the Roman Empire.

In order to utilize a grain crop as food or as seed, it must be processed. The activities associated with processing leave behind remains. These processing remains can be helpful in site interpretation (and in the case of emmer/spelt wheat, the glume bases can be more illuminating as to the type of grain than the actual grains themselves). The most common remains of processing activities are glume bases and spikelet forks, rachis fragments, occasional awn pieces, denser straw nodes and culm bases, and weed seeds (Hillman 1981).

Table 2: List of Common European Crops/Cultigens From the Iron Age Period and Beyond

Cereals	**Common name**	**Oil and fiber plants**	**Common name**
Avena sativa	Oats	*Brassica nigra*	Black mustard
Hordeum vulgare	Barley	*Camelina sativa*	Gold o' pleasure
Hordeum vulgare nudum	Naked Barley	*Cannibis sativa*	Hemp
Panicum millaceum	Millet	*Linum usitatissimum*	Linen
Secale cereale	Rye		
Triticum aestivum/durum	Club wheat	Tree Fruits and Nuts	
Triticum dicoccum	Emmer wheat	*Vitis vinefera*	Grape
Triticum monococcum	Einkorn wheat	*Corylus sp.*	Hazel (wild but tended)
Triticum spelta	Spelt wheat		
Legumes		**Dye Plants**	
Lathyrus sativus	Grass pea	*Isatis tinctoria*	Woad
Lens culinaris	Lentil	*Polygonum tinctorum*	False Indigo
Pisum sativum	Garden pea		
Vicia ervilia	Bitter vetch		
Vicia faba	Broad bean		
Vicia sativa	Common vetch		
Vigna melanophtalma	Cultivated cow pea		
Spices and vegetables			
Lagenaria siceraria	Calabash		
Malva sylvestris	Mallow		
Origanum vulgare	Oregeno		
Raphanus raphanistrum	Radish		
Satureja hortensis	Savory		
Valerianella locusta	Mache		
(Chenopodium album - goosefoot and Polygonum lapathifolium - knotweed may have been cultivated, it is under contention)			

Table 3: Roman Introduced Cultigens

Tree Fruits and Nuts		**Spices and vegetables**	
Cornus mas	Cornelian cherry	*Anethum graveolens*	Dill
Ficus carica	Fig	*Apium graveolens*	Celery
Julgans regia	Walnut	*Coriandrum sativum*	Corriander
Malus domestica	Apple	*Cucumis melo/sativus*	Melon
Morus nigra	Black mulberry	*Foeniciculum vulgare*	Fennel
Pinus pinea	Pine		
Prunus domestica institia	European plum		
Prunus persica	Peach		
Pyrus communis	Pear		

Gordon Hillman's (1981) ethnographic study of grain processing in Turkey (he sited his work in Turkey where ancient grain varieties were still used) was one of the first studies conducted on processing in European archeobotany (another early study is that of Martin Jones [1982]). In addition to simple observation, Hillman collected soil samples for flotation in order to assess the possibility of archeological preservation of different parts of the processing cycle. He determined that there were clearly activities related to processing that could be seen archeologically, such as threshing, harvesting, and seasonality of harvest. Site interpretation was also possible via the processing remains, as in his view it is possible to determine a "producer" site (where grain is being harvested and processed) versus a "consumer" site (such as a site with predominantly pastoral agrarian activity) which was being supplied with grain from elsewhere. It is this portion of his model- site interpretation via processing remains- that has been the most debated and reinterpreted (see Van der Veen [1992] and Stevens [2003] for examples). Models of production and consumption, as well as other models of labor and tribute based on processing remains, will be discussed in the analysis chapter.

Seeds of weeds are generally found with macrobotanical remains of crops, as it is impossible to completely remove weed seeds from a crop without exceptional diligence and evidence for such diligence in the past is rare (Hillman 1981). In fact, many common weed species are closely related to their domestic counter parts (*Avena* sp. for example) or are grain-like (*Bromus* sp.) and may have been deliberately ignored as they would not have affected the consumption of the grain (Marnival 1988). Weed species present indicate both possible changes in crop regimes and field rotations and extant ecological conditions. For example, the presence (or lack, at earlier periods) of the weed species *Agrostemma githago* may point to Romanization of agriculture, as this is a weed species associated with Roman crop types and may indicate expansion of winter crop cultivation (Wiethold 1996;Kreuz 1999). Weeds can also point to placement of fields, for example a collection of winter weed taxa was used at a collection of Bronze Age sites around a lagoon in Languedoc as an indication that winter fields were located on dry calcareous uplands, which is the weed species preferred soil type (Bouby et al. 1996). Weed seeds can also indicate crop processing and tilling regimes (Hillman 1981).

Grain species characteristics

Grain species and varieties may appear interchangeable to many people but in fact they differ in nutrition, growth requirements and culinary/fodder characteristics. In the next few paragraphs, I will briefly discuss how the key grains: wheat, barley, rye and oats differ in nutrition and cooking characteristics and optimal growing conditions. Grain species also differ in yield and in susceptibility to disease, but given that most varieties that are grown today are not the same as those in the archeological past, it is difficult to address those aspects.

Wheat has seven chromosomes and the differences in wheat species is based on polyploidy between them. *Triticum monoccum* (Einkorn wheat), has the base seven chromosomes and was the earliest variety cultivated. It caries one grain per spikelet fork, and thus is the lowest yielding of the wheats. *Triticum diococcum* (Emmer wheat) is diploid and has two grains per spikelet. *T. spelta and T. aestivum* (Spelt and bread wheat), the last types to come into cultivation, carry 21 chromosomes and three grains per spikelet.

In terms of culinary applications, wheat is the only grain that contains substatial amounts of gluten, which forms sticky strands when combined with water. This characteristic is what allows bread to rise and become fluffy. Earlier forms of wheat, einkorn and emmer, do not have enough gluten content to make light loaves. Bread and spelt are the only ancient grains with high gluten, and combined with their higher yield than other varieties, it makes them the only varieties still commercially cultivated (Langer and Hill 1991).

Wheat can tolerate a range of growing conditions and can be sown as a winter crop or in spring. Mediterranean climate conditions are very good for spring sown wheat, with the wet spring allowing for grains to start their growth and the sunny, dry conditions in summer being a good preventive for disease and allowing for high levels of seed growth (seed growth is related to high levels of photosynthesis [Langer and Hill 1991]).

Barley comes in hulled and non-hulled varieties, and in "three row" versus "six row" varieties, with the six row containing six grains per spikelet, and three rowed with three grains. The 6 row types have "twisted" grains because they are pushed against one another as they grow. The hulled/six row varieties arrive/are developed after the three row type during the late Bronze Age and gain favor over time, in spite of their need for additional processing. This may be related to the increased defenses against insects afforded by the hulls and by expanded yields.

Barley is somewhat less nutritionally sound than other grains (less protein and other nutrients) but not extensively so. Both the grains and the hay make excellent animal fodder. In modern times, malt is the main use for barley, and this malt is often used in beer production, as it was in the earliest accounts of beer making in Mesapotamia.

Barley is fairly tolerant of a wide variety of growing conditions and challenges. It is an autumn or spring sown species, tolerant of cool temperatures. It is also tolerant of poor soils though amendments are helpful for it, so poor soil is not a requirement, merely within its tolerance.

Rye probably was originally a weed species of wheat and barley that was adopted as a crop. Its yield is average compared to other grains. Nutritionally it is high in the protein lysine, but does not have as much overall protein as wheat. Rye is not suitable for animal feed by itself as it gums up animals mouths (Langer and Hill 1991). It does not contain a lot of gluten, if it is used in bread making by itself, pentosans bind with water creating what little rise it gets. Traditional pumpernickel bread is a long cooking bread which is not very fluffy- in America and other areas rye is mixed with wheat for a lighter loaf. Rye hay was preferred for thatch and bedding. Rye also was and is used in alcohol production.

The major advantage to rye is that it is very tolerant of trying conditions. Rye prefers to grow during the warm summers, but can be sown as a winter crop. It is drought resistant and will happily grow on acidic and low fertility soils. Rye is probably the most rugged of all the grains.

Oats, like rye, probably originated as a weed species, as wild oats are very difficult to control; it is a pervasive weed with a short life cycle. Oats are very nutritious compared to other grains, and this is also true of its hay. It has traditionally been considered good for porridge and especially for fodder. But its yields are very low compared to other grains.

Oat is a rather picky species when it comes to its climate and growing requirements. It demands cool, maritime climates. But it is not frost tolerant and prefers cool summer conditions. Acidity in soils and low manganese are also problematic for high oat yield. The specificity of its growing conditions explains why it is not more prominent in spite of its high nutrients.

Having discussed the general form of macrobotanical plant remains, I will now turn to summaries of macrobotanical studies from the regions (Northern Europe, France, and Britain) that cover the time period (Iron Age through Medieval Period) under consideration in this chapter.

Macrobotanical studies from Britain

There are many fine summaries of agrarian activity from Britain. Notably, Peter Fowler's (2002) book: "Farming in the First Millennium AD" as well as a nice summary in Iron Age Communities in Britain by Cunliffe (2005). The Fowler book is too extensive to summarize and the Cunliffe overview is very general (though it admirably covers regional differences), hence I will not present them here, but they are very much worth mentioning as excellent references. Also, the often cited work of Martin Jones (1981), "The Development of Crop Husbandry" is a good, but very dated summary (it focuses mainly on the presentation of species characteristics and I chose not to summarize it here). A study by van der Veen (1992), "Crop Husbandry Regimes: An Archaeobotanical Study of Farming in northern England 1000 BC – AD 500" provides a regional summary of Iron Age and Roman agrarian activities. The Wavedon Gate study (Williams et al. 1996) is an example of archeobotanical evidence from a site with a long chronology in the Iron Age and Roman periods. Danebury, both the hillfort (Cunliffe 1983) and its environs (Campbell and Hamilton 2000) provides interesting evidence of crop planting strategy change over time as evidenced by plant remains. Francis Green (1994) has written numerous surveys of the Saxon period throughout Europe, and one is summarized here to provide a medieval study example.

M. Van der Veen (1992) summarizes plant remains from nine sites spanning the late Bronze age through the late Roman period located in the highland area of north east England.

Traditionally, it had been assumed that arable agriculture was barely practiced in the highland region of Britain, and that the emphasis there had been on pastoral activities. Van der Veen's work aimed to refute this model to a degree, and also to investigate changes in agriculture in the region during different time periods. Especially the period of Roman occupation, as the bulk of Roman forces were stationed in the North and grain consumed by the forces have been assumed to be imported (Van der Veen 1992).

Van der Veen (1992) found cereal remains of the following types in her samples: emmer wheat, spelt wheat, bread/club wheat, six-row barley, rye, and flax. Barley is the only grain found on all sites, and generally it is found in the same quantity as wheat. Spelt wheat is found in Britain only after the Bronze Age, and replaces emmer wheat progressively after its introduction. Van der Veen finds this pattern repeated in her study at three of the sites. This is in contrast with other authors, such as M. Jones (1981) who propose that in the highland zone, this transition did not occur and emmer maintained its presence. At several other sites (three, all within Northumberland), emmer maintained dominance with spelt wheat being present, however. The club/bread wheat she discovered is in most cases problematic. This is because the remains are likely contaminated from the medieval or modern periods (they are only partially charred) or in other cases a possible import (this is the case of the Roman fort site). The small amount of rye found at only one site is typical of the periods under consideration, as rye typically comes to prominence in the medieval period after being first introduced during the Roman period. The weed species, *Agrostemma githago* and *Centaurea cf. cyganus* were found with the introduction of rye and club/bread wheat, which is typical as they are associated with Roman activity. Other weeds species found were typical of arable fields. There were also many seeds from plants that thrived in damp environments, indicating that the fields were probably not well drained.

The Wavendon Gate farmstead excavation included various subsistence and environmental studies, including macrobotanical studies of both water logged and carbonized materials (Williams et al. 1995). The site is a farmstead that existed from the late Iron Age through the Roman period. The Iron Age activity occurs in two separate habitation events. The first major occupation being at the end of the first century BC and the second is during the first century AD (the “Belgic” phase) just prior to the Roman period. The first phase consisted of a collection of round houses, with the second phase being a collection of more organized rectilinear buildings (called “paddocks” by the excavators).

During the mid-first century AD the site shifted slightly to the south, and is considered from that point on a Roman settlement. The majority of plant remains come from this phase of the settlement. During this period the site is in proximity to a Roman town, Magiovinium, which probably provided an economic center for trade with the site. The settlement was partitioned with ditches, perhaps to separate work and habitation areas. Kilns were recovered, and there was a new small cemetery to the north on the site of the earlier settlement. After the first Roman period occupation, ditches silted up and were recut, with some minor rebuilding episodes occurring at the beginning of the third century AD. During the late third century and fourth century, the site occupation continued, but declined or possibly moved to an unexcavated location. The site was abandoned after the fourth century, with a minor (or highly disturbed- preventing recovery) occupation during the 6th century Saxon period. Very few plant remains were recovered from the Saxon portion of the site.

Plant remains from the Iron Age period at the site include spelt wheat, bread wheat, and barley. These remains were minimal, and thus little can be said about them beyond noting (as the authors did) that they indicate probable cultivation on a range of soil types around the site.

The Roman period was the most productive in terms of the plant remains recovered, with both water logged and carbonized plant remains recovered. During the Roman period at the site there was a general emphasis on arable agriculture (cereals), with this emphasis declining in the later part of the phase as evidenced by expansion of zooarcheological remains of cattle and a decrease in processing remains pointing to an expansion of cattle rearing. The majority of the remains found in granaries was cleaned emmer wheat with some barley also being present. A decrease in brome-type weed seeds may indicate that heavier clay soils were being newly exploited. An increase in species (as compared to the Iron Age) was found from waterlogged plant remains: seeds of black mustard, coriander, celery, caper, spurge, and summer savory were present. These common Roman-type horticultural remains are presumed to come from a garden near the waterlogged pit in which the remains were found. This waterlogged pit is unusual, as it contained a wide range of cultivars, and yet was not a deposit from sewage or a collection of refuse. Weed seeds and beetle remains also support the idea of disturbed ground in proximity to the pit. The authors propose that the pit may have acted as a cistern for garden irrigation. *Prunus insitia* (Bullace – a shrubby plum type), plum and cherry remains were also found, indicating probable orchard activity associated with the site during this period.

There was a brief Saxon occupation at the site, but few plant remains were recovered. Those found included *T. aestivum* (bread wheat) and *Hordeum vulgare* (barley). The zooarcheological remains also did not reveal any major shifts, with an only minor expansion of pig remains (pig farming being more typical of the medieval period).

A macrobotanical analysis was conducted in conjunction with the Danebury project, as described in "Danebury: Anatomy of an Iron Age Hillfort" by Barry Cunliffe (1983). Danebury is a hillfort site in Southern Britian. The settlement within the hillfort was extensive, and earthworks were transformed and intensified over period of 550-100 BC The results of these excavations and investigations of the surrounding environment were prolific. Faunal remains, agrarian remains, extensive settlement information, ancient crop patterns and local environmental conditions were all available and investigated. M. Jones analyzed agricultural remains mainly from storage contexts (Cunliffe 1983). Spelt wheat and six-row barley were the most common remains found. There was some discussion of processing within the analysis (helped along by the recovery of agricultural implements such as sickles and querns) that argued for on site processing rather than a "provisioned" site. In order to contextualize the Danebury remains, G. Campbell and J. Hamilton (2000) conducted an analysis of seven sites dating from 470 BC to 50 AD containing various periods of occupation and reoccupation. In general, at Danebury and the surrounding sites, the economy was based on spelt wheat and six row-hulled barley with sheep and cattle as the primary domestic animals. The remains from Danebury and the surrounding sites show evidence for a change in arable agriculture planting regimes over time according to the two authors (Campbell and J. Hamilton 2000). The two dominant species do not shift over time, but the temporal organization of agriculture activity is shown to move from autumn sowing to both autumn and spring sowing (which in turn is evidence of expanded production). The evidence for this shift over time comes from both changes in the distribution of cereals, types of crops grown and weed species. Barley and wheat were stored together in the first portion of the sequence. This mixing is considered to be evidence of their being sown as a maslin (i.e. together in the same field at the same time), which is a typical fall sowing strategy. Later in time, barley and wheat typically appear separately in storage contexts. This would be evidence for the possibility that the barley was sown in the spring, and wheat in the autumn. Two new crops appear late in the Iron Age at Danebury and the other sites, *Avena sativa* (oats) and *Pisum sativum* (peas) which are both spring sown crops. Weed species, *Avena* sp. and *Bromus* sp. both expand their presence later in the sequence, and both of these are related to specific seasonal sowing, with *Bromus* sp. being more common in fields cultivated in the fall, and *Avena* sp. being more likely to reach maturity in spring sown fields. Extending their comparisons to sites found to the North and the East the authors find different agricultural regimes than in the environs of Danebury. Northern published sites provide some evidence for consistent seasonal sowing in the spring throughout the Iron Age, and in the East there is evidence for shifts similar to those that occurred around Danebury. These shifts in agrarian practice, to the east and surrounding Danebury, were accompanied by shifts in settlement, including the gradual abandonment of the hillfort with reoccupation of surrounding sites. The authors do not propose a reason why these changes in settlement and agrarian practice occurred.

There is some difficulty in creating summaries of archeobotanical materials from the Saxon and Anglo-Saxon periods, as many studies have not been published and the grey literature is substantial (this is actually true in general, but it is especially true of studies from this period, according to F. Green [1994]). In addition, there is substantial historical documentation from these periods that in some ways eclipses archeobotanical work, which is why syntheses using both types of data such as Peter Fowler's (2003) are so valuable. That being said, there have been some summaries produced. One of these is a summary for the Wessex region of southern England produced by F.J. Green (1994), based primarily on five site reports she produced. She discusses the issue of variation and critiques over generalization in her summary. As she points out, on the whole the trend based on raw counts would suggest that rye gained significant importance over the course of the middle ages, but in actuality the majority of the rye occurred at one site. In that instance she believes that the rye was an experimental addition to the crop regime during a relatively short period- less than a century (albeit an addition that occurred at the expense of barley, which is typical in the general expansion of rye during the period). There is, among all of the sites, a large presence of *T. aestivum/compactum*, which is typical in the medieval period. Fruit species were recorded only in settings where they were preserved by mineralization, which is typical, and this lack of preservation may cause under representation of these remains. The few fruit remains from urban sites included: *Prunus* sp. (plums), *Rubus* sp. (blackberries), *Fragaria* sp. (strawberries) and from rural sites: *Sambucus nigra* (elderberry), *Prunus spinosa* (sloe), and *Malus* sp. (apples). *Vitis* (grape) is only recovered from rural settings; however, it is suggested that the remains of viticulture are under represented due to preservation issues. Vegetable species are under represented much in the same way fruit crops are, *Daucus carrota* (carrot), *Apium graveolens* (celery), various *Brassica* sp. (cabbage, turnip and mustard) have all been found, however, only in the form of mineralized seeds. Beets were not found, which is considered to be a problem of preservation, as that species was undoubtedly in cultivation during the period. Exotic species found are very few, with only one, *Ficus* sp. (fig) being found. Plant remains pertaining to dye and fabric production were not found, most likely due to preservation issues, again, not because they were not in use. This study can be considered cautionary, as it suggests that earlier periods without historical records contain significant gaps in species used due to preservation/recovery issues.

Macrobotanical studies from France

Marnival (1988) and Matterne (2000) both discuss selections of many French sites covering the time period under consideration here and their studies and will be summarized in this section. In addition, an example of a single site study from the Iron Age is also provided by Matterne (1996). Julian Wiethold (2000) surveys Roman food production in Burgundy that identifies many trends of change in the period, especially those of arboriculture. A study of the plant remains from the Iron Age period at Lattes provides unusual evidence for early viticulture (Capdevila 1996). Finally, M.P. Ruas (1992) presents results from various excavations of the medieval period in northern France that show general trends toward expanding species use.

P. Marnival (1988) surveys archeobotanical remains from 256 sites in his book ”L’alimentation végétale en France.” Of these sites, 67 are from the Iron Age, and located throughout France (though mainly in the north central and south of France). All of these sites were excavated before 1985, so his study represents an early archeobotanical work from France. Marnival finds some generalized trends within the data, based primarily on qualititative results (i.e. relative amounts and presence/absence data). Marnival records the presence of all the grain species and the bulk of other species found in Table 1. He notes that rye expands during the Iron Age compared to early periods, as does the presence of *T. aestivum* in comparison to other wheat varieties. Grape and olive were only found from Mediterranean sites. Vegetables and fruit remains (representing perennial culture) were nearly non-existent; this may be again, due to issues of preservation or sampling. Interestingly, unlike nearly all other authors summarized in my survey of literature, Marnival finds extensive evidence for gathering activities within his data. Most other authors find *Corylus* sp. (hazel) as the exclusivly gathered plant foodstuff. Marnival finds several species that were probably gathered and consumed including: *Polygonum* sp, *Rumex* sp., *Atriplex* sp., *Chenopodia* sp. (all used for greens), and *Quercus* sp. (acorns). The acorns are particularly notable, as the remains were found whole in caches. Marnival proposes that these could have been used as either pig fodder (for which there is extensive historic and ethnographic evidence) or as human food (for which there is less ethnographic evidence, but is also likely). Acorns need to be processed before consumption by humans to remove tannins and shells, and this can be done by boiling (to remove tannins) and toasting (to more easily remove shells). The processing raises the odds that acorns will be carbonized and thus archeologically preserved. Veronique Matterne (2000), in her summary of sites from the Iron Age and Roman period, which I will now discuss, also finds evidence for acorn usage in the French Iron Age.

Véronique Matterne (2000) conducted an extensive paleobotanical study of 78 settlements located in the Northern Paris basin (from the regions of Picardy, Ile-de-France, Normandy, Nord-Pas-de-Calais, Champagne-Ardeme) and dating from the Iron Age through the Gallo-Roman period. In the course of her study 232,000 plant remains were analyzed. Nearly all the major crops found in Table 1 were recovered from the sites she analyzed. Indications (similar to those found in Danebury environs study) were found for changes in the intensity of agriculture in the course of the Iron Age. Maslins are less commonly found (granaries begin to contain only a single grain type) and a decrease in the number of grain species is seen as evidence for expanded monocropping during the course of the Iron Age. Increases in remains of Iron Age fields during the middle La Téne also support the idea of intensification of agriculture. Roman conquest did not extensively change this trend or other agrarian activities. Bread wheat and rye both expand during the Roman period as emmer declines, which is typical and linked to changes in taste (expanded consumption of bread and new bakeries) as well as the need for fodder (in the case of rye). Pulses also expand in the assemblage, as do remains associated with arboriculture during the Roman conquest.

An example of a study conducted and published on a single site by V. Matterne (1998) is “A study of the carbonized seeds from a La Tène D1 rural settlement, “Le Camp du Roi” excavation at Jaux (Oise), France.” This is a site with a chronology beginning in the Hallstatt and ending in the Roman period; however, the plant remains are all from a single period, the late La Tène. She mainly concentrates on site interpretation, as the plant remains support the idea that certain buildings on the site served as granaries, based on the abundance, concentration and state of processing of grain finds. Grains concentrated in samples taken from ditches in proximity to the buildings represented 98% of all the remains. *T. dicoccum* was by far the most abundant grain found, but *Hordeum* sp. and *T. aestivum* was also found. Weed seeds were very scarce in comparison to grain remains, but those found indicate human impacted soils.

Julian Wiethold summarizes some finds from recent Gallo-Roman period salvage excavations in Burgundy (2003). The sources of the macrobotnaical remains he discusses are mostly finds from cesspools and wells- features which have also typically provided macrobotanical data from the Roman period in Germany (Kreuz 1999;Wiethold 2003). The findings reflect some of the new species available, namely the large presence of remains from fruit trees. Additional new species included *Lupinus* sp. (cultivated lupin), *Lagenaria siceraria* sp. (calabash) and *Prunus persica* (peach). While remains of *Olea* sp. (olives) and *Piper nigrum* (black pepper) are found, they weren't cultivated in the region and probably represent imports. Also, he reports an expansion of weed seeds in his Roman samples, especially the highly undesirable corncockle, *Agrostemma githgo*. In his view, this weed expansion may indicate less care given to the fields (which were possibly larger than in the past, meaning it wasn't possible to care for them as intently as before) that encouraged the growth of weeds. It appears that another major shift was in oil plants, as there is very little *Camelina sativa* (Gold of pleasure) a common Gaulish source of oil seeds. Wiethold does not report any changes in grain composition in the samples he looked at; it appears that all the same grain species were present in Roman times as were found in earlier Iron Age contexts. I would suggest that the contexts he had available to him were not the best indicators of grain agriculture, as he mostly had data from cesspools and fanum, versus more applicable grain storage contexts. He characterizes this lack of change as a sign of continuity and finds it likely that there was indigenous influence over agriculture. Further, he notes that variation in grains found regionally across Burgundy may be due to microclimates and soils.

The site of Lattes, near Montpellier, provided plant remains for a study of possible grape cultivation during the 4th century BC to the 1st century A.D by Ramon Capdevila (1996). The site is a port city located on the bank of the river Lez that runs into the Mediterranean Sea 7 kilometers away. Plant remains were collected from ditch fill, wells, and road fill. The majority of the remains were carbonized, with some (predictably, given the riverside location) water logged samples being present. A total of 61,164 items were identified from 142 samples, of these identified items the vast bulk were grape related (mostly seeds). Hulled barley and free-threshing wheat were common in all periods, but especially in the 4th and 3rd century BC *T. aestivum* and a variety of *T. compactum* were consistently common throughout the samples. The early adoption of these crops in comparison to other areas is related to the fact that this is a Mediterranean site. *Panicum millaceum* (millet) decreases at the site over time. Emmer wheat also decreases over time with Einkorn being present in from 4th-3rd century BC Olive was found in the 4th and 3rd century, and unlike other regions discussed, the remains could possibly be from indigenous production. Legumes (*Vicia faba, Pisum sativum, Vicia ervilia*) were found in all time periods except the 1st century BC and no explanation was given for this gap. Earlier studies found a few nuts (hazel) and peach stones which may indicate wild plant collection and orchards. The majority of the materials were grape pips. These pips are remarkably homogenous in their dimensions, with some change over time to a larger size. The dimensions indicate that these pip were from one variety of grape, and that grapes were probably grown locally as imported grapes would not provide such homogenous pips. Tools for viticulture have also been found on the site, in the form of curved pruning knives, which also supports the idea that production was local. The expansion of grapes is linked with pollen diagrams indicating the decline of oak forest, and is linked to the 3rd century BC expansion at the site. Grapes may have been consumed as food, not necessarily as wine. However, grape production at the site is associated with increases in "dolia" a type of pottery vessel associated with wine making. Regionally, grape remains are also more common in the 4th and 3rd centuries BC and decrease after Roman contact. There is actually a decline in grape remains as the Romans imposed restrictions on non-Italian grape production in order to expand Roman wine exports. During the Roman period there is an expansion of horticulture, as evidenced by the plant taxa found at the site.

M.P. Ruas (1992) summarizes results from 36 sites dating from the 6th-15th century A.D about one fourth of France is represented, in a North/South axis across the Massif-Central. Her study recorded the presence of 55 species of cultivated plants and 12 wild species. She only states general trends, as the wide variety of reporting strategies, sampling strategies and the problems of distribution of sites, varied collection techniques, and the uneven types of contexts across sites all make subtle distinctions difficult. The majority of the archeological contexts were dumps (pits/ditches) and storage (silos). Various contexts provided different types of remains, with latrines/pits/wells containing the bulk of fruit/nut remains (in water logged or mineralized form). Dumps provided the bulk of the dye plant remains. Cereals and pulses were found mainly from storage contexts, and were generally preserved by carbonization. Cereal remains were the most common type of cultivated plant remains found (as is typical during all time periods). Generally, hulled barley decreases in importance, but it still dominates other hulled cereals (oat, broomcorn millet, einkorn and emmer) and rye until the 13th century. Rye, a free-threshing grain, shows large expansion at the beginning of the Middle Ages compared to earlier periods, and in the late Middle Ages rye overtakes barley in abundance. Oats expand in abundance during the early Middle Ages, and henceforth consistently remains the fourth most abundant cereal. Oats expansion may be a result of the expanded role of horses as traction animals, Ruas suggests. Millet is a minor crop within the results, but this, Ruas points out, may be due to the problems of over sized mesh used in collection at many sites. *T. monococcum* and *T. diococcum* are considered to be “relic weeds” in this study, as they appear in such low number (even if they are found from 25% of sites with cereal finds). *T. spelta* is much reduced in its presence compared to earlier periods, Ruas suggests this is related to the rise of rye as a crop. *Pisum sativum* (peas) replaced *Lens culinaris* (lentil) as the most common legume from the early Middle Ages onward. In the Mediterranean region, *Cicer arietinum* (chick pea) replaces *Pisum* sp. (peas) as most the most common legume, and it is very possible that this species failed to be transported to the North. *Vicia faba* (celtic bean) is the principal pulse, related to expanded irrigation, a wider soil tolerance than lentil, and higher cold tolerance. Polyculture (agriculture based on a wide variety of crops) is evidenced from the late Iron Ages onward. *Vitis* (grape) is most common from the 36 sites from the Late Middle Ages, most likely consumed as "table fruit" according to Ruas. The low presence of grape may be due to issues of preservation, and there are abundant historical documents showing the rise of viticulture, hence it may be that historical sources are a bit better at tracking viticulture activity. Various archeobotanical remains of fruits have only been found from the Medieval period (Ruas is careful to point out "by available data" meaning this could change in the future), these include*Castanea sativa* (chestnut), *Prunus oeconomica* (a variety of plum), *Mespilus germanica* (medlar – a fruit tree similar to apple), *Morus nigra* (black mulberry), *Prunus armeniaca* (apricot), *Cydonia oblonga* (quince), *Sorbus domestica* (service berry) and *Pyrus communis* (common pear). Fruits/nuts found at the sites in general (including those found in earlier periods, such as *Julgans regia*, *Prunus insititia*, *Malus domestica*) show an increase and diversification in production during the Early Middle Ages with a pronounced increase during the Late Middle Ages. Other economic plants (dye and fabric plants) are generally under represented in the remains due to lack of preservation.

Macrobotanical studies from Northern Europe

The studies summarized in this section are all from areas in Northern Europe, namely, Germany and countries in proximity to it. This section summarizes the following studies: Manfred Rosch's (1998) study "The history of crops and crop weeds in south-western Germany from the Neolithic period to modern times, as shown by archaeobotanical evidence," Otto Brinkkemper and Louise van Wijngaarden-Bakker's (1999) study "All-round farming: Food Production in the Bronze Age and the Iron Age in the Netherlands," A. Kreuz's (1999) study "Becoming a Roman farmer: a preliminary report on environmental evidence from the Romanization project," Peter Wells' (1983) report "Rural Economy in the Iron Age: Excavations at Hascherkeller1978-1981", Udelgard Korber-Grohne's (1981) study "Crop Husbandry and Environmental Change in the Coastal Area of the Feddersen Wierde," and Groenman-van Waateringe and L.H. van Wijngaarden-Bakker's (1987) volume "Farm Life in a Carolingian Village."

Manfred Rosch (1998) has compiled the results of over 100 sites in south-west Germany from the Neolithic period to modern times. This compilation revealed certain trends in the plant remains. The general trends he points out are an increase in the number of cultivated taxa present at the sites over time (with the significant period of increase being during the Roman period), a decrease in emmer wheat over time, and a corresponding expansion of spelt, rye and oats over time, and an expansion of open space/crop field weed types over time (1998). Crop taxa generally shift only slightly in diversity over time, however, orchard and garden crops expand greatly in Roman times, decrease the in the Early Middle Ages and then expand again in the later Middle Ages. The expansion of garden and orchard plants is what accounts for the increase in cultivated taxa over time. Oats and rye generally only expand in abundance after the Roman Period. Leguminous crop varieties (such as *Pisum stavium* and *Lens culinaris*) remain relatively constant throughout the Neolithic to the Medieval period. Weed taxa expand in number over time, with the bulk of new varieties coming from the south, and again, expand sharply during the Roman period. Also, weed types preferring acidic soils expand over time, which may indicate progressive soil exhaustion.

Brinkkemper and Winjngarrden-Baaker (2005) review data from different eco-regions of the Netherlands (Riverine areas, Western dune and peat areas, and Northern salt marshes) during the Bronze and Iron Ages. In the riverine areas, the flood plains were denuded of hardwood forests (shown by playnological evidence) during the Iron Age period. Soils were excellent in the riverine areas for pastures, cereal and horticultural cultivation. However, there is little macrobotanical evidence from this region, which (the authors suggest) is due to preservation issues rather than lack of activity. Other regions (sandy and peat regions in the West and salt marches in the North) provided more challenging farming opportunities. In the peat areas it is presumed, based on strong evidence for pastoral activity and weak evidence (few macrobotanical remains) for arable agriculture, that people in these regions were mainly raising animals for subsistence. Yield experiments were carried out in the sandy dune/salt marsh regions and they were found to support most available Iron Age crops and in fact *Camelina sativa* (gold of pleasure) grew quite well in these experiments. Nearly all common Iron Age crops (emmer wheat, hulled barley, millet, linseed, gold of pleasure, rape seed, and oats) were found across the western region with sandy soils, though millet and linseed were generally found in very small quantities (which is somewhat expected as these crops prefer warmer drier conditions than the region supplies). In the loess areas, the authors highlighted the presence of *Triticum aestivum* (bread wheat) and *Papaver somniferum* (poppy) at a few of the Iron Age sites. The presence of these crops is fairly unusual for the Iron Age, with the expansion of *Triticum aestivum* usually being a Roman era phenomena, and poppy, while a common crop of the Bronze Age, generally not returning to prominence until the Roman period as well. In sum, the patterns the authors highlight are based more on pastoral rather than arable agricultural. The regional variation is relatively minimal, with the same general pattern of crops being grown across regions, but with variation in proportions and preservation.

A. Kreuz (1999) reports on macrobotanical remains collected as part of the "Romanization" project, a series of excavations in the Saarland region (valley of the Mosel), Wetterau (valley of Lahn), Bavaria and in Thuringia. The study was based on macrobotanical remains preserved in a variety of ways, by charring, water logging or materialization. Her study loosely compares remains from German/Celtic sites and Roman sites, though she gives minimal details regarding the German/Celtic sites. Crop remains included cereals: *Hordeum* sp (barley), *Triticum dicoccum* (emmer), *Triticum spelta* (spelt), *Triticum durum* or *aestivum* (naked wheat), *Panicum miliaceum* and *Setaria italica* (millet), *Triticum monococum* (einkorn) and *Secale cereale* (rye). Non-cereal crop remains included*Vicia faba* (celtic beans), *Pisum sativum* (pea), *Lens culinaris* (lentil), *Linum usitatissimum* (linseed- probably used for fiber) and *Camelina sativa* (gold of pleasure), *Papaver samniferum* (poppy) and *Cannabis sativa* (hemp- used for fiber). Fruit/nut trees and garden plants were also common, including *Prunus persica* (peach), *Prunus domestica* (plum), *Julgans regia* (walnut), *Anethum graveolens* (dill), *Coriandrum sativum* (coriander), *Beta vulgaris* (beet), and *Apium graveolens* (celeriac). Wild foods, such as *Corylus avellana* (hazel), *Fragaria vesca* (strawberry) *Rubus idaeus* (raspberry) and *Rosa* sp. (rose hips) were also found. *Phoenix dactylifera* (date), *Olea europea* (olive), *Pinus pinea* (pine nut) and *Piper nigrum* (pepper) were all found but were undoubtedly imports, as the regions' climate could not support their growth. Kreuz notes that the plant remains found on the Roman sites were more varied and more abundant than on the earlier Celtic sites in her study region. She also notes that a major difference between the cultivated plants of the two periods is the relative lack of "garden" plants and tree crops in Celtic contexts. There is evidence in these shifts for a change in diet preferences between the two periods (written sources also support this). Kreuz also speculates that the "garden" and tree crops demand more attention in the form of more fertilizer but also (in the case of tree crops) a large time investment as the trees take time to bear fruit. These costs in labor and changes in agrarian knowledge necessitated by an increased presence of horticultural activities would have been significant (Kruez 1991). In terms of major shifts in cereal crops grown, there is no corresponding change in concordance with the expansion of horticultural species. She states that *Secale cereale* is the only new crop grown in Roman territories and this then indicates continuity in agricultural practice. She points out, therefore, that the differences between the Iron Age and Roman periods' subsistence activities may not be visible merely by looking at changes in crop species. It is only by quantifying results rather than looking at the presence or absence of a species that difference between the two periods is shown.

The site of Hascherkeller in Lower Bavaria in Germany revealed some macrobotanical remains (Wells 1983). The site dates to between 800-1000 BC and shows evidence for activity during the late Bronze Age and Hallstatt B periods (though the duration of occupation was probably no more than a century). The site was a collection of structures enclosed by ditches and fences, including farmhouses and workshops (kilns and evidence for weaving were found). The population at the site is not known, but there were multiple family units (based on the presence of household compounds). The plant remains (analyzed by C. Caroline Quillian) that were found in 60 floated soil samples collected from site features included: *Panicum millaceum* (millet) *Triticum* sp. (wheat- not identified to species), *Hordeum* sp. (barley, again not identified to species), *Lens esculenta* (lentil), *Camelina sativa* (gold of pleasure), and *Papaver* sp. (poppy). These crops were found in samples from both the late Bronze Age and Early Iron Age phases. It is likely, according to the principal investigator of the site, that these recovered plant remains do not represent the full extent of plants being cultivated and used at the site (as evidence for the cultivation of oats, beans and peas has been found from nearby excavations carried out in the first half of the 20th century). There is also evidence for gathering as well as farming, in the form of wild animal bones as well as edible wild plants such as: *Corylus* sp (hazelnut), *Prunus* sp. (wild plum) *Rumex* sp. (sorrel) and *Chenopodium album* (fat hen).

Abundant botanical remains were collected in a highly systematic fashion from the late Roman era settlement site of Heeten, in the Neatherlands (Lauwrier et al. 1999). The site was occupied from the late 2nd century through the 4th century AD, with the most intense occupation occurring in the 4th century AD As a consequence, all of the plant remains recovered came from the 4th century, as did the abundant animal remains. The site is located in the province of Overijssel, in the central Netherlands in a damp area with fertile soils. During the 4th century, the site was comprised of a palisade that enclosed several buildings (including a large central building that was rebuilt several times), wells, and large granaries with extensive foundations. There was a great deal of iron slag indicating iron production.

Plant remains were found in the sieved samples associated with the iron production workshops on the site. Also, samples were collected across the site for flotation analysis (with the exception of the water logged samples from well contexts). Over 100 samples were collected and all samples contained plant remains. Crop remains included: *Secale cereale* (rye), *Hordeum vulgare* (barley), *Panicum miliaceum* (millet), and *Vicia faba* (celtic bean). Rye was by far the most abundant crop found at the site and it was concentrated in a specific part of the site, possibly in association with a large granary. Tthe authors propose that it would have been more than the site inhabitants needed for subsistence and may have served as a depot. Rye is sporadically found prior to the Roman period, but during the Roman period it becomes more common. In a survey of rye finds across the Netherlands, the authors find links between high amounts of rye and Frankish (native) settlements. In contrast, Roman sites (forts and the like) typically produce larger amounts of wheat, specifically *T. aestivum* and *T. dicoccum* (bread and spelt wheat). The authors propose that the high amount of rye at the site, along with certain architectural features such as the oversized foundations on the granaries, reflects a Frankish cultural affiliation. Another aspect of the rye the authors consider is the lack of rachis internodes associated with the first processing step (threshing). This may indicate that the rye was imported from elsewhere. However, an alternative explanation proposed is that the processing of rye, being a free threshing grain (no parching needed), does not produce conditions that preserve the processing remains. In addition to rye, a single grain of millet was found. Millet was a crop north of the boundary of the Roman Empire and was consumed (the authors cite a find in the intestines of a Roman era bog body as evidence for its consumption). In addition to the crop remains, weed remains were found, which come from a suite of weed types that are generally found in open, sunny environments. These weeds may indicate strong local deforestation related to agriculture and iron production.

The site of Feddersen-Werde demonstrates that the suite of plants common across Europe (see Table 2) was grown even in the harshest and most unlikely of circumstances (Korber-Grohne 1981). The site of Feddersen-Werde is located near the coast of the Black Sea (currently 6 km away), in proximity to the city of Hamburg, Germany. The site is a werde (which is the same as the term "wurt"), a raised platform mound upon which domestic living spaces were protected from flooding in a marsh setting. The site was occupied from the 1st century BC until the 5th century AD and was a werde from the 1st century AD on. The site was essentially a small village in the 3rd century when it reached its peak activity. The site was abandoned in the 5th century, probably due to expanded flooding in the region. Despite its difficult location, the typical set of crops was grown there, as is evidenced by both water logged and carbonized remains. Remains included: *Hordeum vulgare* (barley-threshing remains), *Avena sativa* (oats), *Triticum* sp (wheat- not identified to species), *Panicum miliaceum* (millet), *Vicia faba* (horsebean), *Linum usitatissimum* (flax), *Camelina sativa* (gold of pleasure), *Brassica* sp. (field cabbage) and *Isatis tinctoria* (woad- probably grown on the werde itself). These remains were frequently found with processing remains, in some cases (specifically in the case of gold of pleasure) with roots, stems and leaves intact. The fact that there were abundant processing remains, along with the fact that weed seeds reflecting non-local environments were not found in conjunction with the plant remains, point to the fact that they were locally grown. Also, in order to test the hypothesis that local sand dunes could support summer agriculture, modern planting of emmer wheat and other crops was carried out. These tests provided evidence that the local area could support some arable agriculture, though probably not without some risk and generally low yields.

The study “Farm Life in a Carolingian Village” is a relatively early example of a multi-disciplinary project aimed at reconstructing farm ecology and economy during the medieval period (Groenman-van Waateringe 1987). The excavation that provided the evidence for the reconstruction was a farmstead site in the Netherlands, dating to 750-1000 AD in the Veluwe region (bordered by the Rhine). Excavations revealed several large boat-shaped farmhouses, smaller domestic structures, storage facilities (mainly pits), wells, field boundaries and fence rows. Evidence from the excavations (palynological, macrobotanical and zooarcheological as well as expansion within the settlement) indicates that farming expanded during this time period at the site, perhaps as a result of the innovation of sod-manuring. Forests were also substantially denuded (probably as a result of a thriving Iron industry) yielding some desertification. J.P. Pals analyzed Macrobotanical evidence collected from the site (Groenman-van Waateringe 1987). The majority of the macrobotanical remains were collected from wells and preserved by water logging (carbonized grains were also found in the wells). Due to the lack of a systematic sampling strategy early on in the site’s excavation, collection of carbonized macrobotanical remains was seriously hampered; however, remains were collected from a ninth century house which was destroyed by fire. Crop remains include: *Avena* sp (specifically *Avena sativa* based on glume bases- oats), *Hordeum* sp. (barley), *Seacle* sp. (rye), *Linum usitatissimum* (flax), *Vicia faba* (horse bean), and *Camelia sativa* (gold of pleasure). Other species found were *Reseda luteola* (dyer’s rocket- a dye plant, it was found in several contexts) and *Brassica rapa* (turnip). The most abundant of the grain remains was *Avena* sp. and the most ubiquitous grain type was *Secale* sp. (rye). Rye was a common 10th century crop of the region, its expanded role may have been due to its suitability to the drier climate regime that appeared during the time period (rye is tolerant of dry conditions) or alternatively due to the fact that it is a winter crop (which may have been favored as this would have been the wettest period). Also, soils adjacent to the site were poor, and rye can tolerate poor soils. These factors may have influenced its abundance. Weed seeds were also analyzed. Weed species indicating dry, sandy soils were present, and perennial weed species (namely *Artemisieta* sp.) were notably absent, indicating that fields were most likely in continuous cultivation and no fallow/field rotation system was in place. Weeds associated with tillage and ruderals (plants that lives on depleted and/or disturbed soil, typically associated with agrarian activity and land clearance) including *Plantago lanceolata* were also common.

Conclusion: Macrobotanical trends and change

There is remarkable homogeneity in the macrobotanical remains from Britain, France and Northern Europe. Even in very marginal areas, such as the site of Feddersen Werde and in the uplands of Britain, the grain varieties found are the same as those found in more favorable areas (Korber-Grohne 1981;Van der Veen 1992). The grains and plants in Table 2 appear across Europe. It may be that the homogeneity is due in part to homogenous soils which may have been present in prehistory, as erosion and long term agriculture would not have reduced deep soils to the point where “the parent substrate” (bedrock) could have an impact on the soil quality as Pelgar proposes (1993). Also, local economies were more diversified in a time when long distance transportation was not easy and market economies were in embryonic form at best. This may account for the lack of specialization between a wide range of regions. Differences in specialization and crops found do appear between sites within regions, however, as is found in the study of remains from Medieval Wessex among others (Green 1994;Marnival 1988;Van der Veen 1992). Smaller regional studies comparing several sites in a tightly focused area are important and will be needed to refine the future over all understanding of pre-historic and early historic agriculture.

Within this homogeneity of crops, over time there is an expansion of species utilized by farmers. This is probably due to greater communication and cultural sharing over time, and also the development of new husbandry techniques. During Roman times, arboriculture seems to expand greatly throughout the Empire (Wiethold 2003;Rosch 1998;Kruez 1999;Williams et al. 1995). This arboriculture expansion may not be as pronounced as the expansion of macroremains may suggest, as differential preservation may obscure remains from previous eras.

Other changes in crop types that are not related to expansion in crops utilized but rather shifts in emphasis on various staple grains include changes in barley species used, changes in wheat species used, and the inclusion of rye and oats in larger amounts within the staple grains being cultivated.

The change from using non-hulled to hulled barley is initially mystifying, as the hulled barley variety takes more effort to process and could be seen as a step backwards in terms of productivity. However, it may be that a blight infected the hulless variety, or that pests and disease became more prevalent and the hulled variety proved more resistant to these problems. Also, changes in climate or soils used, specifically situations which created damp conditions during the ripening period may have encouraged the use of hulled barley as it is more resistant to fungus which proliferates in damp environments.

The shift from *T. spelta* (spelt) and *T. monococcum* (einkorn) to *T. dicoccum* (emmer wheat) is probably related to emmer wheat's ease of processing in comparison to spelt wheat. Emmer is also tolerant of a wider variety of growing conditions, and especially of more acid soils. The shift from the *T. mono/dicoccum* varieties of wheat to *T. aestivum* (bread wheat) can be explained in terms of productivity and nutrition (bread wheat is higher in gluten protein than other available varieties of wheat) and in terms of changes in taste. Bread wheat is more suitable for milling and bread making, whereas emmer, spelt and einkorn wheat are more suitable for making porridge and flat bread, which were the preferred means of wheat consumption in the early Iron Age.

In sum, what can been seen in this survey of studies of archeobotanical macroremains is a remarkable homogeneity in which there are some shifts over time towards greater number of species utilized and changes in the amounts and varieties of staple grain crops which are produced.

General conclusion: Expectations for Mont Dardon macrobotanical remains

Expectations can be drawn from these surveys and the trends they demonstrate in regards to the archeobotanical remains found at Mont Dardon. The landscape would have been clearly under human influence and control throughout the Mont Dardon occupation, with possible areas of abandonment and re-colonization, judging by the trends found in the palynological studies. There may have been expansion in agriculture during the early Iron Age, although that intensification may be difficult to ascertain from the remains at Dardon. Palynological studies are not present from the region. However, macrobotanical remains in the form of homogeneous grain deposits in granary pits indicating single species sowing and thus likely multiple seasons of crop sowing (rather than a single season in the case of a maslin) could provide information regarding intensification. This circumstance of mixed grains shifting to a single species found in granaries was present in the Danebury environs study and the analysis of “Le Camp du Roi” excavation at Jaux (Oise), France (Campbell and Hamilton 2000;Matterne 1996). The change in practices may indicate an expansion in the intensity of agricultural activity.

It is likely that remains representing most of the crops in Table 2 would be found during the sequence of Mont Dardon. Expectations regarding their placement in the sequence can be made based on trends in the rest of Europe. Rye should appear late in the site’s history, after Roman incursion. T. aestivum should become, over time, the most common wheat found. Oats in larger amounts will probably appear later in the sequence. If barley is found, the hulled variety should replace the non-hulled variety over time (though without processing remains, determining varieties may be difficult). Generally, there should be an expansion of the number of species over time. However, the major expansion of garden and fruit crops may not be detected at the site, because the remains from Dardon are carbonized only, and do not include cesspools or wells which tend to produce the remains of fruit crops. Also, it is unlikely that many plants related to fabric production and dying will be found, because, as with fruit and vegetable remains, these tend not to preserve via carbonization.

These expectations for the contents of the Dardon macrobotanical assemblage will provide a basis for placing the results of the analysis of the materials in the context of wider European trends in agrarian practice.

CHAPTER TWO
REGIONAL AND SITE ARCHEOLOGY

Introduction

This chapter gives archeological background information pertaining to Mont Dardon and the region in which it is located. In the first section I discuss hillforts, the site type of Mont Dardon. In the second section, several local surveys are presented to place Dardon in its regional archeological context. Bibracte, a large hillfort/oppida 25 km away from Dardon, is discussed as another example of a local hillfort. Finally, I talk in detail about the excavations at Mont Dardon and the results thereof. The information presented in this chapter is vital to the interpretation of the Mont Dardon archeobotanical remains.

Hillforts

Mont Dardon is a hillfort which was first fortified during the early Hallstatt. Hillforts are a prominent site type across continental Europe and Britain. Hillforts have been considered as evidence of hierarchy and its intensification, centers of redistribution, homes to elites, territorial markers and as evidence of warfare, though all of these inferences can be debated. This section discusses the definition of a hillfort, their range and duration of prominence and their potential ritual significance as evidence for hierarchy in Iron Age society.

Hillforts are typically defined by “a circuit of man made defenses” surrounding a hilltop or other defensible location and are classified not by possible function, but by the architecture of the ramparts (Ralston 1981). Ramparts are massive defensive walls constructed with earth (often in the form of embankments), timber, and stone. These basic building materials are used in conjunction with one another, or singly. In temperate Europe, timber is commonly used in rampart construction (Ralston 1981). The type of rampart construction is significant for several reasons. The defensive capabilities and durability of the different types varies. The labor and resources necessary for construction also varies widely depending on the type of rampart. Ramparts represent a cultural artifact as the dominant style of rampart construction varies across regions and time periods. Ramparts are thus significant enough that they can be used as a classifying element and to define a site type as a hillfort. Hillforts throughout Europe have varied purposes: ritual centers, animal pens, residential settlements and the obvious defensive centers are all functions hillforts have served (Ralston 1995). Hence, the type of activity occurring within the hillfort does not broadly define the site type, whereas temporality and the quality of having ramparts do delineate the site type.

Hillforts were common beginning at the end of the Bronze Age and especially during the early La Tene 3 period (prior to and at the beginning of Roman contact). Hillforts exist from the early Iron Age/late Bronze Age period (1000 BC) through the first century BC (the late Iron Age), after the Roman conquest hillfort building ceases. Generally most hillforts have periods of abandonment and reuse in their chronologies (as is the case with Mont Dardon; during the La Tene 2 period it was unused). The general progression through time is that the hillforts become more “developed” (representing a larger labor and resource commitment often with associated growth in settlements).

During the last part of the Iron Age hillforts are sometimes large fortified settlements which housed hundreds of people (Cunliffe 1997;Wells 1984). The size and density of populations is a new development in the late La Tène period, nothing similar had existed previously.

Hillfort sites have been found throughout Europe, including on the Iberian Peninsula (where they are called “castros”), Ireland, Britain and across continental through eastern Europe. The best-studied hillforts are located in Britain and Ireland. In general, on the continent, hillforts have not been as well studied or placed within a strong regional context. Even within England, where hillforts have been the best studied, the state of excavations is typically rather minimal with the ramparts and entrances being excavated, but little else (Cunliffe 2005). The broad excavation of Mont Dardon is one of the things that makes the site unique and worthy of further study.

Hillforts were clearly potentially highly symbolic places for Iron Age peoples. Beyond their obvious placement in the landscape, there are several other features that point to this. One line of evidence for the symbolic quality of hillforts is the “hidden/revealed” aspect of hillfort construction and placement. The hillfort is clearly visible as a massive structure upon a hilltop while the activity within it is hidden by ramparts and palisades. This state of being both prominent and hidden has been compared to an amphitheater in quality (Ralston 2006). It also bears some similarity to ritual sites in other cultures, such as mounds and the buildings on top of them in the SE United States and elsewhere.

Direct evidence of ritual activity comes from animal burials, especially those in conjunction with well-developed “showy” entrances (Ralston 2006). These burials are assumed to be ritual in nature, as they have been found at more than one hillfort (hence there is evidence for a repeated pattern of activity) and there is no practical explanation for the activity. Animal burials have been found in former storage pits at Danebury (dog burials) and at Blewstonbury (horse burials, which seem to have the horses oriented along east-west axis) (Ralston 2006;Cunliffe 1984). These sorts of animal burials are not exclusive to hillfort contexts within Bronze and Iron Age Europe; animal burials similar to hillfort burials are quite common as a global ritual activity as represented in the ethnographic and archeological record (Wilson 1999). It is difficult to ascertain the objectives and meanings in these ritual burials. There have been arguments regarding both luck and fertility in conjunction with these activities (Wilson 1999).

Hillforts have been considered as evidence for hierarchy in Iron Age society. This is based primarily on assumptions of labor organization and control involved in the creation of hillforts, the idea that those living in prominent places such as a hillfort must have an exalted status, and that hillforts were involved in the collection and redistribution of foodstuffs. However, these are all merely assumptions. While it is obvious that labor was organized and mustered to build the hillforts, this does not necessarily translate into a “princely class” or other permanent superior group. There is little evidence for differences in status within hillforts, as the buildings and goods found with a hillfort resemble those outside the structure. Furthermore, there is a drop off in status laden grave sites during the middle Iron Age, which may argue against a high status group within Iron Age society. Thus, the question of whether hillforts are a reflection of an “upper class” within Iron Age society is an open one.

Regional Archeology

As is the case throughout most of Europe, archeological sites abound in Burgundy, and the area around Mont Dardon is no exception. There is evidence for nearly all time periods in the sites within the region. However, compared to the rest of Europe, and especially within France, this is a relatively unexcavated area. Many sites have been identified near Mont Dardon via survey and have been given approximate dates. But only a few of these sites have been excavated with any degree of thoroughness. Talented amateurs have carried out most of the regional excavations and their activities are documented in difficult-to-access gray literature, or often not published at all. Amateur archeology dominated until the 1990's, when the French government took a firmer hand and created a strict permitting process. This permitting process has restricted excavation in the region, for the most part limiting excavation to small, scattered, salvage operations and extensive excavations at Bibracte (Mont Beuvray).

Regional Archeology: Local Surveys

This section discusses a few surveys that have been conducted in the region in an attempt to provide some idea of the archeological setting in general. I will then describe some sites in the regions, in an effort to give a sense of the regional activity during different time periods in a more detailed fashion. The largest and most prominent local site, 30 km away from Dardon, is Bibracte, and the bulk of this description will be focused on this site. It is also the only other local site that has had systematic archeobotanical study, making it doubly relevant to purposes of my dissertation.

Evidence for trade and connectivity in the region comes from a discussion and analysis of road systems in the area surrounding Mont Dardon conducted by French Project researcher Jason Dowdle (1987). His survey was conducted mainly using historical data, observations on topographic maps, and specific evidence for trade between two places (the assumption being, a road would by necessity connect the two places). Dowdle wisely presents most of his work as being incomplete reconstructions, as there are major limitations in the evidence available and assumptions made.

Gaulish roads are particularly difficult to map, as they were unpaved (the exception being a possible main road running through Bibracte;Dowdle 1987). Aerial survey may be helpful in discovering and verifying Gaulish roads in the future, but has not been tried for this purpose in the region (Dowdle 1987).

However, in spite of the lack of direct archeological evidence, there was obviously a Gaulish road network in place during the Iron Age period, and probably earlier. Large Gaulish sites that were later connected by Roman roads give circumstantial but compelling evidence for earlier roads that the Romans paved over, for example. River valley routes were also important corridors of movement. Bibracte was undoubtedly connected by road to many other major population centers of the Aedui, such as Cabillonum, Matisco, Decetia, and Noviodunum, as well as outlying population centers (Dowdle 1987). The evidence for this can be found in Caesar's campaign memoirs, where he gives accounts of troop movements (Dowdle 1987). The evidence for roads of great distance indicates that there was likely a merchant class, or at least a great deal of trade activity, supported by the road network (Dowdle 1987)

Dowdle astutely notes that drawing a clear line between pre-Roman and Roman networks is a somewhat arbitrary endeavor, given that many of the Roman-era roads were in fact developed from extant networks, rather than a complete novel transformation of trade geography (Dowdle 1987). In his discussion of Roman roads, Dowdle found that the majority of Roman built roads (i.e. paved) mentioned or implied in historical sources probably replaced extant Gaulish roads (Dowdle 1987). This suggests that there was a thoroughfare network already in place at the time of conquest, which the Romans could expand upon (Dowdle 1987). Roman roads creating new routes were generally placed for efficiency, creating new shorter or easier routes for travel, or integrated new Roman city centers into the extant network (Dowdle 1987).

This road study is significant, as it implies a high level of community connectivity already present in the Aedui territory prior to Roman activities. Though artifact evidence is scarce for internal trade, it is likely trade was occurring using perishable agricultural products, in Dowdle's view (1987). This probable trade in agricultural materials presents a possible avenue for future studies in paleoethnobotany, once a larger body of data has been collected from both major and minor sites.

French Project researchers in conjunction with their excavations of Mont Dardon conducted an extensive regional archeological survey (Crumley et al. 1987). The aim of this survey was to study the relationships between smaller, rural sites and the larger (better studied) hillforts of the region, and to place the site locations in relationship to environmental factors (geology, elevation, etc.) in order to look for patterns of site distribution (Crumley et al. 1987). Approximately 60 square kilometers was surveyed on foot (with territory being divided into 10 sections;Crumley et al. 1987). The survey area was selected in relationship to major hillfort sites of the region, rivers and a (presumed Celtic) road (Crumley et al. 1987). In addition to the foot survey, there was an aerial survey, as well as informant interviews (Crumley et al. 1987). This survey produced evidence for 122 "localities" or possible sites (Crumley et al. 1987). Fairly even component numbers from Iron Age, Roman, and Medieval periods were found (Crumley et al. 1987). Patterns that were found within the study include a greater number of Iron Age sites in areas of higher elevation, with Roman site being more often located in the river valley bottom (Crumley et al. 1987). Explanations for this change in land use may be found in either the removal of a perceived threat on the part of the Romans by forcing the threatening highlanders to conform to lowland territories, or alternatively a choice made by individuals to take advantage of easier trade routes and Roman commerce opportunities (Crumley et al. 1987). Medieval activity was found in both upland and lowland areas (Crumley et al. 1987).

This survey demonstrates that the area around Mont Dardon was an activity-laden landscape throughout the site's history. The activity may have been concentrated in higher or lower elevations depending on the time period, however.

Lucien Oliver and Claude Rolley (2002), researchers associated with excavations at Bibracte conducted a brief survey (via literature review) of the prehistoric sites of the Morvan Mountain Preserve. Dardon is located in the foothills of the Morvan Mountains, and thus is in proximity to the survey. Their survey was conducted mainly as a summary of known sites that had been reported to the different departments (similar to states in the United States) associated with the Morvan (Olivier and Rolley 2002). The survey was hampered by a lack of good maps of the Morvan (Olivier and Rolley 2002). It concludes that a lack of good-quality top soil in the Morvan may have hampered preservation of sites, as well as potentially discouraging habitation (Olivier and Rolley 2002). Additionally, the Morvan is forested and probably has been for millennia (Olivier and Rolley 2002). All of these elements make finding, recording, and researching prehistoric activity in the Morvan difficult.

The only finds within the Morvan from the late Bronze Age were a few menhirs (man-made or manipulated ritual stone formations), and various scattered bronze objects (Olivier and Rolley 2002). These do not constitute adequate evidence of occupation sites but do imply activity in the region. There are several large sites in the foothills of the Morvan (including Mont Dardon, which gets a mention as a late Bronze Age site) many of which have better preservation due to more favorable climate and topsoil conditions in the foothills.

There are scattered Iron Age artifacts recovered in the Morvan; these include two swords and a “curious” and “unique” vessel (Olivier and Rolley 2002). Again most of the documented finds are from the edges of the Morvan, and even here they are quite sparse, with only a few bronze objects being found in town of Avallon, and a statue from the period being found in Autun. A general de-occupation of the region is suggested by the authors during the middle of the Iron Age. This is consistent with general trends within continental Europe, as this is considered a “migration period” (Olivier and Rolley 2002;Cunliffe 1997). It is also consistent with evidence from Mont Dardon, which is abandoned during the middle part of the Iron Age.

The final period of the Iron Age (La Tène final) represents the busiest period in the Morvan. New ceramic production areas (Pont Charriot) appear, which continue into the Roman period, as well as sites associated with springs (Les Sources de L’Yonne). In Avallon, a town which comes into being in the early medieval period, there was a large circular sanctuary constructed during the 1st century AD (Olivier and Rolley 2002 pg 273). So while Bibracte dominated the Morvan landscape, it was not alone as an activity site during the end of the Iron Age and the early Roman period.

These three surveys show a picture of activity surrounding Mont Dardon during its period of use; the region was generally active, and Mont Dardon can be presumed to have been a part of the networks of activity and trade present at all times during its occupation. However, trade with within Morvan doesn't seem to start until the later Iron Age, with the expansion of Avallon and other sites, as well as the creation of Bibracte.

Regional Archeology: Excavated sites

Excavated sites in proximity to Dardon do not represent the end of the Bronze Age and early Iron Age. There are no farmsteads or other small settlements (which would have been typical for the period) that have been excavated. One would expect, based on other sites excavated in central Europe and within France, that these farmsteads would consist of a few houses (usually rectilinear) and families, with some palisade/ditch enclosure, and occasionally some minimal evidence for long distance trade (and possibly defense, although weaponry is generally preserved and recovered in ritual deposits and burials rather than in former battle situations). Usually these households would be engaged in a mixed economy, with both animal husbandry and agriculture being practiced.

This lack of excavation is in part a preservation issue, as farming and tilling through the millennia have damaged many of the smaller, older sites in the region, or they are located under farmland currently in use. Also, as was mentioned earlier, the current restriction on excavation permits and previous preferences for richer sites on the part of amateurs may have contributed to the lack of excavation of sites from this era.

However, there have been some investigations of tumuli nearby Dardon from the early Iron Age, and tumuli sites make up a large portion of those that have been excavated in the larger region.

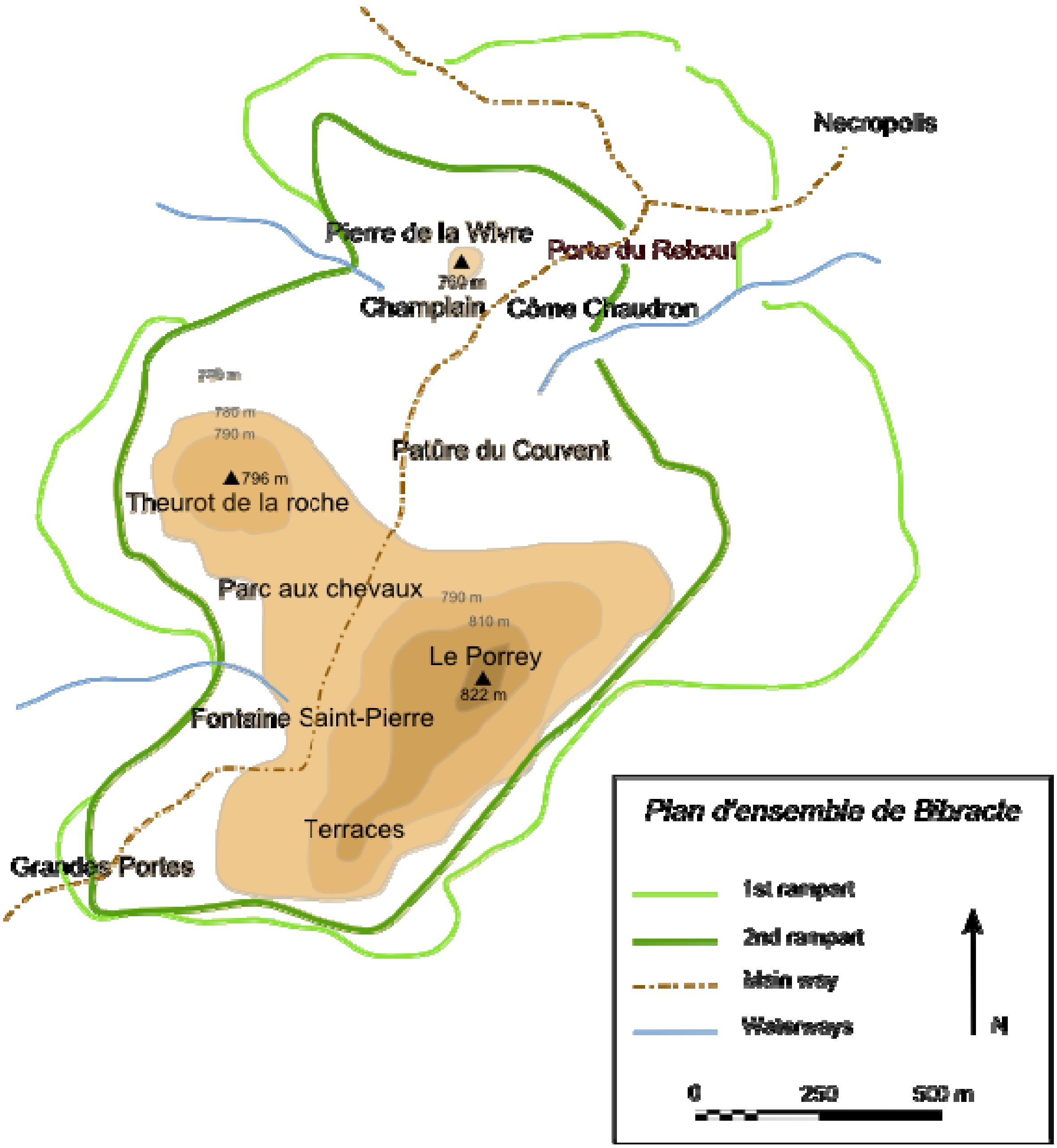
Tumuli are grave mounds, usually with a chamber burial within the mound, and occasionally with a shaft burial beneath the mound (in addition to the chamber). There is also evidence for multiple burial events at some of the tumuli. They represent communal labor, as they can be fairly large. This factor of labor, and the status that is implied by differential burial, as well the occasional tumuli with rich grave goods has given rise to the notion that the tumuli represent a Hallstatt “princely class” or incipient warrior elite. This idea of a clear connection between tumuli and an obvious hierarchy is one that is receiving some critique, as patterns in the burials seem to emphasize ritual rather than status, and also more women seem to be found in the burials than men (undermining the notion of “princes”). After the late Bronze Age/early Iron Age tumuli are replaced with necropolis, areas enclosed by a rectilinear ditch and earth embankment (often with ritual deposits at the corners) where bodies were laid out to decompose.

The local tumuli which has been investigated by French Project researchers is called Le Taureu de l’Abime or La Revivre. It has been dated to the earliest portion of the Dardon sequence, and can be considered a contemporary site to Dardon during the Hallstatt period. The site is 3.5 km from Dardon, and presuming forest cover was not extensive over the site (recovered pollen supports this supposition) it would have been visible from Dardon. The site has been excavated and looted several times, and as such the center of the mound is now missing. However, a profile was cleared from which pollen and Carbon-14 (C14) samples were acquired. These samples provide evidence for the ritual use of mistletoe (specifically burning large quantities of mistletoe), and this is a unique find within Europe (Crumley and Meyer 2006). This site demonstrates the range of activity happening in the first portion of Dardon’s sequence; particularly, its uses are not simply economic.

There is a lack of activity in the region (as detected by surveys and the abandonment of Dardon) during the middle of the Iron Age, which means there are no sites representing this period in proximity to Dardon. This is likely a reflection of the migratory period that occurred across Europe, wherein large numbers of people and whole Celtic groups moved about. It is not specifically known what the cause of this migration was, although over-population is a prime suspect, with members of an overpopulated North and East moving towards the Mediterranean (Cunliffe 1997). During a time of over-population, a "warrior elite" (as evidenced by the armor and swords found as grave goods in tumuli and other evidence of warfare as well as historical accounts) may have found long distance raiding a valuable way to expand status in the face of increased competition (Cunliffe 1997). Climate change (the start of the Roman Climate Optimum) may have played a role as a disruption, further destabilizing populations.

A site in proximity to Dardon that falls at the end of the Iron Age and early Roman contact period is Mont Beuvay, or Bibracte. Bibracte's size, historical importance, and excavation history make it the most prominent Iron Age site in proximity to Dardon. Bibracte is located 25 km to the north of Mont Dardon on the mountaintop of Mont Beuvray and its smallest enclosed area is approximately 135 hectares in size. A map of the site, Figure 1, is below.

Figure 1: Map of Bibracte, Mont Beuvray (used under Creative Commons license 2)



The chronology of Bibracte is somewhat short, with minor amounts of activity occurring before and after its existence as a hillfort/oppida, its major period of activity is during the last two centuries BC. Bibracte has some activity occurring during the Neolithic, when there were palisades at the site, however, activity was most intense during the late Iron

Age and very early Roman periods. There were several phases of rampart construction and re-fortification as the site's use expanded and intensified. Excavations at the Port du Rebout, one of the entrances to the oppida showed several periods of construction and one of disuse, ranging from Neolithic palisades, followed by non-maintenance of defenses, a complex Murus Gallicus rampart, and the addition of a talus (slope) earth fortification (Ralston 2002). There is excavated evidence for districts of artisans (metal workers and potters) at the site during La Tène D2 and D3 which indicates specialization and a higher level of urbanization than was there previously (Guillamet 2002). Bibracte was also a center of trade; evidence of artisans inhabiting and working at the site and coinage from across Celtic territory are found at the site. There were terraces within the rampart walls, which may have been used for farming or grazing purposes. But these terraces would not have been sufficient to supply the settlement, given the poor quality of the soils. Trade for agricultural products from the lowlands is almost assured (Wiethold 1996). Bibracte appears in the historical record as the capital of the Aedui (who were allied to Caesar), as Caesar completed writing his Gallic Wars on the site itself and it was apparently the location of Vercingetorix's election as the Gaulish Celt's coalition leader in their fight against Caesar. After the Roman take over of the region, the inhabitants of the oppida either were moved by force or chose to relocate to the large Roman city of Autun after an edict in 12 BC by Caesar Augustus ordered it (Crumley et al. 1987).

There has been some archeobotanical work conducted at Bibracte, primarily by Julian Wiethold. His study published in 1996 summarizes his findings from 2 portions of the site, the La Terrasse sanctuary dating to late Celtic times and a Roman cellar found in the Pâture du Couvent area of the site. His results may make for interesting comparisons with the

Dardon results. The different natures of the two hillfort sites and the time periods concerned do not make for a one-to-one comparison.

The samples from the La Terrasse part of the site came from a rather interesting object, a burned wooden box. The vast majority of the remains were of chaff and processing remains rather than actual grains, and the vast bulk of the chaff was from wheat, specifically *Triticum diococcon*, or emmer wheat. Other grain remains were found, from bread and club wheat as well as six rowed hulled barley, but these remains were significantly less in number than the emmer remains. *Triticum spelta*, or spelt wheat, was only represented by a few processing remains. Two types of millet were present, which, small in quantity, is nevertheless unusual due to the scarcity of millet during the time period (Weithold 1996), making the finds of *Setaria italica* and *Panicum millacum* significant. They may be the first finds of millet from the Late Celtic period found in France (Weithold 1996). Pulse crops, hazel shell, and weed seeds were also found. The interpretations possible for the use of the box are several, they may represent an offering (given that it was found in a sanctuary area), packing material for an object shipped in the box or fodder.

The other samples considered were seven samples from Pature du Couvent, which represent finds from a grain storage area. Identification of grain was difficult due to its being burnt while germinating and otherwise damaged. The germination may have been deliberate and related to the process of beer making (Weithold 1996). Composite grain categories, *T. diococcon/spelta* and *T. dioccon/aestivum* were used to address this problem. T. *diococcon* (emmer wheat) represented the majority of the finds, at 78%, with *Hordeum vulgare vulgare* (six rowed barley) following at 13% and *T. aestivum* (bread wheat) at 4%. *Panicum millaceum* was present, but in small quantity and may have been an incidental weed. *Seacle* *sp*. (rye) and *Avena fatua* (oat) were also considered as weeds, given their small numbers and the physiology of the oats. Two imported olive pits were also found. Pulse crops and wild fruits were, as in the first area reviewed, scarce. Weed seeds such as *Agrostemma githago* (corncockle) were indicative of Roman period agriculture. Also, seeds of *Orlaya grandiflora* (white lace flower) may point to trade, as this weed does not grow on soils found around Bibracte. Small weed seeds were not found, indicating threshing had already occurred.

After the Roman military success in the region the residents of Bibracte were ordered to move to the city of Augustadunum (the modern city of Autun). This town was fairly typical of a thriving Roman settlement, with a stadium, large Roman walls and arches which are still extant today. Sarah Bon-Harper conducted a study of the foodways of the relocated settlers based on ceramics found at the ceramics-manufacturing site of the Lycée Militaire within Roman-era Autun (Bon 1999). She documents that the settlers had likely already adopted Roman foodways before their transfer to the city. Celtic vessels are typically more generalized and communal than Roman dining sets, and the Roman vessels tend to be used for specific preparations (bread baking, frying, etc.) that were not part of Celtic foodways in which there was less emphasis on grains. Celtic grain foodways emphasize porridge over baking (Bon 1999). Even in the earliest phases there were high numbers of specific-use, individual place setting, Roman-style vessels (Bon 1999). This is interesting as it implies a high level of cultural contact prior to conquest and highlights the lack of a specific date that can be assigned to a "break" with earlier purely Celtic tradition.

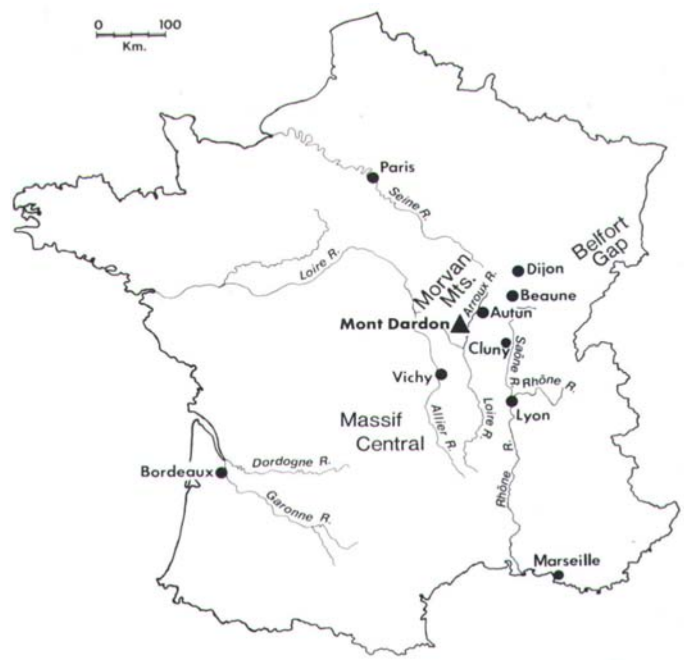
Mont Dardon clearly existed within a large, dynamic community of people who were networked by roads and fairly populous. Surveys and excavation (though limited) demonstrate this. Having discussed the regional archeology, details of the site of Mont

Dardon itself are now presented.

The site of Mont Dardon

The hillfort site of Mont Dardon is located in east central France (Burgundy), among the foothills of the Morvan mountains in the Arroux River valley (see Figure 2 for a map of its location). The site sits at an elevation of 505.4 meters and as the highest point within 25 km has an unobstructed view in all directions (Green et al.1984; Downer 1978). The site is in a rural area approximately 7 kilometers away from the Arroux river (Downer 1978).

Figure 2: Location of Mont Dardon in France (used with kind permission, from Marquardt and Crumley1987)



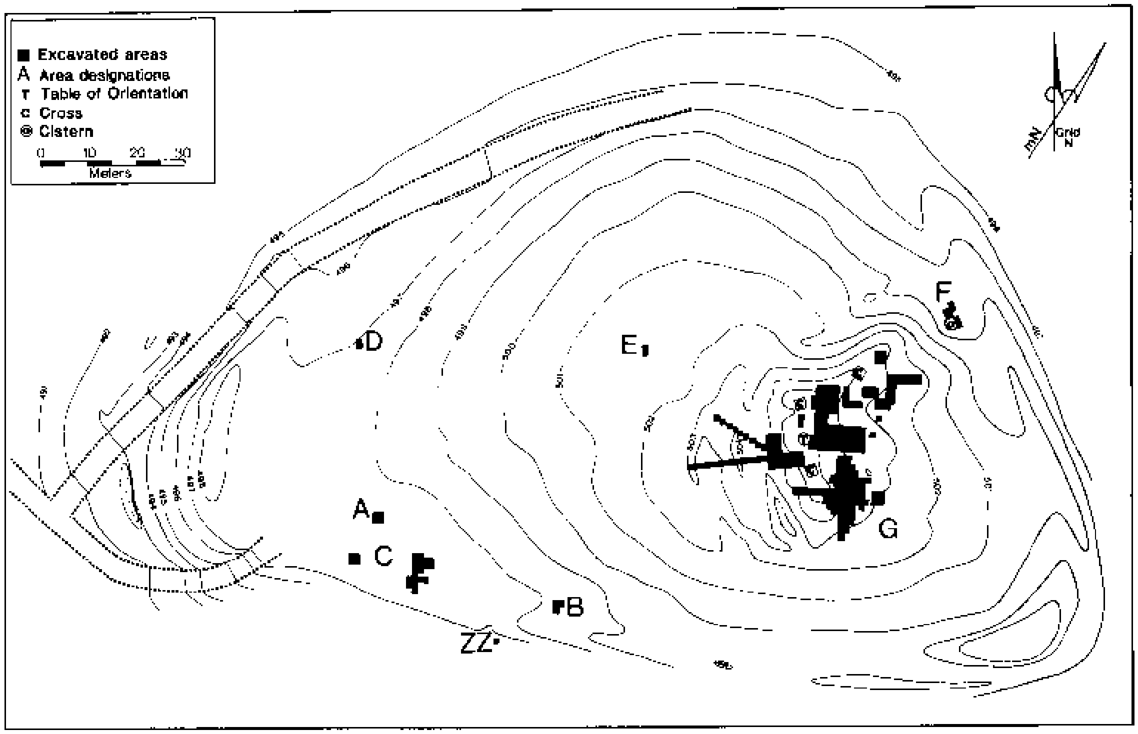
The Arroux River valley runs roughly between the cities of Autun and Digoin and in the past served as a trade route between those two cities. A village, Uxeau (the entire commune- similar to a United States county- has a population of approximately 500) is located at the base of the hill on which the site is situated. The commune of Uxeau can be described as a "farming community" with cattle farming (of the white Charollais variety) being a dominant local activity.

Amateur archeologists carried out the first excavations on Mont Dardon, with the first recorded (though not documented in an extensive way excavation occurring in 1865) (Downer 1978). This first excavation uncovered ceramics, house foundations, and tiles but the relationship between these artifacts was left unclear, though a date was given for activities on Mont Dardon based on them, 100 BC or late La Tène (Green et al.1984). The well-respected amateur H. Parriat led the second excavation in the years 1965-69 (Green et al.1984). Parriat's excavations, consisting of several trenches running through the southern ramparts, were aimed at testing the La Tène III date that had been assigned to the site. His excavations revealed a much deeper time scale than was previously thought, with three periods of occupation during the Neolithic (revised by the latest excavations), the Late Bronze Age/Early Hallstatt and the La Tène III/Gallo-Roman periods. The Neolithic occupation was identified by the presence of flake stone tools, though these may have been the result of later activity during the Bronze Age, when metal was scarce (Downer 1978). Parriat's assumption of a Neolithic zone was made doubtful by further excavation, carried out by the French Project (Green et al.1984;Downer 1978).

French Project excavators led by Dr. C Crumley carried out excavations on Mont Dardon from 1975-79, with funding from the National Science Foundation. The aims of this excavation were to: "1) to establish a chronological sequence for the local research area, focusing on the Arroux river valley; 2) to discover the cultural functions of the mountain over the millennia; and 3) to characterize artifact variability for each cultural period, thus facilitating the interpretation of material recovered in the region" (Green et al. 1987). The largest portion of the excavations was focused on a flat area just down from the summit of

Dardon (Area C) and on a medieval chapel on the summit (Area G). A map of the excavation is provided below (Figure 3).

Figure 3: A map of the French Project Excavations of Mont Dardon



The French Project collected botanical samples from Mont Dardon from Area C. Area C is near the rampart wall and consists of 12 contiguous 1 by 1 meter square units that were dug in 5 cm arbitrary levels. Soil samples were collected from Area C from each level using a "column" type strategy and from areas of possible features. The soil samples were floated using an early SMAP–type water flotation system that was selected with help from Patty Jo Watson (Crumley 1987). The use of a flotation machine at the early date of 1975 in France was remarkable, and it may have been the first example of its use in France.

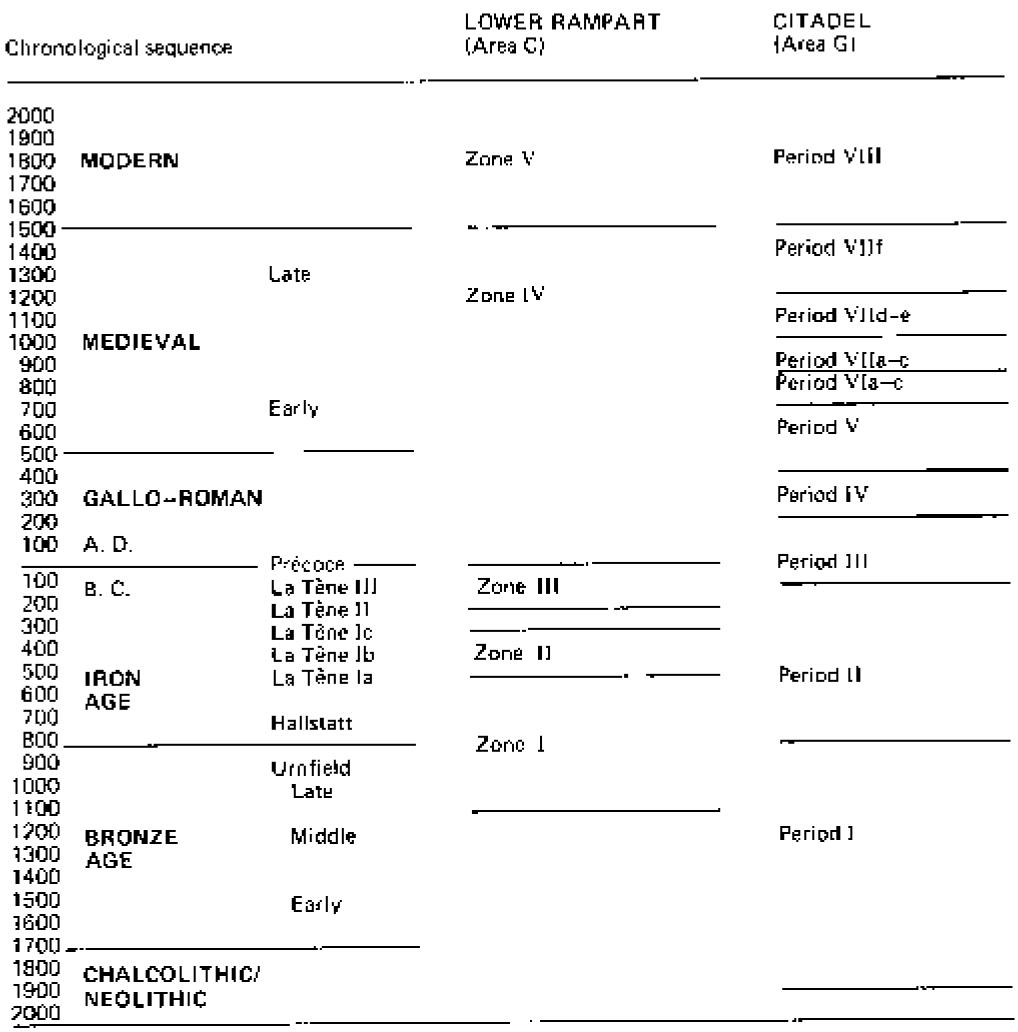
Five cultural zones of occupation were uncovered in Area C. I will discuss the assignment of chronology in the next section followed by excavation data for Area C cultural zones, as well as Area G located at the summit.

The Chronology of Mont Dardon

The chronology used in this summary of the results of the excavation of Area C follows Green, et al.. (1987) and Crumley (2004, unpublished notes), who base their temporal assessments on a combination of radiocarbon dates, artifacts and ceramic data. Paul Green and Al Downer initially conducted ceramic analyses. Ceramics were not commonly used to create chronologies, French archeology had historically given preference to metal objects for chronology creation (Downer 1978). Also, comparative ceramic materials from the region were scarce. The chronology could be improved by further radio carbon dating of materials recovered in certain areas, as the technique has improved in the years since the first dates were procured. Also, a reanalysis of ceramics is underway, using improved comparative materials. Both of these activities could be helpful for further understanding of the site. However, all the data currently available (including the chronology by the first excavator to establish a site chronology, Parriat -- his assumption of a Neolithic phase at the site notwithstanding) are in concurrence regarding the chronology, which is remarkably consistent among investigators. The chronology is summarized in Figure 4 below.

Zone 1 comprised the late Bronze Age through the Hallstatt period (1200 BC to 450 BC). Zone 1 was discontinuous across the units of Area C, which may indicate a small and minimal occupation of only a few homesteads. Two features were found in this zone, a pit (Feature 9) and an artifact concentration spreading across several excavation units (Feature 24;Green et al. 1987). The artifact concentration comprised large sherds, a block of unfired clay, and a scattering of boulders and cobbles. There were also some circular charcoal stains abutting Feature 24 (Green et al. 1987). These remains may represent a living area (Green et al. 1987). Ceramics found in Zone 1 include mostly dark gray and black Dardon ware, with one nearly complete vessel of red-yellow variety. The nearly complete vessel appears to be very similar to Urnfield ware (Green et al. 1987). There was also a complete Urnfield vessel in this zone, as well as a rim sherd (Green et al. 1987). These were the only Urnfield remains found. Urnfield type vessels

Figure 4: The Chronology of Mont Dardon (from (Green et al. 1987) used with kind permission



can be found across a fairly broad region in Europe, including parts of Germany, Switzerland and Eastern France. Typically Urnfield culture is associated with the end Bronze Age (1300 BC – 750 BC), and the presence of the vessel in a zone shows persistence of Bronze Age culture at the site and a slow taking up of Hallstatt culture. The excavators gave the vessel a date of 900 BC (Green et al. 1987).

There was probably a rampart present during Zone 1, just to the South of Area C as well as a small settlement during the phase associated with Zone 1 (Green et al. 1987).

Zone 2 represented the La Tene 1 period (450-200 BC) and possibly earlier (Green et al. 1987 p48). Features in Zone 2 include 3 probable pits and one artifact concentration (Green et al. 1987). This is the only area of the site where intact animal remains were recovered. Some teeth and mandibles of domestic *Bos* sp. (cattle) were identified from these animal remains. Zone 2 was quite thick, and seems to indicate a more significant occupation than found in Zone 1. Also, the average sherd size is larger than in Zones 3-5, which points to less disturbance in this Zone. Ceramics found include Lassois ware (common in Eastern France) and burnished Dardon ware. Lignite bracelet fragments were also found, similar to those found in other regions of France (the Jura and Champagne), as well as two spindle whorls. These remains and the depth of this zone indicate there was undoubtedly some sort of settlement on Dardon during this period, but it may not have been located on the summit. Area G did not produce many similar remains, and remains washed down from the slope in Zones 3-5 also do not include similar ceramics (Green et al. 1987); settlement was probably concentrated around rather than directly atop the summit during this period.

There was a period of abandonment between Zone 2 and Zone 3, which corresponds to a wider abandonment of the valley which was typical in the middle Iron Age migration period.

Zone 3 dates to the La Tene 3 period or Roman contact period (100-52 BC) via ceramic analysis and is corroborated by the find of a coin dating to the 1st century BC from

Leuci (a polity to the North;Green et al. 1987). At the time of excavation, twenty-five years ago, this zone did not produce any samples suitable for mid-1970s radio carbon dating (Green et al. 1987). There were 9 features found in this zone, including several pit features. Artifacts found include some bronze objects, such as beads and ornament pieces. There were intrusions into the layer of Roman roof tiles, and medieval artifacts (mostly iron nails) in parts of this zone. In the La Tene 3 period of the Iron Age, Dardon was within the polity of the Aeduan tribe. An earth embankment rampart was constructed during this period, and it may be that it was hastily constructed in response to events during the time period; there were migrations of other tribes during this time, as well as conflicts between the “pan-Gaullic” forces of Vercingetorix;Green et al. 1987). It is likely that the majority of La Tène 3 activity occurred on the summit (Area G) rather than being concentrated in Area C. A portion of this zone was very close to, and later covered by the rampart. Zone 3 deposits are slender as compared to zone 1, and the relative abundance of La Tène III tiles on Area G on the summit all point to an activity center on the summit rather than in Area C.

During the period of Zones 2-3, Mont Dardon was a hillfort, as it had several circuits of manmade defenses (ramparts). The architecture of the ramparts at Mont Dardon was simple ditch and earth embankments, possibly supplemented in areas by wooden stockades (Downer 1978). The first rampart enclosed approximately 10 hectares, the second approximately 6 hectares, and a final set of stockades, another 900 square meters. Other regional hillforts (most prominently Bibracte) have more elaborate timber laced (“Murus Gallicus”) embankments. Hillforts throughout Europe have varied purposes: ritual centers, animal pens, residential settlements and the obvious defensive centers are all functions hillforts have served (Ralston 1995). Hence, the hillfort and its ramparts may not necessarily have been used in warfare (Ralston 1981 p79).

In the case of Dardon, we can say that it was unlikely that its hillfort ramparts were used in warfare. The only remains and activity that may point to warfare at the site during its entire chronology is the destruction of the church on the summit during the medieval period (10th century AD) long after the embankments were constructed and the site was active as a hillfort. A wall of the church was collapsed, possibly allowing for use of the damaged structure as battlements; this would be consistent with the general violent upheaval present during that time period.

Zone 4 consists of both Gallo Roman and Medieval materials. There were upper and lower sections to this zone, with the lower portion showing evidence of an 11-12 century AD occupation (Green et al. 1987). Two pits in this lower portion (features 2 and 7) were found to have many carbonized grains in them (Green et al. 1987). Tiles similar to Gallo Roman tiles found on the summit are found in this zone, and provide an approximate lower stratigraphic limit for the Roman period (mid-first century AD). Most remains in Zone 4 (with the exception of the pit features) may be eroded material shifted downwards from the summit. Roman period remains were also disturbed in Zone 4 by medieval activity, as evidenced by the medieval dated pits within the Zone 4 (Green et al. 1987). These disturbances make samples collected from this area difficult to interpret. After zone 4 (1500 AD) there is no more evidence for human occupation on Dardon.

The majority of the remains of activity from the summit (Area G) are in the La Tene III and later periods. Botanical samples were not taken from the summit area (due to a decision by Walter Berry who led excavations beginning in 1977).   Area G is a prominent region at the site, and has significance in interpreting remains at Area C. Erosion heavily disturbed the Bronze Age/Hallstatt and La Tene III remains on the summit (there were no La Tene 1 or 2 remains;Green et al. 1987). There were fragments of fibulae and Gaulish coins found dating to 50-0 BC but this is the limit of Celtic remains (Green et al. 1987). Roman occupation on the summit left no structural remains, however, roof tiles, terra cotta figurines, a bronze statue of Mercury, coins, glass vessel fragments and iron construction nails indicate the presence of a rural temple on the summit area during the Roman period (Green et al. 1987). From the 4-7th centuries, there was a period of abandonment on the summit. There was construction of a rectangular building (in the 9th century) and a chapel (in the 2nd half of 10th century;Green et al. 1987). The chapel consisted of an asped sanctuary, and a nave with a tower. A lack of tiles indicates a thatched roof (Green et al. 1987). There was a children's cemetery discovered in the same period as the chapel. The chapel was destroyed sometime in the 11th century. Traces of habitation were found from the 12th-15th centuries (including earthen embankments) but evidence was scarce for this time period (Green et al. 1987).

Conclusion

Mont Dardon was located in a networked, well-populated landscape, and was contemporaneous with sites of ritual significance. It was a contemporary of the large site of Bibracte in its later phases and ritual sites such as the tumuli of La Revivre in its earliest phases. It is likely, based on its site type of hillfort, that Mont Dardon had ritual significance as well as represented communal activity (collective labor being necessary to create ramparts) and some type of group organization (which may imply hierarchy). Its excavations also reflect those assumptions, as throughout its chronology, it was likely a site of settlement with communally built ramparts and/or religious buildings.

CHAPTER THREE
THE ECOLOGICAL SETTING

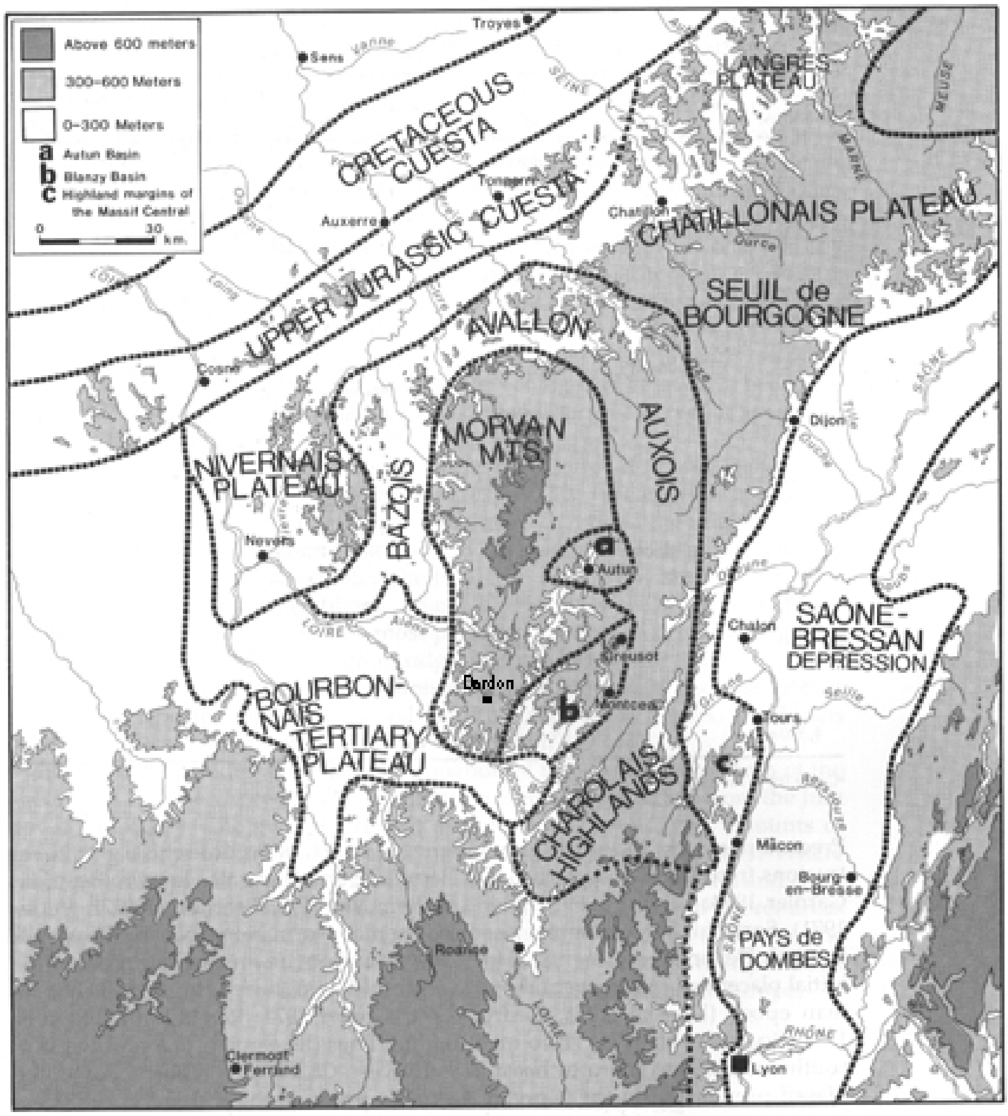
Introduction

Burgundy, France is an ecologically diverse region; climatic regime, hydrology and topography all produce wide variation across the region. This chapter provides a description of the biophysical landscape surrounding and including Mont Dardon, with discussion of the general geography, climate, soils, and plant communities. The diverse regional ecology of Burgundy is a rich context by which to consider the archeobotanical remains from Mont Dardon.

Figure 5 shows the regional topography, cities, and primary geological formations. The scale of this figure is quite large; the region discussed in this chapter is somewhat smaller, focusing on the river valley in the vicinity of Mont Dardon.

The geography of the immediate region surrounding Mont Dardon is hilly, as the site rests in the foothills of the Morvan mountains. Mont Dardon is situated in the Arroux river valley, and the Arroux river runs about 5 km away. There are no natural “zones” resting in neat discrete bands as there might be in a relatively undeveloped area in North America. For example, even small areas of forest that have been present for hundreds of years according to historic maps have, upon survey, very different plant constituencies, and this is related to management of those areas, not native ranges of plants (French Project in prep).

Figure 5: Large Scale Regional Map (used with kind permission, Crumley and Green 1987)



The area is a patchwork of climate and plant ecology, all under human influence dating back much prior to the historical record. Agrarian activity contributes greatly to the variegation of the landscape with few if any places not influenced by human activity in the region (as was described in the palynology studies discussed in Chapter 1). Figure 6, an aerial photograph taken in 1944 of Mont Dardon illustrates the patchy quality of the region.

Figure 6: Aerial photograph of Dardon taken in 1944 as part of WWII surveillance (from the collection of Scott Madry, used by permission)

In spite of the regions difficult-to-generalize geography, there are regional biophysical qualities that can be described in general terms. This chapter will cover those elements: climate, soils, and regional botanical information. These qualities are important for agrarian activity in the region, and can be presumed to have impacts on the Dardon archeobotanical remains, as they are a reflection of agrarian practice.

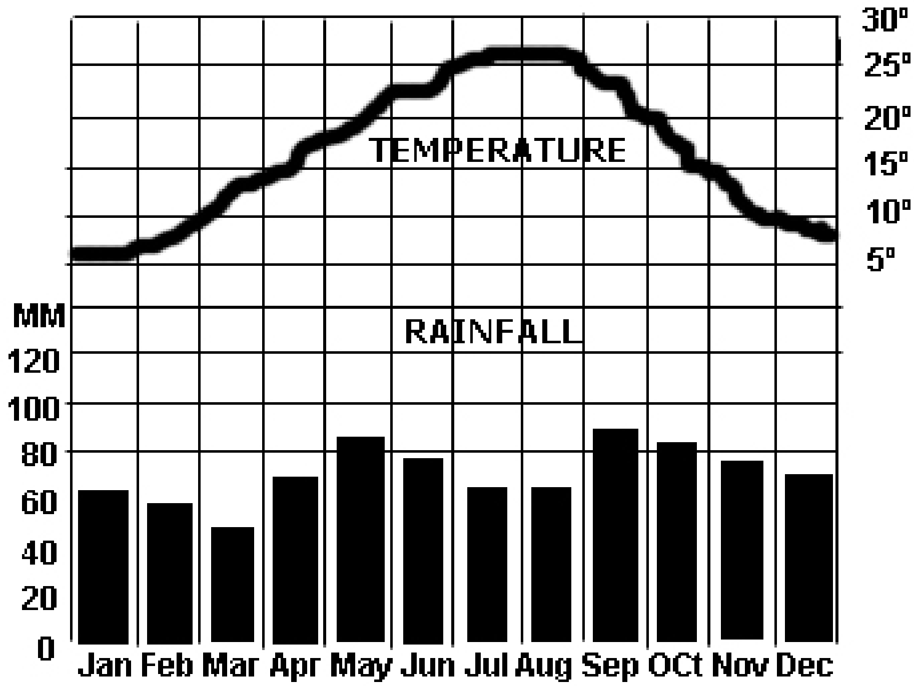
Climate

To discuss climate, one must define it, as it is easily misconstrued. Climate is the aggregate of weather; one droughty summer or exceptionally cold winter does not define climate, it is a longitudinal set of weather events that provides a mean and extremes during a certain period. Fine-grained data are necessary to describe the outer limits of the set. Generally, climate sets are constructed of periods of 30 years in modern times; however, in the case of past climate reconstruction, this fine scale is not practical and there is flexibility in defining a range (Lamb 1995).

This section is devoted to discussing climate in Burgundy during the period of Mont Dardon's habitation (approximately 800 BC to 1400 AD). My tactic for accomplishing this will be to describe the modern climate and then to discuss the differences in various periods under consideration. Our modern climate began with the end of the last Ice Age and the beginning of the Holocene (which began ca.12,000 years ago). There has been some variability in the climate in the Holocene, but generally it has remained fairly stable.

Burgundy rests at the juncture of several different climate regimes, oceanic and continental influences from the North and mountainous and Mediterranean influences from the South (Crumley and Green 1987;Crumley 1994a;Vaucoulon and Chiffaut 2004). All of these climate regimes influence weather in Burgundy, though usually one of them dominates at a time. Weather can vary widely from year to year in the region. Typically the last frost date is around May 17th, the Advent of St.-Boniface (Wilson 1998). Summers are generally dry, with most rainfall occurring in winter and spring. Strong storms often sweep in from the Morvan mountains (from the southwest and the north;Crumley and Green 1987). Average annual rainfall is about 28 inches (Wilson 1998). Typically there is considerable rainfall in the region in early summer and late winter, and these heavy rains occasionally cause the Arroux river to inundate lower lying fields (Crumley and Green 1987). Temperatures range from around 0 C to 27 C overall, with peaks occurring in August and July, and lows occurring in December and January (Wilson 1998). Figure 7 illustrates these patterns.

Figure 7: Rainfall and Annual Temperatures for Burgundy, France (based on figure in Wilson 1998)



The location of Mont Dardon in the Morvan foothills provides for an interesting array of microclimate regimes. Microclimate is the term for a small area which differs in its climate from the surrounding area. An example of microclimates around Dardon is the phenomenon of rain shadows, which means one side of a hill may receive more rainfall than another. These microclimates are features that provide variation in the crops and (consequently) wines produced in the region through time.

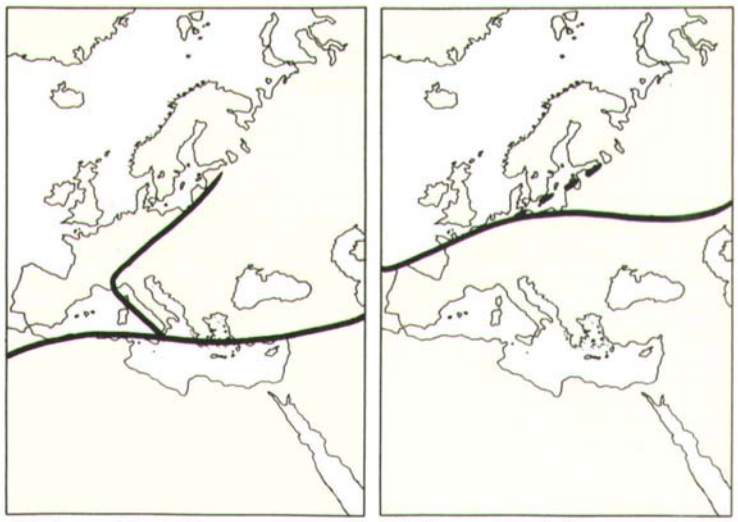
The beginning of the Dardon occupation sequence, at around 1100 BC, followed the end of the Holocene climax. The Holocene climax occurred 3,000 – 2,000 BC and was a period of warmer, drier conditions than today, with a probable difference in temperatures from present of plus 1-2 Celsius. The period following the climax was one of climate instability, with colder and wetter conditions generally prevailing (Lamb 1995;Burroughs 2005).

Following the colder conditions, there was a shift to a more Mediterranean climate regime. Roman Climate Optimum was a period (300 BC to AD 300) in which the Mediterranean climate regime occurred far north of its current boundaries in Europe; past Burgundy and at least 100 km north of its current position (although the effects presumably extended beyond the "boundary";Crumley 1994a). Figure 8 illustrates the shift in air masses that created this climate change.

This shift would have meant warmer and more stable weather overall, with dry summers and mild, wet winters rather than a more continental regime of highly variable weather, cold dry winters and damp summers (Crumley 1994a). The stable Mediterranean pattern could have encouraged the expansion of arable agriculture, as that climate type is particularly good for the growing of grains, especially wheat.

The end of the Roman Climate Optimum at around 400 AD undoubtedly contributed to the chaos surrounding the fall of the Roman Empire. It may have even sparked the fall, by provoking the many migrations of peoples from the North and East, who then proceeded to attack Rome and fight for territory (Burroughs 2005). There were many abandoned villas during the 4^{th} and 5^{th} centuries and farming activity was seen to decrease in many areas; this contraction of activity has been related to shifting climate (Cheyette 2008). Annual average temperatures may have dropped as much as 1 C during the 4^{th} century, and there is geological evidence of increases in rainfall as well (Cheyette 2008).

Figure 8: Shifts in air masses corresponding to changes in climate regimes
(Crumley 1994 used with kind permission)



Relative position of air masses
ca. 1200-300 BC

Relative postion of air masses
ca. 300 B.C. - A.D. 300

Excessive rainfall can lead to crop failure, both from the flooding and drowning of seedlings in the early part of the growing season and from rot during the end of the growing season. This period of instability in climate and peoples coincides with a period of abandonment of Dardon.

The period of instability in climate and culture continued until 900 AD, which ushered in a period of warmer stable climate that was again highly favorable to agriculture. This period of clement farming and stable climate ended in approximately 1400 AD with the beginning of an exceptionally cold period, the Little Ice Age, the beginning of which coincides (roughly) with Dardon's abandonment.

Geology (Soils)

After climate, geology (representing soils, lithic structures and drainage) has the largest impact on agrarian success and plant communities. Soils are formed by the weathering of underlying rock (an effect of climate) and are composed of colloids (clay and organic matter) and sands. The composition of particles within soils and their acidity change the soil properties, both physical and chemical, which are critical for their nourishment of plant life. Three elements, chemical composition, the ability to hold and release water (its physical property), and the potential for soil amendment (the addition of fertilizer etc.) are all critical for the interaction between soils and plants (Harpstead et al.. 1997;Ashman and Puri 2002).

There are three major geological regions associated with the larger region of Burgundy, the Massif Central (igneous), the Paris Basin (sedimentary) and the Rhône Saone valley (tectono-sedementary;Crumley and Green 1987;Vaucoulon and Chiffaut 2004). Burgundy also contains watersheds of three major drainage basins, the Loire, Rhône-Saône and the Seine (Crumley and Green 1987;Vaucoulon and Chiffaut 2004).

When one visualizes Burgundy, France, one may conjure images of endless expanses of relatively flat vineyards, as this is the view often presented in coffee table books and travel magazines. However, the foothills of the Morvan mountains and the mountain region itself are different that the traditional wine regions which are located on limestone marls that provide a substrate for basic soils (Wilson 1998). Basic soils such as those in the wine-growing region favor viticulture and agriculture more than the more acidic granitic soils of the foothills surrounding Dardon (in part because they hold moisture well, but also due to the fact that grapes especially prefer slightly basic soils). A high water table in lower areas also aids in providing water to crops in this region (Wilson 1998). As conditions across Burgundy are not uniform, various areas will have different agrarian potential.

Mont Dardon sits in the Arroux River valley within Burgundy, in the foothills of the Morvan Mountains. This highland/foothills area has a mixture of substrates, Precambrian granites and Mesozoic sea sediments (Gunn et al. 2004). Soils in the immediate river valley are generally granitic in nature, with high levels of acidity and low levels of humic content (organic matter in the top layer of the soil;Crumley and Green 1987).

Granitic soils contain a wide range of silt, sand and clay particle sizes (Harpstead, Sauer and Bennett 1997). However, with low levels of humic content, soils can easily become compacted upon repeated tilling in spite of having adequate particle differentiation. Humic content allows for the creation of aggregates (soil particles combined with humic material). Well aggregated soil has the physical properties of allowing water into it, holding the water for plants, and allowing for roots to move easily within the soil (Harpstead, Sauer and Bennett 1997). Adding organic material to the soil can amend low humic content.

Plants generally prefer soils that are slightly acidic or moderately basic (with some exceptions, certain species may prefer extreme conditions;Harpstead, Sauer and Bennett 1997). High acidity may have implications for the capacity of the soil to hold nutrients that are important to plant growth, as well as plants' ability to absorb nutrients and for the presence of soil microbes. The highly acidic soils surrounding Dardon do not prevent growth of crops but might have negative impacts on crop yield.

Soils close to the Arroux river are generally podsols (Straffin 2000). Podsols are soils in which leaching by water has occurred on the upper soil profile, driving iron and other minerals, as well as some clays, into lower horizons. Sometimes a layer of iron oxide appears in the B horizon (Ashman and Puri 2002). This podzolization does not necessarily create negative conditions for agriculture, but may again decrease yields, as nutrients are driven lower into the soil where they cannot be used by plants.

The dynamic nature of soils makes generalization from present to past conditions difficult. Because soils are the result of both cultural and environmental processes, and as such activities of the past shape the soils we see in the present. The nature of soils is in part a function of the underlying geological substrates but also a cultural artifact in that cultivating, fertilizing and other cultural practices can alter soils substantially. Knowing something about soil conditions can give some basic information about the potential quality for agriculture and the difficulties that were faced in raising certain crops. But because of the changeable nature of soils, it can be difficult to know how amending practices and other cultural activities were changing conditions. There is little strong evidence for manuring in the Iron Age, but it is likely that it was being practiced at least in some circumstances (Bakels 1994). Amending practices begin to be used extensively in the Roman period and intensify again during the medieval period. It is likely the basic soils were similar to the unamended soils we can observe today, with their attendant challenges. Another alternative is that the soils were significantly better than they are today, because at that point in time they would have been less impacted by long-term agrarian activity and erosion.

Plant Communities

Information on plant communities in archeobotanical studies generally comes from palynology. However, in the case of my study, I will include current plant ecology information as few palynological studies have been conducted within close proximity to Mont Dardon; modern plant communities may give some insight to past landscape ecology.

Because of varying climate regimes as well as the diverse topography, Burgundy has a great deal of botanical diversity, with alpine, Mediterranean and middle European flora all being found in the region (Crumley and Green 1987;Vaucoulon and Chiffaut 2004). The bulk of the plant life falls into the mid-continental group.

In the past forests were highly productive areas in which pigs could acquire fodder in the form of mast from beech and oaks, lumber could be harvested for fuel and building, and wild foods could be collected. Forests also render areas of poor soils productive without extra effort expended in amending the soils, though often some form of management occurred, usually in the form of added drainage ditches. Historically, areas of managed forests have been an important component in the diverse economy of the region.

Non-plantation forests of the modern region are mixed forest types that include both coniferous and deciduous trees. Conifers dominate within the Morvan Mountains proper and deciduous types are more prevalent at lower elevations. Beech and oak are the most common trees, and as elevations increase beech is supplanted by hornbeam. The dominant oaks are English oak and Sessile oak, with hybrids of the two being common. Maple, ash, chestnut and some exotic introductions from the acacia family are also present. The understory of most forests is generally comprised of bushes, such as boxwood, as well as saplings. In gap/edge areas and hedgerows raspberry and blackberry bushes are common. Hazel in its bush form is found in hedgerows, as are wild rose bushes.

The only palynology study completed in near to Mont Dardon is one that was conducted on a soil column from the Tumulus of La Revivre. This is an unusual pollen study, as it does not come from lake varves and contains non-wind borne pollen, some of which (mistletoe) was probably the result of ritual activity. However, the study does contain some information regarding the plant communities near to the tumulus, and by extension, Dardon. The pollen record for the tumulus during its period of use (Late Bronze/Early Iron Age) indicates a local oak forest that also supported a variety of other types of trees including maple, alder, birch, members of the hazel family, willow, and possibly pine (Cummings and Puseman 2005). The area around the tumulus is damp, and there may be a spring head nearby. The ground surrounding the tumulus was damp during the extreme drought of 2003. The damp quality of the area may be the reason for the slightly unusual alder and willow trees, which are not extant today. Open areas supported grasses, members of the aster, pink, barberry, and heath families (Cummings and Puseman 2005). Plantain, a ruderal, was found and is probable evidence for fields. Ferns probably grew as part of the forest understory (Cummings and Puseman 2005). Cereal pollen was recovered as well, and may reflect nearby fields (Cumming and Puseman 2005).

Conclusion

The use of environmental information beyond contextualization of my dataset will be speculative. Furthermore, it may be the case that environmental impact on agrarian practice is very low. This possibility is hinted at by the fact that farmers throughout Europe grew many of the same crops in much the same proportions despite even the harshest conditions. This ubiquity of crops points to the possibility that culture is trumping environmental considerations, as the farmers were determined despite all conditions and variation in environment to pursue the cultivation of the same crops.

However, the environmental context is useful for envisioning the landscape in which the agricultural remains at Mont Dardon were produced and in which Mont Dardon and other sites existed. The information is also useful in considering which crops may be favored (those that do best in acidic soils, for example). The diversity of the ecological conditions in the region also indicates that there is a wide range of possibilities for agricultural activity, and this may be reflected in the remains from Dardon. Also, the shifts in climate during the occupation sequence at Dardon may have had impacts on agrarian practice. The analysis chapter discusses these possibilities further.

CHAPTER FOUR
ANALYSIS

This chapter begins with a discussion of the selection of the samples and methods of lab analysis. Following that, a summary of results, a comparison to the rest of Europe, a discussion of consumer/producer models, beer making, agrarian practice and environmental influences are presented.

Samples were selected based on lack of previous analysis, provenance in zones deemed relatively undisturbed, and definitive dating by layer (the Hallstatt, La Tène 1 and the La Tène 3). This selection yielded a total of 114 samples. The methods of my lab analysis follow standard procedures in the field of archeobotany (Pearsall 2000). The samples were weighed as were all the plant remains found. I generally sub-sampled samples weighing more than 10 grams using a soil splitter (a tool which allows for random and equal selection of portions to be sorted and left unsorted). While this level of sub-sampling would normally be rather extreme (for perspective, in the majority of analyses of archeobotanical remains I have conducted, I would not consider sub-sampling until samples reached at least 50 grams or more), the samples from Mont Dardon are unusually rich in plant remains; sub-sampling was utilized to cover the breadth of the dataset.

Archeobotanical samples coming from flotation processing are in two parts, a “heavy fraction” (the portion of the sample which is heavier than water, which can contain denser, carbonized material, such as nutshell) and a “light fraction” (the portion which floats). Shortly after the excavations were complete, the heavy fractions of the samples from Dardon were scanned by J.B. Newsom and found to contain no plant remains, and thus discarded (Crumley 1987). Juilian Wiethold, an archeobotanist also working in the region, observed that the lack of remains in the heavy fraction is consistent with other remains he has analyzed from sites within Burgundy (Wiethold, personal communication 2003). Because the heavy fractions have already been analyzed and discarded, my analysis was conducted on the light fractions of the samples.

Plant materials were sorted and idedntified using a low power stereoscopic microscope. I divided the samples using a geological sieve into fractions of 2.00 mm, 1.4 mm, .07 mm and bottom pan >.07 mm. I sorted the 2.00 mm fraction completely, and scanned the rest of the fractions for non-wood charcoal (i.e. grains, grain constituents, nutshell and seeds). In the .07 mm and dust (bottom pan) levels, I did not sort out grain fragments as I deemed this unproductive (these fragments were too small to be identified to type or even often definitively as grain fragments) and time consuming.

The samples have been left in their original chronological categories, which are somewhat antiquated, as newer chronological schemes have been created in the interim (finer grained designations “Hallstatt A, B, C, D” etc.). The old categories are adequate for a cross-chronological comparison, however, which is an objective of this study. Replacing the current chronology may be possible after a ceramic re-analysis is complete, or with further radio carbon dating, but at this time, it would be problematic. The labels used to designate the different Dardon site phases are the Hallstatt, the La Tène 1, and the La Tène 3. The Hallstatt samples represent the earliest part of the Iron Age, the La Tène I samples represent the beginning of the second half of the Iron Age, and the La Tène 3 samples represent the end of the Iron Age, just prior to Roman contact.

Having described the sample selection, lab methods, and chronology in which the samples have been ordered, the following section presents a summary of results.

Summary of archeobotanical remains found at Mont Dardon

Both cultivated and wild edible plant remains were found in all time periods. Table 4 summarizes these results (for a full list of samples and their contents, please see Appendix 1). Tentative identifications are designated by cf. and the numbers of samples from each time period are given at the top. For each time period, taxon counts are given in the first column, followed by ubiquity values in the second collumn. Ubiquity measures the number of samples within a group of samples in which a taxa appears. Ubiquity gives a sense of the distribution of a species within the samples and can be used to compare assemblages from different sites in order to look at change over time in resource use or to characterize groups of samples from different periods as being similar in deposition to one another (for an example see Popper 1988). Ubiquity can be useful in determining the usage of a taxon in a way which is not biased by absolute quantities of that taxon within any sample (Pearsall 2000). For ubiquity to function properly samples must be assumed to be independent of one another or the measure will be artificially skewed. For example, if a single feature is represented by several samples, they all ought to have similar taxa present in them and may inflate the ubiquity of a taxa within a collection of samples. In the case of my samples, an analysis of ubiquity is problematic, as the independence of the samples in most cases cannot be assured. However, in spite of the problem of sample independence, ubiquity is a useful measure to compare species between the time periods at the site, as the majority of the samples are likely independent from one another.

Table 4: A summary of plant remains found at Mont Dardon

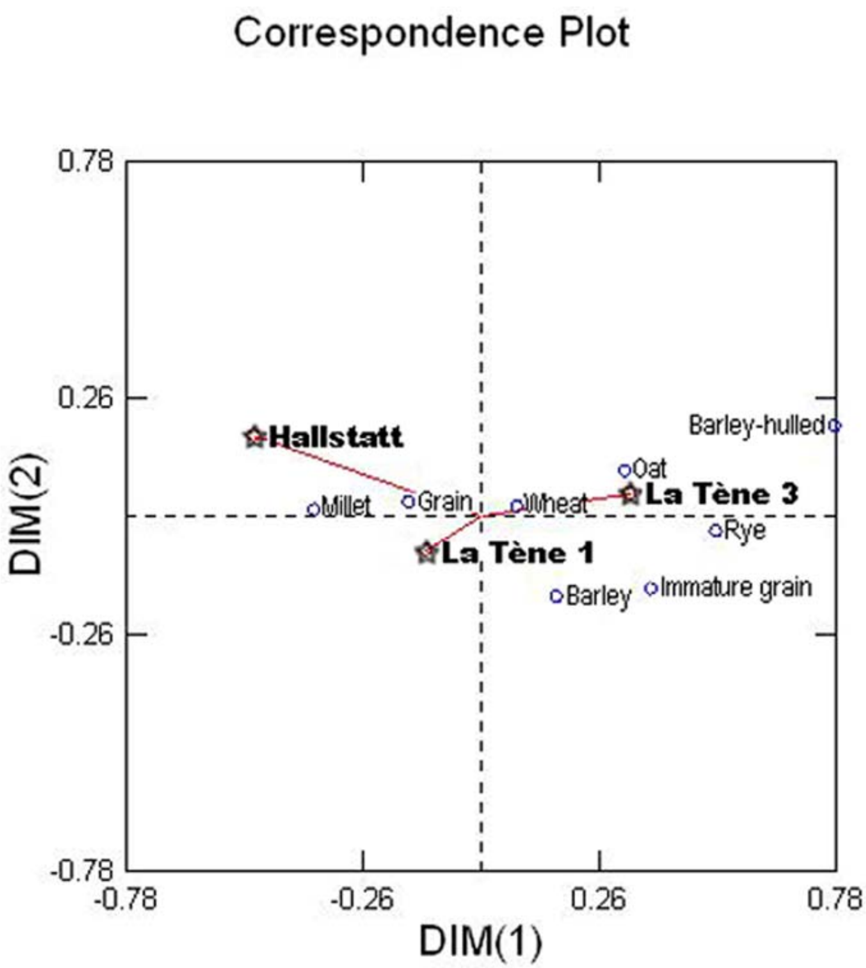
Phase	Hallstatt		La Tene 1		La Tene 3	
Total number of samples=	21		64		29	
Speices	Count	Ubiquity	Count	Ubiquity	Count	Ubiquity
Grain						
Barley	4	14.3%	179	56.3%	817	72.4%
Barley fragment	0	0.0%	10	4.7%	58	17.2%
Barley cf.	0	0.0%	2	3.1%	3	6.9%
Barley - hulled	0	0.0%	5	4.7%	18	24.1%
Barley - hulled cf.	0	0.0%	0	3.1%	8	6.9%
Millet	71	90.5%	425	92.2%	350	69.0%
Millet - fragment	1	4.8%	0	0.0%	0	0.0%
Millet cf.	0	0.0%	7	1.6%	0	0.0%
Oat	5	14.3%	87	23.4%	297	69.0%
Oat - fragment	1	4.8%	4	3.1%	53	27.6%
Oat cf.	0	0.0%	7	4.7%	0	0.0%
Rye	0	0.0%	14	3.1%	32	20.7%
Rye cf.	0	0.0%	13	7.8%	18	13.8%
Wheat	13	33.3%	58	40.6%	147	24.1%
Wheat - Fragment	2	4.8%	1	1.6%	19	13.8%
Wheat cf.	0	0.0%	0	0.0%	1	3.4%
Wheat - Bread	1	4.8%	27	17.2%	248	58.6%
Wheat - Compact	0	0.0%	0	0.0%	1	3.4%
Wheat - Einkorn	0	0.0%	1	1.6%	0	0.0%
Wheat - Emmer	1	4.8%	5	6.3%	23	24.1%
Wheat - Spelt	0	0.0%	9	6.3%	0	0.0%
Immature grain	0	0.0%	1	1.6%	0	0.0%
Immature grains cf.	0	0.0%	0	0.0%	4	3.4%
Grain whole	3	4.8%	6	3.1%	76	31.0%
Grain fragments	120	90.5%	2114	98.4%	6196	79.3%
Processing remains						
Chaff	0	0.0%	0	0.0%	1	3.4%
Glume base	0	0.0%	0	0.0%	2	6.9%
Glume base fragment	0	0.0%	0	0.0%	1	3.4%
Glume base cf.	0	0.0%	1	1.6%	0	0.0%
Internode cf.	0	0.0%	0	0.0%	1	3.4%
Fruit						
Cherry/plum	0	0.0%	0	0.0%	3	6.9%
Cherry/plum cf.	0	0.0%	30	12.5%	0	0.0%
Elderberry	0	0.0%	2	3.1%	0	0.0%
Grape seed fragment	0	0.0%	2	1.6%	2	10.3%
Grape seed fragment cf.	0	0.0%	0	0.0%	2	
Raspberry/Blackberry	2	9.5%	11	9.4%	5	13.8%
Pulses						
Celtic pea	0	0.0%	0.5	1.6%	0	0.0%
Common vetch	0	0.0%	5	3.1%	11	20.7%
Garden pea	0	0.0%	0	0.0%	22	31.0%
Grass pea	0	0.0%	1.5	1.6%	23	20.7%
Pea cf.	0	0.0%	0.5	1.6%	0	0.0%
Pulse fragments	0	0.0%	6	3.1%	28	10.3%
Vetch	2		11	4.7%	10	

Phase	Hallstatt		La Tene 1		La Tene 3	
Total number of samples=	21		64		29	
Speices	**Count**	**Ubiquity**	**Count**	**Ubiquity**	**Count**	**Ubiquity**
Mustard	0	0.0%	1	1.6%	2	6.9%
Wild Edibles						
Fat Hen (Poss. Cultigen)	0	0.0%	3	3.1%	14	17.2%
Hazel	1	4.8%	0	0.0%	0	0.0%
Weeds						
Bedstraw	1	4.8%	2	3.1%	0	0.0%
Bromus	0	0.0%	24	17.2%	1	3.4%
Bullrush/spurge	1	4.8%	0	0.0%	0	0.0%
Catchfly	1	4.8%	6	6.3%	0	0.0%
Chenopodium	0	0.0%	30	25.0%	34	37.9%
Corncockle	0	0.0%	0	0.0%	7	6.9%
Corncockle cf.	0	0.0%	0	0.0%	7	6.9%
Daisy cf.	1	4.8%	0	0.0%	0	0.0%
Dock	4	14.3%	5	6.3%	5	10.3%
Euphorb	0	0.0%	1	1.6%	0	0.0%
Euphorb cf.	0	0.0%	1	1.6%	0	0.0%
Fescue	0	0.0%	0	0.0%	38	10.3%
Field Wood Rush	0	0.0%	1	1.6%	0	0.0%
Glume base - weed	0	0.0%	1	1.6%	1	3.4%
Grass	5	14.3%	66	37.5%	205	86.2%
Grass - round	0	0.0%	1	1.6%	0	0.0%
Grass - small	0	0.0%	3	1.6%	6	3.4%
Grass - tiny	0	0.0%	2	1.6%	0	0.0%
Grass - Quackgrass	0	0.0%	7	1.6%	16	10.3%
Insect Gall	0	0.0%	0	0.0%	1	3.4%
Knotweed	2	4.8%	0	0.0%	0	0.0%
Legume	0	0.0%	12	3.1%	3	6.9%
Lollium	7	23.8%	37	25.0%	49	41.4%
Mallow	0	0.0%	5	3.1%	1	3.4%
Needle grass	0	0.0%	1	1.6%	1	3.4%
Organic Tar	7	4.8%	0	0.0%	5	10.3%
Plantain	1	4.8%	1	1.6%	2	3.4%
Polygonum	0	0.0%	20	20.3%	3	6.9%
Purslane	0	0.0%	8	4.7%	0	6.9%
Sedge	1	4.8%	1	1.6%	3	10.3%
Sedge/dock	1	4.8%	2	1.6%	0	0.0%
Violet	0	0.0%	0	0.0%	1	3.4%
Wild Barley	0	0.0%	4	1.6%	0	0.0%
Wild Oat	0	0.0%	0	0.0%	2	3.4%
Wild Rye	0	0.0%	2	4.7%	0	0.0%
Identifiable weeds	0	0.0%	2	1.6%	0	0.0%
Unidentifiable weed	35	28.6%	230	71.9%	174	62.1%
Unidentifiable						
Unidentifiable	79	42.9%	93	14.1%	20	17.2%

All of the grains commonly cultivated in Europe were found at Dardon. The correspondence analysis plot given below (figure 2.5) illustrates the relationship between the grains found and the phases in which they were found. Correspondence analysis (hereafter referred to as CA) is an exploratory data analysis technique that is related to Principal Components Analysis (hereafter referred to as PCA). CA, while related to PCA, is more useful to archeobotanists than PCA because it works better with counts and with nominal presence/absence data (Shennan 1997). Also, CA does not require a normal distribution of data (Brinkkemper 1996). CA produces contingency plots that demonstrate graphically the relationships between elements in a set of data. The relationships are represented in a Euclidian fashion on a grid, whereby the distances between the points represent the deviations from the average data on the whole (Shennan 1997). The mathematical basis for this plot lies in converting the original dataset to "factors" by taking the counts and replacing them with chi-square residuals and dividing by a constant (x… to the ½ power) (Stephonitis unpublished note 2008). Most of the variance in the samples is carried by the first factor. The factor loading tables for all correspondence plots are given in Appendix 2.

The correspondence analysis (as illustrated by Figure 9) demonstrates that there is some difference in the grain assemblage composition between the phases, especially in amounts of millet (more common in earlier phases) and in presence of rye and oats (more common in the La Tène 3).

Figure 9: Correspondence plot of grains over time



Barley is consistently present in samples form all time periods. Proportionally, it expands considerably in the La Tène 1 and La Tène 3 as compared to the Hallstatt and this is reflected in its placement on the correspondence analysis plot. Its ubiquity also rises through time, from 14.3%, to 56.3% to 72.4% respectively. During the Hallstatt, the ratio of barley to wheat (the two dominant grains in all time periods) was .24, whereas in the two La Tène phases the ratio is 1.94 and 1.95, so there are nearly two barley grains to each wheat grain by the end of the chronological sequence. The number of obviously hulled barley grains also expands in later periods, with none being found in the Hallstatt, the most being found in the La Tène 1 (at a ratio of .06 hulled to naked), and some being found in the La Tène 3 (at a ratio of .03 hulled to naked). Whether 3 row or 6 row was the dominant type is difficult to tell without glume bases or large numbers of grains (from which the ratio of twisted to non-twisted grains could be determined which would indicate the rows type).

The amount of barley found and its dominance over wheat in the later periods is interesting, and puzzling. It may be that wheat was the summer crop, whereas barley was a winter crop that tended to be more successful. It also may be related to use of barley in beer production (though this is very speculative) and this will be discussed in a later section.

Without processing remains such as glume bases (absent in the samples except for one or two battered examples) wheat species identifications must remain tentative. Thus, in the correspondence analysis the wheat types have been collapsed into one general category, "wheat." And predictably enough, as a collapsed category it rests in the middle of the time periods, which indicates that the large category of wheat does not vary significantly through the time periods, its presence is largely constant. This makes sense, as wheat is generally a highly desirable grain, as it has good amounts of protein in comparison to other grain species and is a versatile cooking grain (it can be most easily ground and used for baking).

Oat and rye expand over time, and are significant in differentiating the La Tène 3 in the correspondence analysis. Oat is a sensitive grain but highly valuable as fodder. Rye is useful as a very dependable crop but cannot be used as a fodder grain by itself. These two crops then, complement one another and this is reflected in the typical European crop pattern of the medieval period, which is to sow wheat, oats and rye as a maslin. It is also reflected in the Dardon remains, as the two types expand similarly in the remains. The ubiquity values of oats and rye also expands, in the case of oat, 14.3%, 23.4% and 69% and in the case of rye, 0%, 3.1%, and 20.7%. This concurrent expansion of oat and rye does not necessarily indicate that they are being sown together as a maslin, however. Maslins and seasonal planting will be discussed in a subsequent section of this chapter.

Millet is a somewhat controversial as a crop due to its presence both as an incidental weed and its being consistently labeled as a crop for “poor” people or only usable for fodder amongst Europeans (Fuller 2007). This low reputation of the “small millets” (the varieties found in Europe, as compared to Asian and African varieties which are the “large millets”) combined with the fact they are rarely grown as crops in a modern context within Europe may have contributed to their being overlooked as representing agrarian activity in archeological remains (Fuller 2007).

In the Dardon samples, millet is fairly difficult to identify to species, as the palea and lemma are missing from most examples, so I have collapsed all of the types into the category of “millet.” Most of the seeds identified as millet are probably barnyard, broomcorn, and green types (so all three small type species, *Setaria*, *Panicum* and *Echinochloa*) based on overall shape and size and may or may not be cultivated. Millet has high ubiquity values across the periods which is not the case for other weeds (though millet is very persistent and tolerated as a weed). In the Hallstatt period millet was found in 90% of samples; in the La Tène 1, 92%; and in the La Tène 3, 78%. This may argue for cultivation, as the only other species that are comparably ubiquitous are cultivated grains. Millet is a quick growing crop, drought resistant and could have been sown as a fast maturing emergency crop if other crops failed (as was typically done in the medieval period). It is also has a relatively high amount of protein and other vitamins compared to some other grains (such as rye).

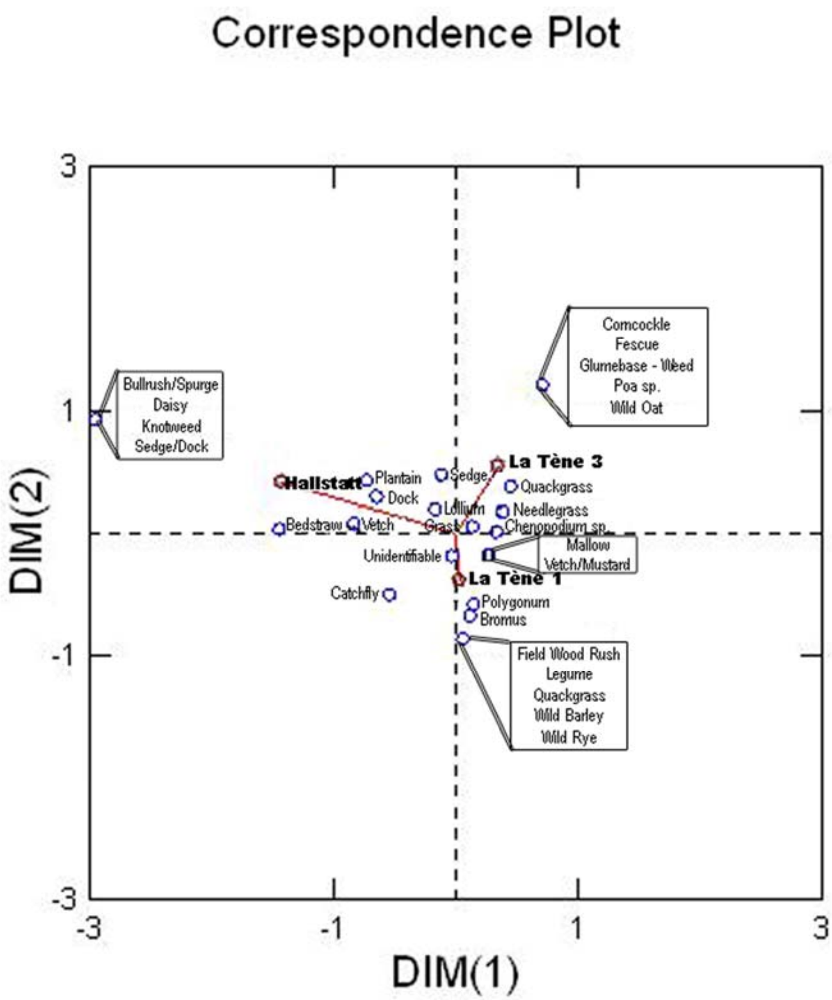
“Grain” is a category used when specific identifications were not possible due to damage and wear of the seeds. This category distinguishing the Hallstatt from the other categories slightly in the correspondence analysis, as can be seen in the graph. This makes sense, as in general the Hallstatt samples were smaller and more damaged than later samples. Why this is the case is not clear, however, other than the fact that they are the oldest.

I suggested in chapter 1 that at Dardon the acidic soil and drainage conditions would lower the odds of finding fruit crops considerably, as there are no waterlogged contexts where fruit pits tend to concentrate. This proved to be fairly accurate, as there are very few fruit remains from the site. All of the fruit remains that are present are from probable “wild” species, raspberry/blackberry, cherry/plum, and some possible grape pip remains (which are likely also from wild types). There is a low but consistent presence of fruit remains from all time periods, with the raspberry/blackberry being found in every time period.

The cultivated remains that were not grain crops or wild species were Gold of Pleasure, a crop cultivated for oil, (during the La Tène 1), Fat Hen for greens (this species from the family *chenopodium* may or may not have been cultivated which is a contested subject), Grass Pea and other legumes.

The samples contained a wide variety of weeds. This is especially interesting in light of the lack of processing remains (which will be discussed later on in this chapter). The weed seeds found may also have significance in reflecting environmental conditions, which will also be discussed in a later section. A correspondence analysis (Figure 10) on the weed species demonstrates that the significance of different species varies across the time periods, as was the case for grains. Again, the factor table can be found in Appendix 2.

Figure 10: Correspondence plot of weeds over time



The majority of the weed species found have no functional uses. Catchfly (*Silene* sp.) and daisy (*Chrysanthemum leucanthemum*) are examples of non-functional weeds, as are the grasses. *Agrostemma githago*, corncockle, found in the La Tène 3 period is a persistent annual which produces abundant seeds. It has no uses and is considered a drag on field yields, and thus undesirable. This weed is associated with Roman contact as it is indigenous to the Mediterranean and was spread by trade and armies (Weithold 2000). It is difficult to make too many assumptions about the presence of this weed, as it may not correlate in a one-to-one fashion with Roman incursion/contact.

Bullrush, sedge and dock are associated with the Hallstatt in the correspondence analysis, however they are also found in other periods as well. These plants do have a traditional use as thatching (Letts 1999). Wheat or rye straw and other miscellaneous weeds (such as heather) are also traditional thatching materials (Letts 1999). In the Iron Age (according to the reconstruction estimates of Letts) water reeds, miscellaneous items (including sedge), and wheat straw were all equally abundant as principal thatching components in England (Letts 1999). So it is possible that the seeds found from thatching species relate to their use as such on Dardon. However, given the abundance of grain that was also found, and the lack of internodes and straw in general, thatch is not contributing in any large way to the overall composition of the plant assemblage at Dardon.

The next two sections compare the finds with those of the rest of Europe (the basis for which was provided in chapter one) and with a large multi-site study in Northern France. These comparisons add to the understanding of the Dardon remains by placing them within a broad context to look for differences in patterns between the site and elsewhere.

Comparison with European trends

Overall, as was demonstrated in the first chapter, the remains found across Europe are fairly homogenous. For the most part the Dardon remains fits with with the general European trends. Comparing the table 2 with table 4 demonstrates that many of the most common remains across Europe are found at Dardon and at the time periods one would expect.

To restate from chapter 1: “Expectations regarding their [grains] placement in the sequence can be made based on trends in the rest of Europe. Rye should appear late in the sites history, after Roman incursion. Bread wheat (*T. aestivum*) should become, over time, the most common wheat found. Oats in larger amounts will probably appear later in the sequence. If barley is found, the hulled variety should replace the non-hulled variety over time (though without processing remains, determining varieties may be difficult)."

Barley is found in all time periods, but does expand over time. The hulled variety does appear in the La Tène I and III, which is consistent with the general European pattern. Hulled barley does not become the dominant type, however. It will be interesting to see if work is done from later periods in the region whether or not hulled barley becomes dominant in the region as a whole.

Rye appears earlier than expected. This may be an artifact of contamination, as the levels in which the La Tène 1 rye appears in La Tène 1 levels that abut the beginning of the La Tène 3 levels, however, rye was domesticated in Europe by the La Tène 1 period. It is possible that it was being cultivated during the La Tène 1. Also, historically, rye was cultivated with great abundance in the immediate region in proximity to Dardon (this is demonstrated in part by surveys conducted for tax purposes during the 1600s;Jones 2006). This places the rye at Dardon within a tradition of use in the region. Additionally, rye is a robust, dependable crop, which will perform when wheat might fail.

Without processing remains such as glume bases (absent in the samples) wheat species identifications must remain tentative, as was mentioned in the first section. With that caveat, the prediction that bread wheat proportionally increases in relation to other bread types holds true for the Dardon samples. Of identified wheat varieties, in the Hallstatt bread wheat comprises 50% (of a very small sample, 2 grains total), in the La Tène 1 it comprises 64%, and in the La Tène 3 it comprises 91%. This is consistent with patterns found throughout Europe and reflects a general trend of intensification, as bread wheat is a higher producing grain (but more risky as it is pickier about growth conditions) than other varieties.

Oat is present in all time periods. This is moderately unusual, as a general pattern oat becomes more common in the medieval period and is rare in earlier time periods. It is not unheard of to find oat in earlier time periods, however, so the Dardon finds are surprising but not spectacular. Oats may be present at relatively high levels due to their qualities as fodder (in support of a pastoralist economy), but to speculate about this further would require some additional evidence pertaining to the intensity and expansion animal husbandry which is generally lacking in the region (in large part due to the acidic soils which erode animal bone, as mentioned earlier).

Millet is a mildly controversial crop. This may be due in part to bias and preservation difficulties (Fuller 2007). Millet (*panicum/setaria*) initially spread east from eastern Europe, where it has been found at 6,000-5,000 BC (Marnival 1992). It is first found in central Europe around 4,000 BC in the Neolithic (Marnival 1992). During the Bronze Age, millet enjoys a period of relative popularity and becomes fairly wide spread and common (Marnival 1992). It does take some time for *panicum miliaceum* to reach southern France (not until the Iron Age) and as of 1992 there was a scarcity of millet finds generally in some regions- though if this is due to lack of excavation is unclear (Marnival 1992).   Given these general trends, it is likely that millet was part of the cultivation regime at Dardon, as it was in other parts of Europe.

Orchard activity is said to expand at the end of the Iron Age and during the Gallo-Roman period. There is little evidence for expanded fruit crops in the Dardon remains, which is in part to due to preservation. So the deviance from the general pattern is unremarkable.

It was unlikely that many plants related to fabric production and dying would be found, because, as with fruit and vegetable remains, these tend not to preserve via carbonization as the samples from Mont Dardon bears evidence to. All of the non-grain crop species appear after the Hallstatt, which reflects the growing diversity in species that was predicted to occur over time based on broad European patterns.

Overall, the expectations based on general European-scale patterns were met. There were no obvious anomalies or unusual patterns in the remains as compared to the rest of Europe. This is, however, a highly general comparison. The next section will compare the remains to other remains found in France, an agglomerate of sites in Northern France (which was summarized in the chapter on European patterns).

Comparisons with the North of France

Véronique Matterne (2001) conducted an extensive archeobotanical study of 78 settlements located in the Northern Paris basin (from the regions of Picardy, Ile-de-France, Normandy, Nord-Pas-de-Calais, Champagne-Ardeme) and dating from the Iron Age through the Gallo-Roman period. This area is north of Dardon, and is some distance away-- a day’s drive, by car -- in the past it probably would have taken at least a week of travel to reach the region.

Nearly all the major crops recovered from Dardon (see Table 4) were also recovered in the course of Matterne’s study (2001). Indications were found for changes in the intensity of agriculture in the course of the Iron Age in the Paris Basin (Matterne 2001). Maslins are not commonly found in Matterne's study during the later phases (2001). This is evidence for expanded monocropping and this shift occurred over the course of the Iron Age (as evidenced by remains recovered from granaries/underground storage—a context not found at Dardon;Matterne 2001). Evidence found in the Paris basin area for Iron Age agricultural fields during the middle La Téne also supports the idea of intensification of agriculture (Matterne 2001). The decrease in diversity of species may also be evidence for intensification, in her view (Matterne 2001).

Figure 11 summarizes some of the information and changes over time Matterne found in her data (2001). The Hallstatt D/La Tène A are roughly equivalent to the La Tène 1, and the La Tène C/D1/D2 is roughly equivalent to La Tène 3, the earliest period at Dardon is not represented in Matterne's assemblege. These figures show that there are changes in the number of species from the Hallstatt to the La Tène periods and similarities between the general patterns in numbers of species between the North and the Dardon remains.

Figure 11: Change over time in agrarian remains: a plot comparing wild and cultivated species from sites within a region (redrawn from Matterne 2001)

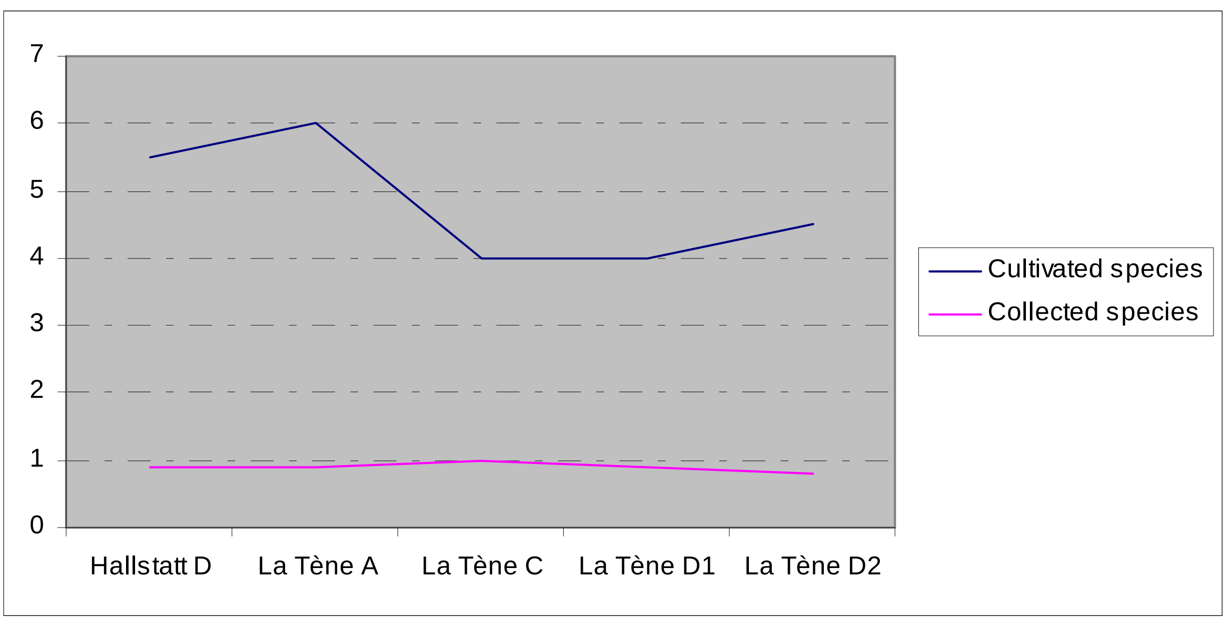
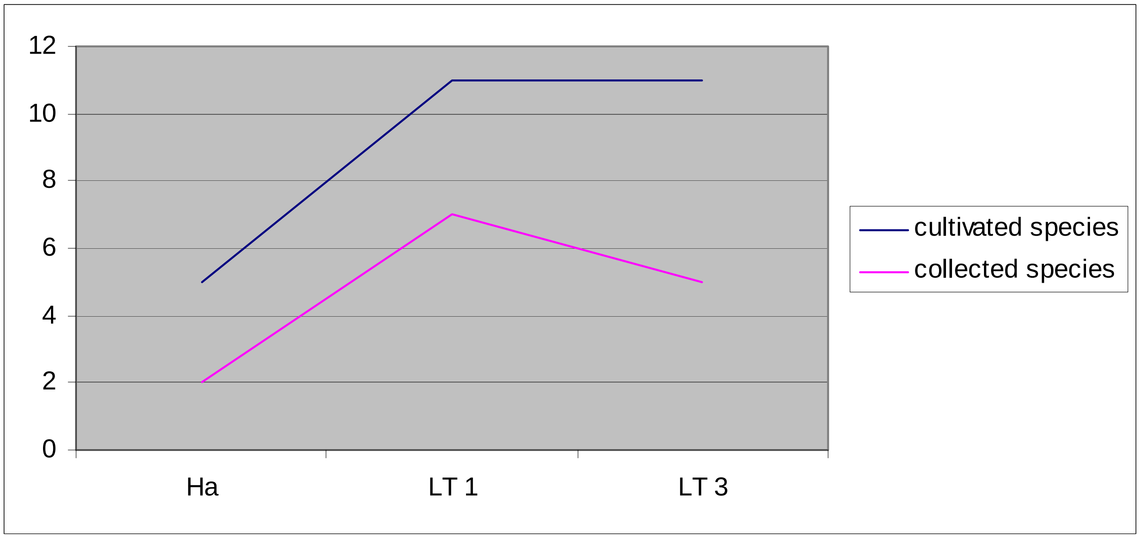


Figure 12: A comparison of numbers of cultivated and wild species found in the different components at Mont Dardon



Interestingly, Matterne finds millet (specifically common millet, *Panicum millacium*) during all time periods at most sites (Matterne 2001). This is similar to the situation at Dardon, where millet is also common. Millet may be more often used in pre-historic agriculture than it has traditionally been given credit for, given this commonality. She also found rye and oats during the early phases at her sites (Matterne 2001). This again is similar to Dardon and may point to the use of these grains as being fairly widespread in earlier time periods within France. She also found a significantly wider range of wild plants (including acorns), especially during the earliest phase of her study, than were found at Dardon (Matterne 2001). Plum/cherry was found during all the time periods, as is the case at Dardon, and she considers them to be wild plants, not from orchards (Matterne 2001). Legumes seem to have more variety and be better represented at her sites than was the case at Dardon (Matterne 2001).

The differences between the archeobotanical remains found at Matterne's sites and Dardon are fairly minor, but the overall pattern of a decrease in the number of cultivated species over time is not the case at Dardon, in spite of the similarities in individual grain species found. The number of collected (wild) species does decrease in the last period at Dardon and that is similar to the pattern found in the North. She does find evidence for intensification of agriculture over time within her samples, which may also be the case at Dardon (discussed in sections to follow).

With the summary of results and the comparison between the Dardon remains and those found in Europe and Northern France, the remains found from the site have been introduced. These next sections analyze the remains in more detail and provide information regarding activity at the site itself, in regards to consumption/production/labor, possible brewing activities, agrarian practice, and finally environmental influences.

Archeobotanical models of production and consumption

This section discusses the plant remains in relationship to several proposed models of consumption/production and labor. Four different models are summarized, followed by some critique, and then the Dardon remains are placed in the context of these models, providing an interpretation of site activity.

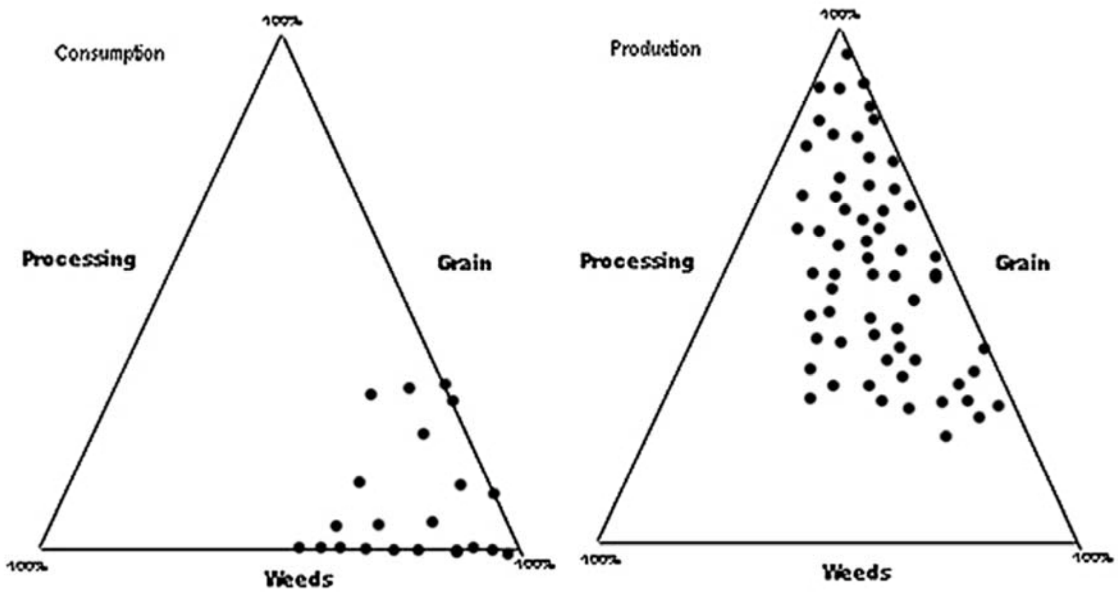
The four models are the G. Hillman (1981), M. Jones (1985), C.J. Stevens (2003), and Van der Veen and Jones (2006) models. The two historically dominant models (formulated by British researchers), one created by G. Hillman (sometimes referred to as the "Ethnographic Approach") and the other by M. Jones (sometimes referred to as the "Complementary Approach") use plant remains to classify sites as "consumer" sites (those that are receiving grain from elsewhere) or "producer" sites (those that are producing and perhaps exporting grain). C.J. Stevens proposes an alternative to these models, suggesting instead that the patterns they use are actually indicative of labor strategies rather than consumption/production. Van der Veen and G. Jones propose another alternative model that is especially applicable to Dardon because it is based on the study of hillfort sites (2006). The models are summarized in the following paragraphs.

The Hillman (1981) or Ethnographic Approach is based on ethnographic studies. The idea behind this model is that different stages of processing (identified ethnographically) will leave different remains in the archeological record and only those sites with the earliest phases of processing present are “producer sites,” whereas the “consumer” sites which receive grain from elsewhere will only have remains from the later phases of processing (in the case of glumed wheats, which generally only have the glumes removed before final consumption), grains only (in the case of free threshing cereals) and primarily weed seeds which are comparable in size to the grains (i.e.. those that typically remain at the last phase of processing;Van der Veen and Jones 2006;Stevens 2003). Grain is assumed to have a greater chance at preservation at producer sites, as toasting grains can be a step in processing (Van der Veen and Jones 2006;Stevens 2003). According to this model, consumer sites will generally only have abundant preserved grain on them if there is a fire in the storage area (Van der Veen and Jones 2006;Stevens 2003).

The Jones (for Martin Jones), or “Complementary Approach” was developed based on M. Jones’ (1985) careful observations and analysis of the context (site and environmental) and contents of many archeobotanical collections from Late Iron Age/Romano-British sites in the southern part of England. The basis of his classification is the idea that consumer sites will be less wasteful, and consequently grain less abundant at these sites (as the grain is assumed to be in smaller units, as well as more carefully controlled and valued). Thus the overall amounts of preserved grain are assumed to be greater at producer sites than consumer sites.

The basis for testing this model is the application of ratios of grains per litres of sediment (i.e. standardized counts) and the comparison thereof. Also, like the Hillman approach, this model considers weed seeds to be more likely at producer sites than consumer sites. The Figure 13 illustrates the differences in data from a consumer versus a producer site following this model (it is based on the figure from Van Der Veen [1992], but originally from Jones [1985]). The triangular scatter plots depict the ratio of grain, chaff and weeds in each sample.

Figure 13: Triangular scatterplots comparing remains representing production and consumption (redrawn from Van der Veen 1992 originally from M. Jones 1985)



There is a laundry list of problems with the consumer/producer models of Hillman and Jones. Neither of them accounts for processing occurring off-site (either away from household sites or away from the harvest site; processing sites can be a site type unto themselves), which is a practice well documented ethno-historically (it is especially common in dry climates, such as on Crete and in Egypt;Smith 2001;Bakels 2001). Most of Jones sites were within pastoralist communities (as is documented by field reconstruction and site details) and this may have made his model not as broadly relevant as it has been applied (Smith 2001). Neither model accounts for the fact that the chaff is also a commodity (for thatch and fodder) and may have been traded as well (Smith 2001;Bakels 2001). The models have also been critiqued on the basis of their lack of specificity in regards to the plant remains under consideration. Internodes, glumes etc. are all treated as one category and furthermore are not quantified with enough specificity (i.e. the question of how many internodes does it take to qualify as significant and how this varies by species is not considered;Van der Veen 1998).

The fundamental critique of these models lies in their objectives, however (Smith 2001;Bakels 2001). Consumer and producer relationships labels may not be extant as absolutes, or at all. Producers are inherently consumers as well, so the assumption of an either/or label lacks nuance. As Wendy Smith states in her paper critiquing the consumer/producer models: “both approaches inadequately account for the range of archeological possibility” (2001: 290).

C.J. Stevens (2003) tested and rejected the consumer/producer model, and instead deduced that the patterns being interpreted as differences in consumption versus production were instead caused by differences in labor and timing of labor expenditures. The assumption of differential labor being shown via the presence of processing remains is based in part on ethno-archeological observations of grain processing as well as historical documents that describe labor practice (Stevens 2003). In a nutshell, Steven’s (2003) proposes that farmers using communal labor will store their grain cleaned, as the assembled labor pool will make cleaning the grain immediately more efficient. Household only labor dictates that there will be an advantage to spreading the labor of grain collection and processing out across time (as it may not be possible to accomplish the time sensitive task of harvesting and complete the process of threshing at once;Stevens 2003), hence in household labor grain is stored in barely processed sheaves.

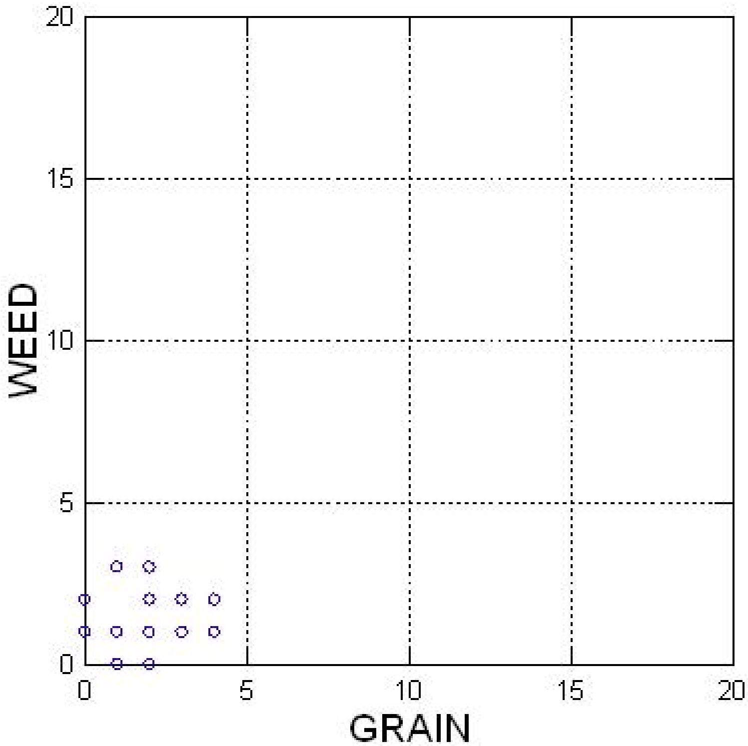
Using these assumptions regarding labor, Stevens suggested that labor patterns could be detected using ratios of processing remains, grains and sizes of seeds (2003). The presence of large seeds and many grains is evidence of communal labor as the larger seeds reflect the final sieving stage of processing after the smaller weed seeds would have been eliminated (Stevens 2003). When grain is processed on an "as needed" basis, there is less likelihood that there will be large amounts of grain preserved at once (resulting in less grain overall) and an increase in the variety of processing remains and the percentage of smaller weed seeds (which reflects the on site processing;Stevens 2003).

G. Jones and M. Van der Veen (2006) have developed another model based on ratios of weeds, grains and processing remains. Their model is based on observations from sites in the south of England, and includes many hillfort sites (van der Veen and Jones 2006). The explanation they propose for the ratios of processing remains, grains and weeds is still based in consumption and labor, but they suggest that expansion of production, surplus grain (and by implication its control) and feasting may be implied by the patterns they observed (van der Veen and Jones 2006). They suggest that for the "elites" the control of surplus grain in the later Iron Age replaced the community control of metal, as iron is more abundant in the environment and less easily controlled (van der Veen and Jones 2006). The primary element in the model is the amount of grain present- it is assumed that in large scale production and consumption there would be more accidental charring of grain, whereas on a household level there would be more care taken and less grain wastage (van der Veen and Jones 2006). Consideration is also given to the kind of grain present- those that are free threshing and those which are not also influence the ratios (in the case of Dardon and most of the sites they discuss most grains are free threshing;van der Veen and Jones 2006).   The implicit assumption is that there was surplus grain present in Southern Britain during the Iron Age, and that agrarian production was intensive enough to achieve this surplus (van der Veen and Jones 2006). They also question the basic idea that most "grain pits" found at hillforts are for seed corn storage- as the typical grain found in the pits was spelt, which being a typically fall sown crop means that fields were harvested only a few months before planting (van der Veen and Jones 2006). While their data includes storage pits and the Dardon materials do not clearly come from storage contexts, the pattern at Dardon of many grains and only a few processing remains is similar to the one they propose as being an indicator of possible feasting and surplus production. These similarities between assemblages then point to surplus grain, and its communal storage or "tribute" and possible feasting activity.

On the whole, the van der Veen and Jones model makes sense and is entirely plausible in its assumptions. However, some aspects they imply regarding the nature of Iron Age society deserve critique. Their model presents a one-dimensional notion of "elite" and the role of said elites in the context of Iron Age society. While they do not discuss the concept of elites extensively within their article, they do suggest that "elites" are controlling a surplus provided by farmers. This notion of a coerced peasant population is problematic. Firstly, it is possible that modern prejudiced notions of "dumb farmers" are at work, as farmers' status within modern societies is not indicative of their importance thereto. Also images of peasant classes from a medieval context are possibly influential. These ideas inform current notions of rural farmers in all periods, but especially when an “elite” is introduced, become problematic in describing the relationships in a primarily agrarian society. Elites may not be so elite, in the sense that they are given status at the pleasure of the farmers who are providing the surpluses. Also, in the Iron Age, there are very few status markers within society, houses are similar sizes with similar provisions, for example, and this does not point to a strong elite class. Surpluses were likely not cohered and may not have been limited in their use to only elites (in other words, many or all members of society may have attended the feasts). That elites were using the surpluses to stage feasts for the purpose of acquiring prestige in not necessarily a given- feasting may have a ritual community building function as its purpose. There may be an element of civic duty in the surpluses, whereby farmers gave those performing community duties other than farming (religious or military) support in exchange for their service to the community. So, the van der Veen and Jones model may not be flawed on the whole, but the assumptions they make about the role of elites can be questioned.

Turning to the application of the models described and critiqued to Dardon, classifying the Dardon remains within a “consumer/producer” model is tenuous, mainly because of flaws within the models. The different time periods are compared within the context of the models to discuss the site activity (consumer vs. producer) across time. This is a relatively novel application of these models, as typically they are applied to a group of contemporaneous sites. Prior to the discussion, scatterplots are presented (Figures 14-16) of my data for comparison. The amount of processing remains in all time periods is very minimal. This means that triangular scatterplots are not terribly informative. So rather than just present triangular scatterplots, scatterplots showing the ratio of grains to weeds are also included.

Figure 14: Scatter plot of weeds versus grains and processing remains, weeds and grains for the Hallstatt



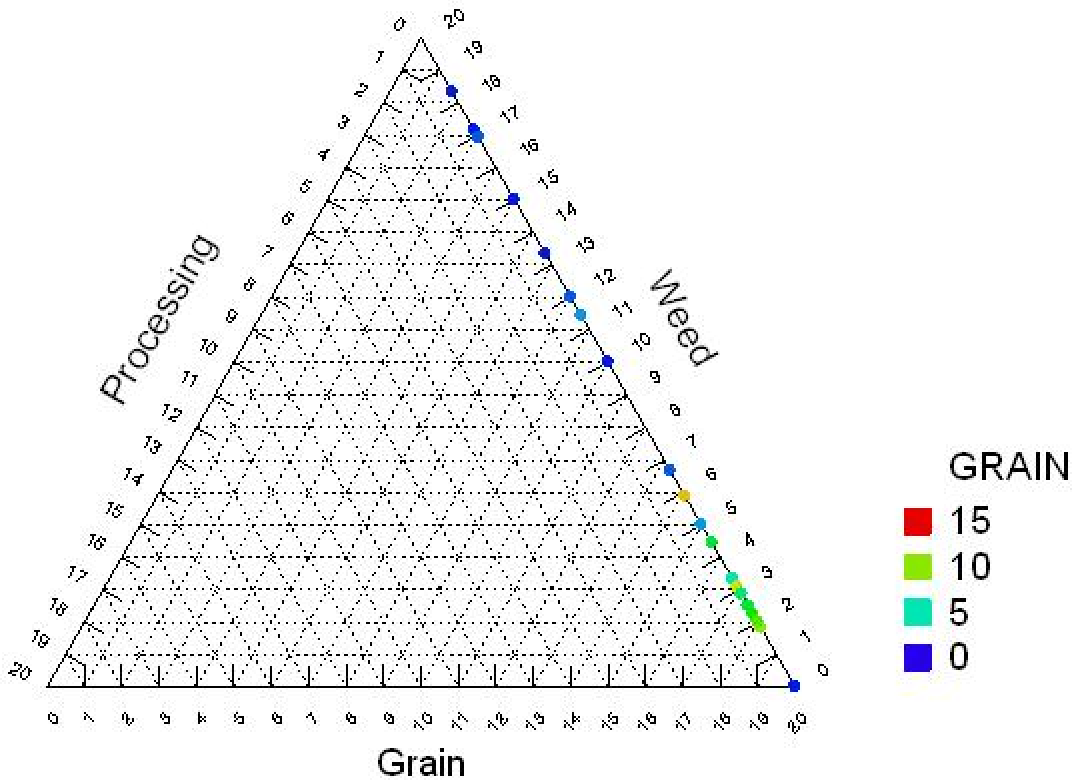
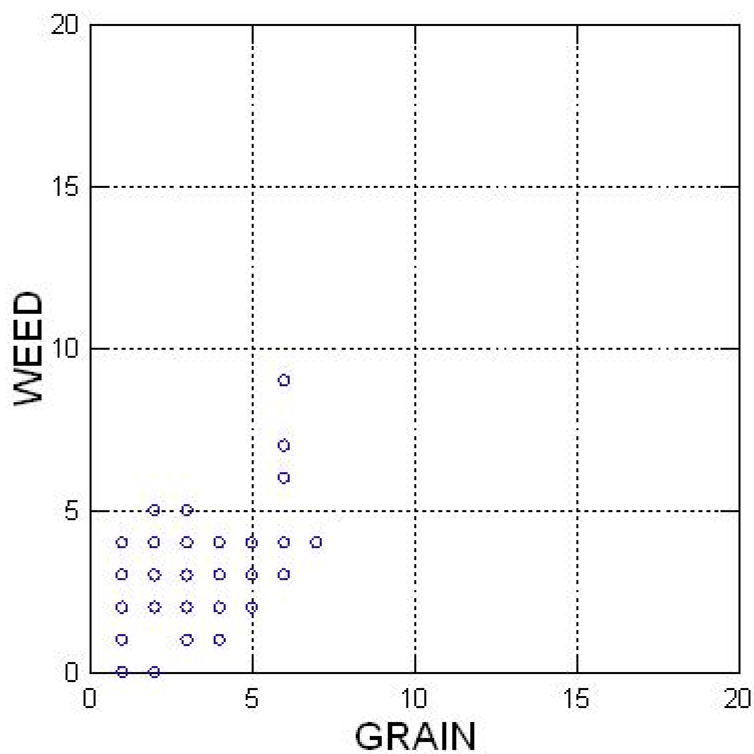


Figure 15: Scatter plot of weeds versus grains and processing remains, weeds and grains for the La Tène 1



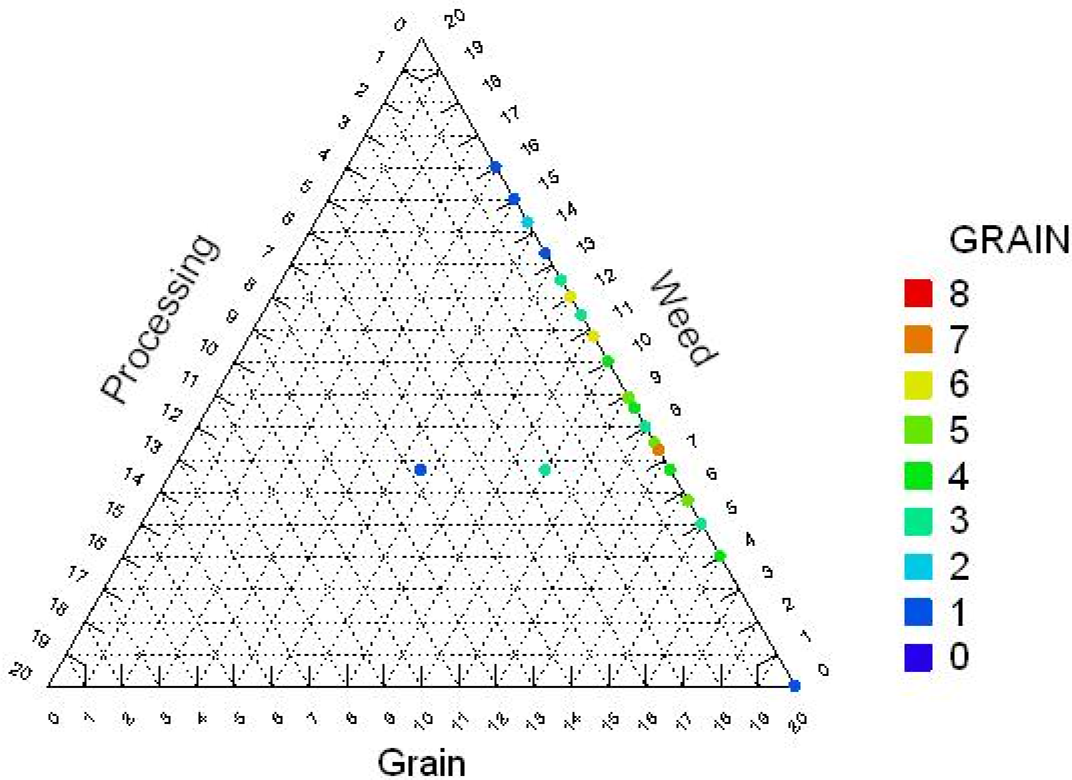
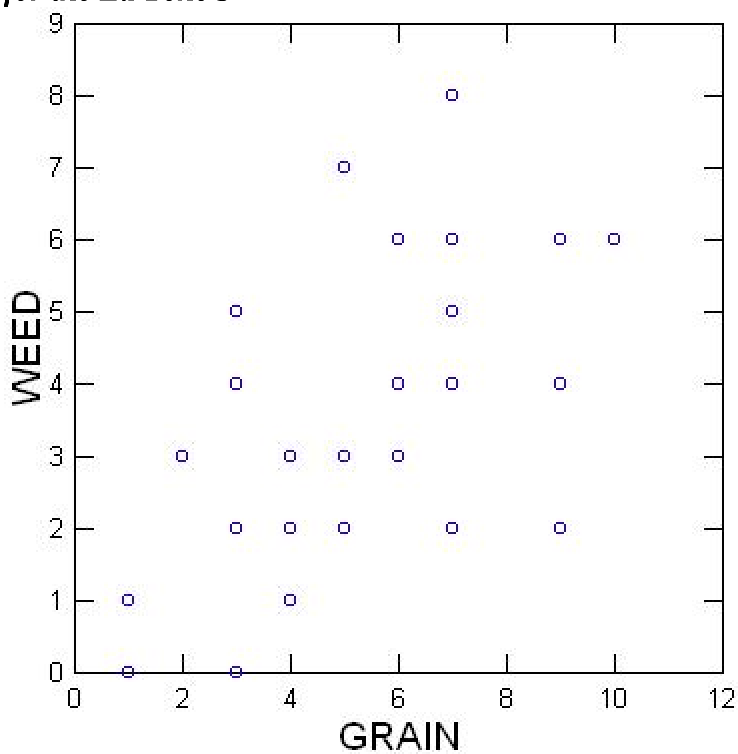
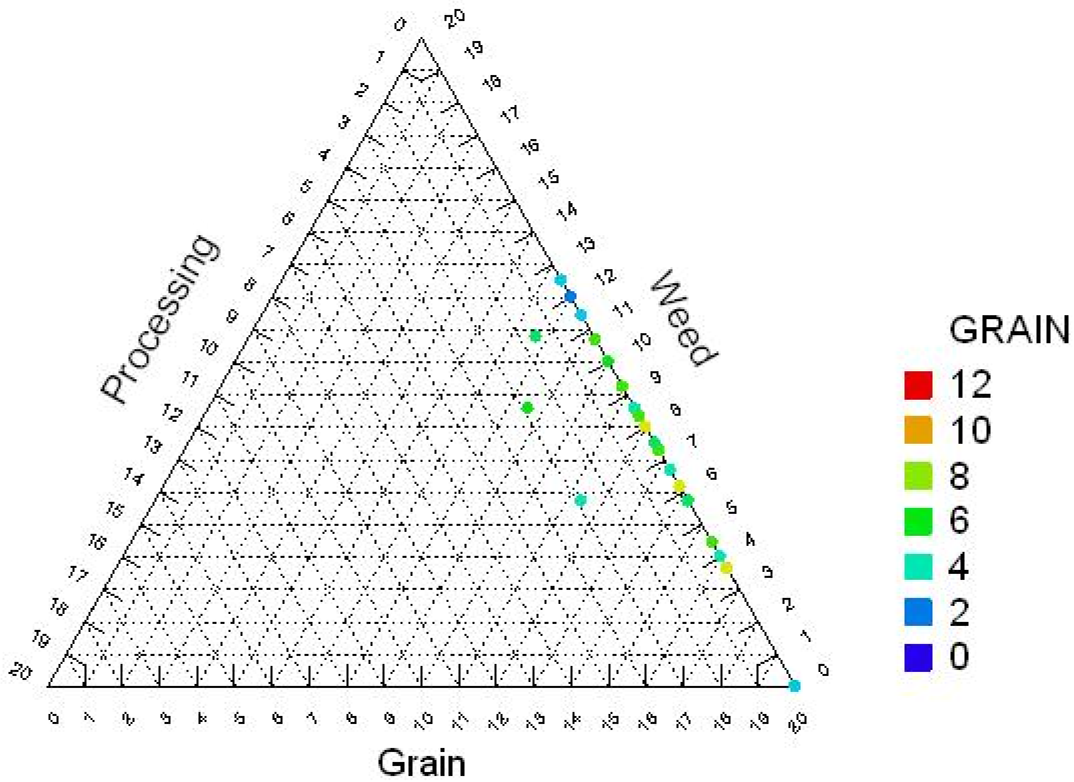


Figure 16: Scatter plot of weeds versus grains, and processing remains, weeds and grains for the La Tène 3





No absolute labels of consumer versus producer should be assigned on the basis of these models, especially given their well-documented flaws. However, the ratios of grain/processing remains/weeds as applied to the models can be used for interpretation, as long as the labels they give are not taken as absolutes. Also, these models can be considered together, and do not necessarily contradict one another. In other words, the label of a "consumer" pattern at a site may be sympathetic with communal labor practices, and may also be indicative of status and feasting, thus all of the models could be applicable under one circumstance. The ratios they are using and the patterns they are detecting are not necessarily in opposition; this is in spite of the fact that within the literature they have been framed as supplanting one another.

An element demonstrated by the ratios of grain, processing remains, and weed seeds at Dardon is the consistency of the data through time. All of the time periods under consideration have similar ratios of grain, processing remains, and weeds. The percentages of large seeds within the total weeds also remain nearly the same. This argues for similar patterns and types of activities at the site over time.

One assumption that is possible based on the grain/chaff/weed ratios is that processing occurred off site. On the other hand, in the ethnographic record, off site processing tends to happen in dry environments. Mont Dardon is not in such a dry environment, so it is likely that processing would have occurred on site. There is the caveat that the whole of the site has not been excavated, and the contexts that provide the archeobotanical samples are limited; thus it is difficult to ascertain where inhabitants were storing and processing their grain definitively. Given the lack of granaries and the possible ritual/special status of the site, it may be that this does, in fact (following Hillman and van der Veen and Jones), indicate a more "consumer" than "producer" group of inhabitants.

Following Stevens' (2003) ideas about labor practice, neither his communal labor nor his household labor patterns fit the data perfectly. There are relatively high amounts of grain in the samples, in proportion to other elements. And there are few processing remains. In general, the remains fit the pattern of communal labor (high amounts of grain) over household labor (low amounts of both grain and chaff, many smaller seeds). However, there are still a fair number of small seeds within the samples, which lends ambiguity to the idea of a strictly communal labor interpretation. The percentages of large weed seeds (larger percentage equals greater likelihood of communal labor) at Dardon are similar in all time periods, 34% in the Hallstatt, 41% in the La Téne 1 and 45% in the La Téne 3. This places all of the phases right in the middle of the "communal labor" versus "household labor" spectrum, according to Stevens range (2003).

If grain is stored cleaned in a communal labor situation it may be that the lack of processing remains reflects a communally cleaned harvest that was processed off site (though, again, processing off site is less likely in the relatively damp climate). This idea that communal labor was used in production does not necessarily negate a "consumer" pattern at the site, as it is possible the grain was processed by communal labor from elsewhere and then given to site inhabitants (though Stevens rejects the "consumer" idea). This again points to the idea that the models are not necessarily exclusive of one another.

The Van der Veen and G. Jones model (2006) suggests that the high amount of grain and low amounts of processing remains found indicate that Dardon was the site of surplus communally collected grain and possible feasting. This idea matches nicely with Dardon's status as a hillfort. However, there is a problem with van der Veen and Jones' model, in my view, which is the issue of the concept of elites using the surpluses as sources of prestige (and, indeed, the whole concept of an "elite" class in a Late Iron Age context).

To sum, looking at all of the models together, it would appear that the materials at Dardon reflect a consumer, communal labor, and grain surplus pattern. This makes sense in the context of a hillfort site; hillforts are strongly related to group and communal efforts in construction and maintenance (and possibly use).

Beer and Mead

It is interesting to speculate on possible beer making at Dardon, given the abundance of barley and the possibility that it was the site of surplus grain collection and feasting (as suggested by the model of van der Veen and Jones 2006). Barley is preferred for beer making. Beer was quite common among the Gauls, and beer drinking is one thing that the Romans looked down upon the “barbaric” Gauls for practicing (Nelson 2005). Beer in prehistoric and medieval times was not the same as modern beer: our beer has a far greater clarity (it is free of sediments- and hence less nutritious) and hops that are now ubiquitous in beer making were not commonly used to flavor beers (Unger 2004).

The procedure for making beer typically involves malt. The process for malting barley is as follows: placing the barley grains in water and leaving for around 24 hours until sprouting, drying the grains and toasting them, roughly grinding them and soaking again, separating the wort (the sugars and proteins which will provide the substrate for fermentation) from the duff (the rough fiberous portion which is sometimes dried and used for fodder), and finally mixing the wort with yeasts and flavorings (Unger 2004).

There were a wide variety of flavorings used; for example one mentioned in a classical text is wild flower fleabane (*Erigeron philadelphicus*;Nelson 2005). From historical records, we know that fruit has long been used as mead (known as “gruit”) and beer flavoring. All of the fruit remains found at Dardon (plum/cherry, raspberry, wild grape) are commonly used to flavor mead or beer.

The most obvious place where barley would be preserved in the beer making process is in the toasting phase. At this point barley grains would have been sprouted. The barley grain found at Dardon does not show evidence of sprouting. Nor are there amorphous remains that may represent duff used for fodder, which is the other stage in which grain preservation may occur.

Residue analysis conducted on vessel sherds found in Area C might be a good avenue for further research, as it would detect if the vessels had contained alcohol. Residue analysis would be a definitive way of identifying beer consumption on Dardon, as opposed to any circumstantial evidence that plant remains may provide.

Seasonal Planting and Maslins

The practice of seasonal planting may also be detectable via the Dardon remains. G. Campbell and J. Hamilton (2000) conducted an analysis of 7 sites dating from 470 BC to 50 AD containing various periods of occupation and reoccupation in proximity to the hillfort of Danebury. In this study they use changes in storage practice and co-occurrence of grain and weed species as evidence for changes within agrarian practice, specifically the seasonality of planting. The temporal organization of agriculture activity was shown to move from autumn sowing to both autumn and spring sowing (which in turn is evidence of expanded production). The evidence for this change over time comes from changes in the distribution of cereals, types of crops grown and weed species. Barley and wheat were stored together in the first portion of the sequence. This mixing is considered to be evidence of their being sown as a maslin or mixture of grains or other crops, which is typical of a fall sowing strategy. Over time, barley and wheat appear separately in storage contexts in their study (Campbell and Hamilton 2000). This is evidence for the possibility that the barley was sown in the spring and wheat in the autumn. Weed species, wild oat (*Avena* sp). and bromus grass (*Bromus* sp.) both expand their presence later in the sequence, and both of these are related to specific seasonal sowing, with *Bromus* sp. being more common in fields cultivated in the fall, and *Avena* sp. being more likely to reach maturity in spring sown fields.

Because the Dardon remains do not come from granaries, it is difficult to know if the plant remains represent planting practice per se. Presuming the remains do speak to the crop constituency, assumptions based on the Danebury study may hold true. Also, it is important to note that nearly all determinations of seasonality based on plant remains may be problematic due to the fact that seeds persist in the environment. Consquently, fall seeds may show up with spring seeds merely because they were present in the environment, not because they represent patterns. However, a study by Jones and Halstead (1995) looking at current practice in Greece, found that seeds from fields in rotation did not leave signatures based on previous rotations. This has two implications. One implication that Jones and Halstead highlight is that field rotation cannot be determined by crop residues. But it also implies that seed persistence may not be a strong taphonomic factor and thus determinations of seasonality may not be flawed by seed persistence after all (at least in a field/grain context).

Weed species and the number of weed species seeds found at Dardon are distinct in the different time periods (as was discussed in the first section of this chapter). Correspondence analysis on the weed species represented demonstrates that the weed communities found in different time periods classify separately from one another. *Bromus* sp. appears in the later phases La Tène 1 and La Tène 3 (though barely in the La Tène 3). *Lollium* sp. expands considerably in these two phases. Other factors, such as the similar ratios of wheat/barley during these phases also point towards a similarity of practice between those two periods.

If the Danebury environs study is correct regarding weed seeds representing agrarian practice, bromus is a fall species and the mixed remains of wheat and barley may point to a fall planting (as maslins are typically sown in fall). The majority of the bromus weed finds (24 seeds from 11 samples, compared to one seed in the La Tène III) occur in the La Tène I and this indicates that fall planting was happening during this period, but not in the later La Tène III. Wild oat, which matures in the spring, is present in the La Tène III but not in the La Tène I, so there was a change of practice to spring planting in this period. Alternatively, there may have been expanded intensity from the Hallstatt, whereby both fall and spring planting was occurring in the later part of the Iron Age.

The advantage to using maslins as a risk abatement strategy is that in years of harsh conditions a hardier crop (often barley, rye, or oat) may perform well when the other crop (usually wheat) sharing the field fails. Jones and Halstead (1995) in their ethnographic studies found that farmers manipulated the proportions within maslins depending on the field quality (as well as when they were preparing the grain for food, the lighter barley was sometimes separated in good years for fodder rather than consumed) and only classified a field as a non-maslin when one crop comprised 90% or more of the seed. This ethnographic discovery likely holds true broadly across Europe and into the past and demonstrates that there is no magic ratio that will demonstrate that a maslin is present.

There is a mixture of wheat and barley in the Dardon samples. Most individual samples contain a mixture of wheat and barley, such that there is no evidence for segregation. Figures 17 and 18 demonstrate this with the lack of clear separate groups or clusters along the axis, but rather vague clouds following a trend lines. (Hallstatt samples did not have abundant enough grain in the individual samples to make using a scatterplot practical). This points to a maslin, but given that the context of the samples is not a granary but most likely household waste, it is difficult to say if the there was a maslin strategy or not. However, the mix of grains supports the idea of a maslin strategy.

Figure 17: La Tène 1 Scatter plot of Barley versus wheat within samples

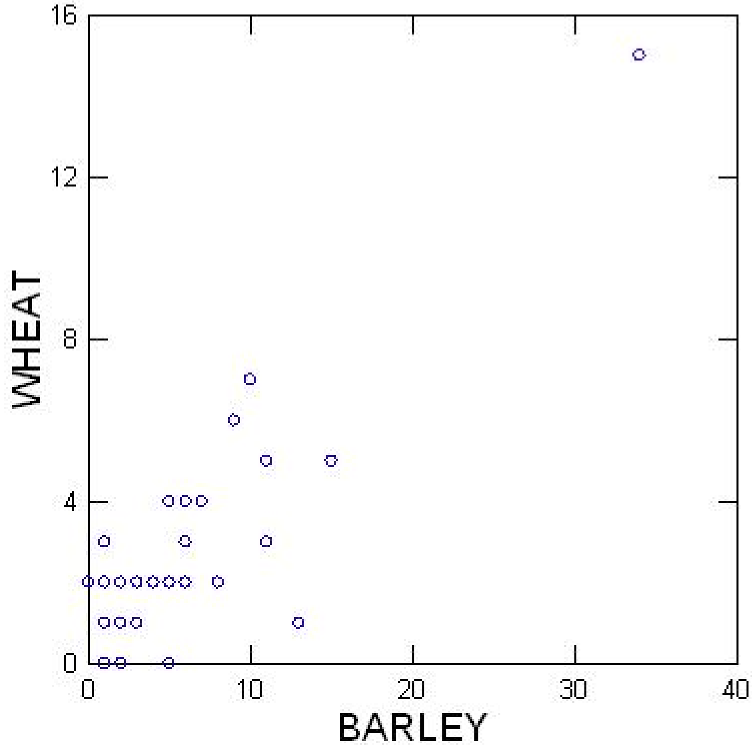
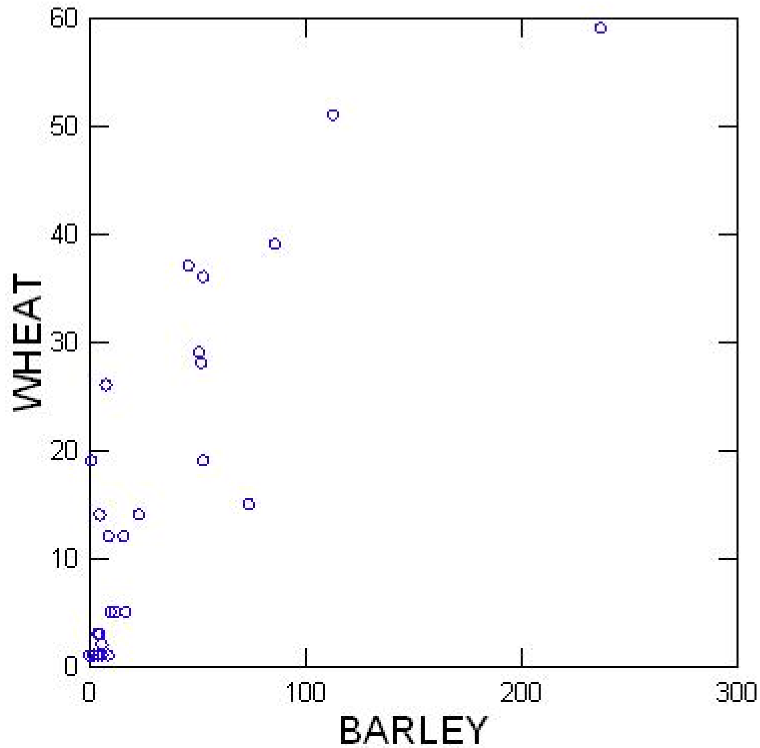


Figure 18 La Tène 3 Scatter plots of Barley versus wheat within samples



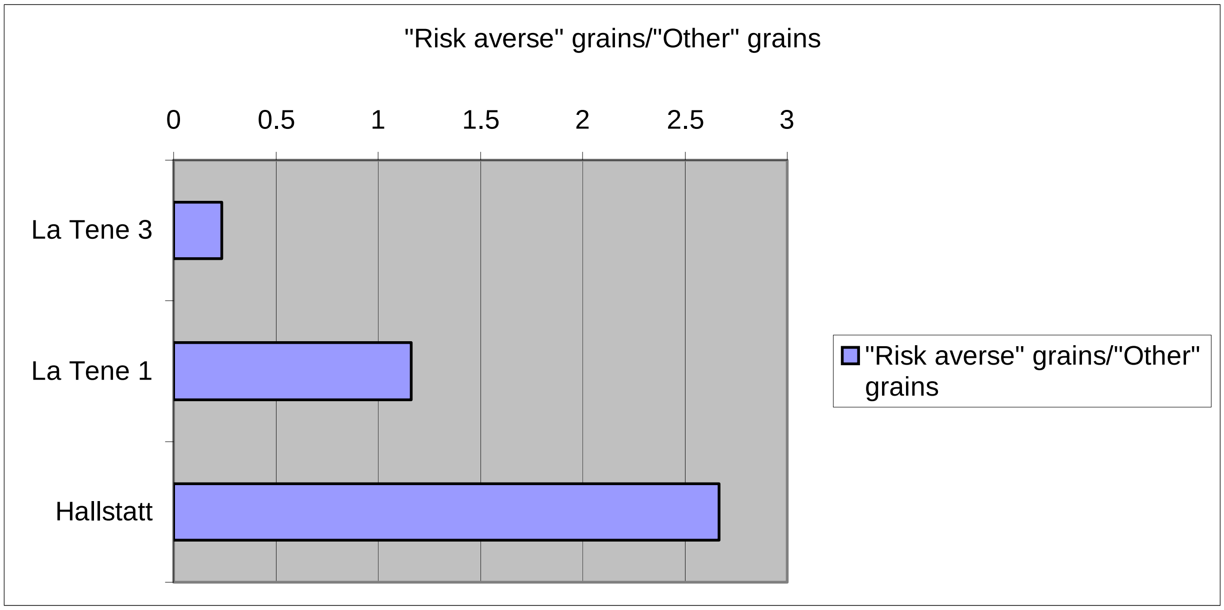
Environment and the remains

There are two approaches that can be taken with macrobotanical remains in regards to the environment. One is to use the macrobotanical remains to determine environmental conditions at the time they were generated, and this is an especially common use for weed seeds. The second approach is to discuss how crops are selected on the basis of constraints or challenges of the environment.

Weeds may reflect climate and landscape use. The weed species found are significantly different between the time periods. Correspondence analysis demonstrates this. The differences in weed communities may reflect changes in local field conditions. The bulrush, spurge, and dock that correspond strongly with the Hallstatt remains may indicate damp fields, as these species favor damp conditions. The later periods have more significant amounts of grasses, which may point to fields that were in use for a long period of time as these species are fairly ruderal (they often occur in fields and open spaces). This notion that the fields would have been in use for some time by the later Iron Age follows the summaries of palynological studies discussed in Chapter 1 and the idea that in the second half of the Iron Age agriculture had intensified over earlier periods, such that fields were not left fallow, but rather kept in production.

Earlier periods, such as the Hallstatt period of Dardon (prior to Roman Climate Optimum, described in the environmental background chapter) would have had damper summers than in the later periods. The crop types appear relatively steady throughout the time periods and do not radically shift in response to a change in climate. However, rye is present early (which could be a response to challenges provided by local soils rather than climate) and millet being consistently present could reflect challenges in the local conditions. These two crops represent a possible risk aversion strategy, which in turn may be a reflection of climate challenges. A comparison of ratios between “dependable/famine crops” (millet and rye) to “other grains” (barley, oat and wheat) might be an indicator of change in the strategies of risk mitigation over time. Looking at the change in ratios (Figure 19) it can be seen that the dependable famine crops decrease in proportion to other crops over time, and this in turn reflects a response to improved climate.

Figure 19: Ratios of low risk grains (millet/rye) to other grains



Additionally, the possible change from a fall to spring planting from the La Tène 1 to the La Tène 3 (as discussed in the prior maslin/seasonal planting section) again reflects the improved climate of the Roman Climate Optimum as well increasing agrarian intensity (regarding the improved climate of the RCO see Crumley [1994] as well as discussion in the environmental chapter of this work).

There is some evidence for changes in weeds, crops and landscape use which reflect a shift in climate in from the earliest period, the Hallstatt, to the later periods, the La Tène 1 and La Tène 3 which were under the influence of the improved conditions of the Roman Climate Optimum. The influence of climate, and thus environmental factors, on the remains is demonstrated by the abundance of damp loving weeds and the high ratio of risk averse grain species to other types during the Hallstatt, in contrast to later periods.

Change and continuity in agriculture

There is a high level of static practice over time within Europe and at the site of Dardon as represented by the Dardon samples. Species do not change radically over time, and it would appear that intensification in central Europe was minimal until the late Iron Age at the earliest. There are several reasons why this was the case.

Risk is a very large issue for the prehistoric farmer and change carries risk. Experimentation is possible only with risk, as there is a chance of failure in untested methods and species. Garden crops may be less risky to experiment with, as they do not provide the majority of calories and fodder for animals (unless circumstances are dire), so it is likely that more experimentation occurred in that area (though preservation is less likely for seeds of vegetable crops and it is difficult to address this with macrobotanical remains).

Necessity is the mother of invention is a hackneyed phrase, but an accurate one in the case of agricultural innovation. If a strategy is successful, why change? Without expansion of population, hierarchy, or trade needs there may not be impetus for change. This idea follows those of Ester Boserup (1965), who applied the ideas on exponential population growth of Malthus as an explanation of change from slash and burn agriculture (small, non-static plots) to field agriculture (intensive, larger scale plots with more time investment).

Also, compared to settings with wide ranging trade possibilities, pre-historic Europeans did not have a trade network capable of providing adequate food during times of crop failure. The trade that provides an emergency fallback in modern settings simply did not exist in the past.

This lack of wide ranging tight networks also means that technology and species migrate slowly; in addition to the disincentives inherent in changing strategies, new strategies in the form of species and practice may not have presented themselves to farmers. Landraces (locally developed varieties- as opposed to species- of crops) are easier to develop and they have obvious returns with low risk. The changes in varieties of crop species are not easy to track via macro-botanical remains (Jones 1998).

The fact that the crops are used for food is also a consideration in discussing change. Our modern taste for novelty may not have been shared in the past. Celtic Iron Age peoples typically used their grains in porridge. This is in contrast to Roman foodways, which placed an emphasis on flour and bread. Changes in Celtic tastes are demonstrated in Sara Bon's study of Celts relocated to Autun during the early Roman period whereby presence of ceramics demonstrate a change in eating practices (as was described in Chapter 2;Bon 1999). The changes in taste undoubtedly play a role in shifts in agrarian practice after Roman contact.

An example of the elements of trade, environment, and changes in taste producing change is the development of vineyards at Lott, the French Mediterranean town site of long chronology discussed in chapter 1. It is likely that grapes and wine were being produced at the site. This change in subsistence, which is unusual for the region and France as a whole was likely produced by contacts with Greece and other areas in the Mediterranean. Trade contact occurred, conditions on the ground were favorable, and tastes changed; all of which combined to create new agricultural practice.

Agrarian transformation of large shifts in species and practice does not seem to have occurred at Dardon based on the plant remains analyzed here. This may be because conditions and culture were relatively stable during the time periods they represent.

Conclusion

The plant remains from Mont Dardon and the practices they represent are not radically dissimilar from the rest of Europe or from those found in the North of France. This was an expected result. It is necessary to go beyond this comparison to illuminate site activity, as this chapter has done, by looking at proportions of remains and specific weed types provides information about site activity.

Changes that occur over the time periods at the site are generally related to climate change. The earliest Hallstatt period has weeds that indicate damper fields. Additionally, millet makes up a larger portion of the grain remains than in other time periods. This indicates that a more conservative strategy, one that reflects the changeable weather conditions typical in the region, was in place during this period.

In the later periods, there is a shift away from dependable crops such as millet and rye. The decrease of millet and rye over time in proportion to wheat reflect the more favorable weather conditions under the Roman Climate Optimum. Also, weed seeds point to a shift from fall to spring planting over time. This may suggest an increase in intensity of farming. The expansion of intensity may also be a response to improved and changed climate conditions (the Roman Climate Optimum with its drier summers). An increase in farming intensity is consistent with Matterne's (2001) study to the North, and the ideas of Van der Veen and Jones (2006) and thus may be a widespread phenomenon and a cultural one as well as environmental, as surpluses may have had more cultural value as the Iron Age progressed.

Fitting the lack of processing remains and sizes of weed seed into the models of consumer/producer patterns, labor, and tribute, a general pattern of activity in regards to plant remains at Dardon is clear. Samples from in all the time periods lack processing remains and are consistent in their weed sizes. This indicates consistency in how the grain was being processed and consumed at the site. The general pattern at Dardon is one of intensification, surplus, and the mustering of communal labor in regards to agrarian production; all of which may have been assisted by steadily improving climate conditions. This does imply an elite and a “subjugated” populace. One, however, could view hillfort activity as a civic activity, whereby the community has made a choice to support a certain structure and engage in communal eating/feasting, collection of grain, and surplus production. This is not the same as a vulnerable agrarian populace being coerced by an “elite.” More discussion of this problem is needed on a regional level using more data than the archeobotanical to clarify power relationships in the Iron Age, and this is a direction for future research (among others that are discussed in the final conclusion, following this chapter).

CHAPTER FIVE

FUTURE DIRECTIONS

This study has expanded the amount of information regarding hillforts and plant remains. It has pointed to possible climate influences on activity in the region, and a culture of feasting/provisioning on the hillfort. There is more work that can be done.

Here I focus on several possible avenues for additional research and further use of this research. First, there is the potential for expanded work at the site of Mont Dardon itself, in several directions. There is a re-analysis of the ceramics collected in the original excavation underway. With the improved ceramic chronologies and collections in France, and the region, this new analysis has the potential for expanding the understanding of site activity at Mont Dardon and the conclusions of the archeobotanical analysis has the potential to be refined and expanded. Additionally, if funds can be found, conducting residue analysis on some of these ceramics (as was mentioned in the analysis) may be fruitful. Furthermore, there is still a substantial amount of the hillfort that remains unexcavated. Further excavations to recover comparative archeobotanical material from within the site are possible, and would be a useful expansion of the current work. With additional materials from the site, the chronology of the samples might be extended into the Roman and Medieval periods, and there would be the advantage of comparison between site features/contexts that is currently lacking. The question of processing on site might also be resolved in a more definitive manner.

Within Burgundy, much work remains to create a body of systematically analyzed archeobotanical remains that can be used to understand regional trends and changes over time. This dissertation contributes to the beginnings of this future regional work. It is hoped that in the future there will be more excavations from both the Roman period and from farmstead contexts (especially) aiding the creation of a dataset which can then be contrasted with the Dardon materials; this is vital for model building and looking at changes in collections over time.

French project researchers are in the process of creating an innovative new GIS base of historical landscape information. Historical maps, such as the 1764 Cassini map, and cadastral maps as well as modern maps are being digitized and connected with one another to look at changes over time. With the addition of the cadastral map parcel information, the GIS will be able to demonstrate changes in agrarian practice over time and its location on the landscape. This GIS and studies associated with it are creating new detailed understanding of the historical agrarian landscape surrounding Mont Dardon. The GIS will be able to provide information about crops grown in various time periods, in a quantitative way (especially if supplemented by archival survey information). Ratios can be generated from these data that demonstrate the proportions of grain and other crops grown in a fashion similar to the ratios which archeobotanical data produces. It is possible then that the remains from Dardon (and hopefully other sites in the future) will be able to be contextualized within this new model. This combination of a GIS in discussion of archeobotanical data would be a new method of analysis and model building and is a very exciting direction.

One of the most important aspects that this study has brought up, and one that needs to be addressed with more lines of evidence , is the nature of hierarchy and tribute in Iron

Age society. Archeobotanical data alone is insufficient to address this question, but they can produce data that can be used to discuss feasting and tribute, both considered important elements in an Iron Age hierarchical system. I believe that with the expansion of the information from the site of Mont Dardon, in form of new ceramic analysis and possible further excavations more archeobotanical data collected on a regional level; and with fine grained historical context, we will come to a more complete understanding of the research uses of botanical materials and consequently a better understanding of hierarchy and ritual in the hillfort, Mount Dardon, in the Burgundy region of France and in Europe as a whole.

APPENDIX ONE

PLANT DATA

Table of summary of sample information, weights are in grams, with the exception of pre-float weight, which is in kilograms.

Catalogue	Unit	Level	Locus	#	Phase	Depth	Pre-float(kg)	Sample	Subsample	Wood	Contam.	Residue	Plant
299	470E420	26	0	1	Hallstatt	139-144	5.85	3.96		0.44	1.24	2.19	0.02
374	470E420	24	2	-	Hallstatt	129-134	unknown	2.9		0.24	0.32	2.27	0.07
355	470E420	24	0	1	Hallstatt	129-130	5.51	2.72		0.16	1.12	1.3	0.07
149	460E421	28	1		Hallstatt	149-154	2.33	0.41		0.04	0.08	0.27	>.01
104	470E420	22	0	1	Hallstatt	-	4.22	2.18		0.21	0.34	1.47	0.07
294	470E420	26	0	2	Hallstatt	139-144	5.74	2.29		0.22	0.35	1.65	0.07
151	470E420	27	0	1	Hallstatt	144-149	5.72	1.56		0.08	0.28	1.14	0.02
298	470E420	25	0	1	Hallstatt	134-139	5.09	3.14		0.27	0.87	1.89	0.09
316	470E420	25	0	2	Hallstatt	134-139	5.26	2.32		0.17	0.65	1.38	0.11
170	470E420	23	0	1	Hallstatt	124-129	5.74	2.4		0.28	0.35	1.64	0.09
83	468E421	28	2		Hallstatt	149-154	unknown	2.38		0.33	0.18	1.73	0.14
157	469E420	28	1	2	Hallstatt	149-154	5.66	1.31		0.09	0.35	0.76	0.04
146	469E420	27	3	1	Hallstatt	144-149	4.46	1.01		0.08	0.09	1.34	0.06
97	469E420	27	1	1	Hallstatt	144-149	4.71	2.01		0.27	0.23	1.48	0.03
179	468E421	33	0	1	Hallstatt	174-179	6.21	1.08		0.11	0.46	0.55	>.01
297	468E421	28	0	1	Hallstatt	149-154	5.93	1.23		0.11	0.27	0.77	0.08
354	470E422	22	0	1	Hallstatt	-	unknown	0.26		0.02	0.04	0.2	>.01
385	470E422	24			Hallstatt	144-149	unknown	0.1		0.01	0.01	0.08	>.01
189	470E422	28	1	1	Hallstatt	149-154	5.21	0.68		0.06	0.13	0.48	0.01
348	470E422	22	0	1	Hallstatt			0.08		0.02	>.01	0.06	>.01
382	470E422	24	2		Hallstatt	144-149	unknown	0.24		0.06	0.04	0.14	>.01
110	471E420	19	0	1	La Tène 1	-	unknown	3.51		0.27	0.66	2.43	0.05
132	471E420	18	0	2	La Tène 1	99-104	4.51	4.21		0.33	0.48	3.03	0.21
265	471E420	17	wall	1	La Tène 1	94-99	7.05	7.85		1.17	1.25	4.82	0.38

72	471E420	21	0	2	La Tène 1		4.39	5.1		0.28	0.34	4.31	0.07
10	471E420	20	0	1	La Tène 1		4.18	2.28		0.06	0.41	1.72	0.05
91	471E420	18	0	1	La Tène 1	99-104	5.01	5.78		0.24	2	3.29	0.11
353	470E421	24	1	2	La Tène 1	129-134	4.56	2.52		0.14	0.55	1.72	0.04
105	470E421	27	1	1	La Tène 1		6	4.5		0.32	0.78	3.24	0.05
197	470E421	27	1	1	La Tène 1		5.22	1.84		0.25	0.23	1.24	0.09
252	470E421	23	1	1	La Tène 1	124-129	4.7	4.9		0.31	1.06	3.34	0.11
335	470E422	21	2		La Tène 1			0.42		0.02	0.06	0.32	>.01
331	470E422	21	1		La Tène 1			0.29		0.02	0.09	0.16	>.01
267	470E422	20	1	1	La Tène 1	121-126		0.45		0.02	0.17	0.24	0.01
308	470E422	19	1	1	La Tène 1	116-121		0.65		0.05	0.24	0.38	0.01
301	470E422	19	1	1	La Tène 1	116-121		0.3		0.02	0.06	0.21	>.01
297	470E422	18	1		La Tène 1			0.29		0.03	0.05	0.19	0.01
280	470E422	20	1		La Tène 1			0.17		0	0.04	0.12	>.01
294	470E422	18	2		La Tène 1	SW		0.5		0.02	0.18	0.28	0.02
120	470E420	20	0	2	La Tène 1	109-114		3.66		0.39	0.23	2.9	0.13
118	470E420	18	0	1	La Tène 1	99-104	4.9	3.37		0.18	0.78	2.05	0.25
15	470E420	18	0	2	La Tène 1	99-104	5.72	7.86		0.28	1.7	5.3	0.33
85	470E420	19		1	La Tène 1	104-109	4.62	2.32		0.1	0.35	1.61	0.2
46	470E420	20	0	2	La Tène 1	109-114	5.08	3.88		0.41	0.76	2.71	0.13
47	470E420	20	0	1	La Tène 1		5.68	3.97		0.5	0.72	2.56	0.2
139	469E421	19	1	3	La Tène 1	104-109	5.48	7.51		0.36	0.77	5.78	0.41
152	469E421	26	1	1	La Tène 1	139-144	4.11	2.15		0.16	1.26	0.68	0.05
175	469E421	23	1	2	La Tène 1	124-129		2.17		0.22	0.26	1.69	0.11
365	469E421	25	1	1	La Tène 1		5.15	3.06		0.23	0.88	1.85	0.05
326	469E421	21	3	1	La Tène 1	114-119	0.53	1.05		0.12	0.06	0.38	0.49
357	469E421	23	1	1	La Tène 1	124-129	4.59	2.26		0.09	0.46	1.59	0.12
174	469E421	24	1	2	La Tène 1	129-134	4.94	1.79		0.22	0.23	1.24	0.06
192	469E421	22	1	2	La Tène 1	119-121	4.64	1.77		0.5	0.1	1.03	0.12
137	469E421	24	1	1	La Tène 1		5.04	1.83		0.14	0.45	1.15	0.07
167	468E420	26	2	1	La Tène 1	139-144	5.09	0.44		0.1	0.12	0.18	0.03
159	468E420	26	2	1	La Tène 1	139-144	5.4	2.65		0.25	0.13	2.12	0.08
317	468E420	26	2	2	La Tène 1	137-144	5.77	3.12		0.3	0.77	1.78	0.16

135	468E420	26	2	2	La Tène 1	139-144	5.25	2.65		0.3	0.27	1.98	0.05
144	468E420	26	1	2	La Tène 1	139-144	5.54	3.32		0.3	0.45	2.5	0.01
89	468E420	26	1	2	La Tène 1	135-144	4.95	2.54		0.42	0.22	1.75	0.07
356	468E420	26	1	1	La Tène 1	139-144	5.45	2.3		0.47	0.18	1.59	0.07
133	468E420	24	2	1	La Tène 1	129-134	2.67	0.4		0.03	0.02	0.34	0.01
153	468E420	24	2	2	La Tène 1	129-134	3.29	2.26		0.14	0.51	1.54	0.04
150	468E420	25	1	2	La Tène 1			1.06		0.14	0.12	0.74	0.04
154	468E420	23	0	1	La Tène 1	124-129		0.84		0.08	0.19	0.54	0.05
?	468E420	25	2	1	La Tène 1	134-139	4.95	3.51		0.25	0.24	2.89	0.05
200	468E420	21	0	2	La Tène 1		4.65	2.96		0.23	0.52	2.04	0.11
251 - 115	468E420	20	0	1 and 2	La Tène 1		10.17	16.15	6.84	0.46	0.48	5.51	0.24
138	468E420	19	0	2	La Tène 1			4.04		0.29	0.21	3.23	0.21
140	468E420	19	0	1	La Tène 1	104-109	6.18	3.59		0.21	0.31	2.67	0.19
122 - 130	468E420	24	0	1 and 2	La Tène 1	129-134	9.06	10.31		0.89	0.87	8.3	0.12
372	469E420	20	1	2	La Tène 1	109-114	3.2	8.51		0.17	0.8	7.3	0.24
49	469E420	17	1	1	La Tène 1	94-99	4.24	11.3		1.75	0.69	6.66	1.93
169	469E420	20	0	1	La Tène 1	109-114	1.52	0.21		0.21	0.26	0.97	0.06
?	469E420	22	0	1	La Tène 1	119-124	5.96	3.25		0.36	0.21	2.43	0.13
190	469E420	21	1	2	La Tène 1		5.74	3.29		0.35	0.4	2.34	0.11
131	469E420	23	1	2	La Tène 1	124-129	4.42	2.59		0.4	0.18	1.95	0.02
164	469E420	25	1	1	La Tène 1	134-139	5.84	2.54		0.44	0.2	1.81	0.07
172	469E420	23	1	1	La Tène 1	124-129	5.37	4.19		0.21	1.36	2.48	0.05
354	469E420	25	1	2	La Tène 1	134-139	4.98	3.89		0.44	0.6	2.68	0.14
124	469E420	24	1	2	La Tène 1	129-134		3.07		0.34	0.4	2.23	0.08
173	469E420	18	1	1	La Tène 1	99-104	4.64	4.44		0.44	0.69	2.5	0.65
171	469E420	24	1	1	La Tène 1	129-134	5.27	1.51		0.33	0.06	0.97	0.06
128	469E420	24	1	2	La Tène 1	132-134	4.91	2.49		0.43	0.21	1.78	0.05
143	469E420	19	0	2	La Tène 1	104-109	3.92	5.43		0.37	0.98	3.39	0.53
151 - 162 - 157 - 164	470E423	13	1	1, 2, 3, 4	La Tène 3		?	2.9		0.42	0.28	1.4	0.71
149 - 139	470E423	12		1,2	La Tène 3	81-86	?	6.16		1.12	0.11	2.95	1.71
133 - 136	470E423	11	1	1,2	La Tène 3	76-81	?	2.04		0.42	0.1	1.07	0.38
153 - 165	470E423	13	2	1,2	La Tène 3		?	2.94		0.47	0.06	1.14	1.15

134 - 129	470E423	10	0	1,2	La Tène 3	71-76		1.47		0.04	0.13	1.21	0.06
117 - 127	470E423	9	0	1,2	La Tène 3	66-71		0.7		0.02	0.1	0.54	0.01
58 - 82 - 67	468E420	16	0	1,2,3	La Tène 3	89-94		75.03	10.43	1.69	0.57	6.07	1.43
155 - 310	468E420	18	0	2,1	La Tène 3	99-104		9.27		1.24	0.61	6.2	0.96
51	468E420	15	0	1	La Tène 3			21.42	10.87	1.53	0.24	6.83	1.87
65	468E420	17	0	0	La Tène 3	94-99		22.38	10.87	2.25	0.35	6.01	1.91
201	470E422	16	1		La Tène 3	101-106		1.46		0.07	0.63	0.73	0.05
217 - 219	470E422	16	2	1	La Tène 3	101-106		5.02		0.07	2.89	1.84	0.17
154 - 161	470E422	15			La Tène 3	96-101		0.74		0.02	0.2	0.46	0.05
22 - 23 OR 72 - 73	470E422	14	2	1,2	La Tène 3			0.9		0.03	0.21	0.47	0.09
24 - 23	470E422	10			La Tène 3	71-76		0.8		0.07	0.1	0.31	0.11
227	470E422	17	1		La Tène 3			0.48		0.06	0.09	0.29	0.04
223	470E422	17	2		La Tène 3			0.43		0.02	0.2	0.2	>.01
22	470E422	12			La Tène 3			1.02		0.21	0.09	0.38	0.28
52	470E422	13	1		La Tène 3			9.8		0.84	0.38	6.26	1.73
23	470E420	14	1		La Tène 3			7.26		0.82	0.11	3.99	2.04
269	471E420	13	wall	1	La Tène 3	74-79	6.89	21.42	9.73	0.82	0.52	6.53	1.47
4	469E420	16	0	1	La Tène 3	89-94		26.17	12.84	1.86	0.26	7.06	3.06
103	469E420	15	0	1	La Tène 3	84-89	4.22	25.35		3.96	0.35	15.07	5.97
50	469E420	17	1	2	La Tène 3	94-99	4.17	4.14		0.64	0.1	2.63	0.58
94	469E420	16	2	0	La Tène 3		4.03	21.71		3.4	0.47	12.31	4.87
456	467E422	14-15			La Tène 3			1.18		0.16	0.04	0.71	0.23
473	467E422	16-17			La Tène 3	99-109		1.32		0.15	0.04	0.69	0.4
467	467E422	17-18	0	1	La Tène 3	99-109		0.89		0.09	0.04	0.49	0.22
481	467E422	19		1	La Tène 3	114-119		0.69		0.04	0.01	0.29	0.25

Table of species found organized by catalogue number (can be cross referenced with the table above for detailed provenience information)

Catalogue #	Unit	Phase	Plant weight	Common Name	Scientific Name	Count	Weight
299	470E420	Hallstatt	0.02	Millet	Panicum sp.	5	>.01g

299	470E420	Hallstatt	0.02	Sedge	Rumex sp.	1	>.01g
299	470E420	Hallstatt	0.02	Grain fragments	Poaceae sp.	7	0.02
374	470E420	Hallstatt	0.07	Millet	Panicum sp.	2	>.01
374	470E420	Hallstatt	0.07	Millet fragments	Panicum sp.	1	>.01
374	470E420	Hallstatt	0.07	Bullrush/spurge	Scirpus sp.	1	>.01
374	470E420	Hallstatt	0.07	Wheat	Triticum sp.	2	0.03
374	470E420	Hallstatt	0.07	Grain fragments	Poaceae sp.	7	0.03
374	470E420	Hallstatt	0.07	Vicia sp.	Vicia sp.	1	0.01
355	470E420	Hallstatt	0.07	Millet	Panicum sp.	1	>.01
355	470E420	Hallstatt	0.07	Grain fragments	Poaceae sp.	9	0.04
355	470E420	Hallstatt	0.07	Wheat	Triticum sp.	3	0.03
149	460E421	Hallstatt	>.01	Millet	Panicum sp.	2	>.01
149	460E421	Hallstatt	>.01	Grain fragments	Poaceae sp.	1	>.01
87	469E427	Hallstatt	0.07	Grain fragments	Poaceae sp.	11	0.02
87	469E427	Hallstatt	0.07	Grass	Poaceae sp.	1	>.01
87	469E427	Hallstatt	0.07	Millet	Panicum sp.	9	0.01
87	469E427	Hallstatt	0.07	Wheat	Triticum sp.	1	0.01
87	469E427	Hallstatt	0.07	Oat	Avena sp.	1	0.01
104	470E420	Hallstatt	0.07	Grain fragments	Poaceae sp.	10	0.06
104	470E420	Hallstatt	0.07	Wheat	Triticum sp.	1	0.02
104	470E420	Hallstatt	0.07	Millet	Panicum sp.	2	>.01
104	470E420	Hallstatt	0.07	Raspberry/Blackberry	Rubus sp.	1	>.01
104	470E420	Hallstatt	0.07	Dock	Rumex sp.	1	>.01
104	470E420	Hallstatt	0.07	Weed unidable	Unidable	1	>.01
104	470E420	Hallstatt	0.07	Unidable	Unidable	9	0.01
294	470E420	Hallstatt	0.07	Dock	Rumex sp.	1	>.01
294	470E420	Hallstatt	0.07	Millet	Panicum sp.	3	>.01
294	470E420	Hallstatt	0.07	Oat	Avena sp.	2	0.02
294	470E420	Hallstatt	0.07	Grain fragments	Poaceae sp.	6	0.01
294	470E420	Hallstatt	0.07	Unidable	Unidable	12	0.01
294	470E420	Hallstatt	0.07	Vicia sp.	Vicia sp.	1	0.03
151	470E420	Hallstatt	0.02	Vicia/Mustard	Vicia/Sinapsis	1	>.01
151	470E420	Hallstatt	0.02	Millet	Panicum sp.	1	>.01

151	470E420	Hallstatt	0.02	Grain fragments	Poaceae sp.	8	0.02
298	470E420	Hallstatt	0.09	Sedge/dock	Rumex sp.	1	>.01
298	470E420	Hallstatt	0.09	Millet	Panicum sp.	7	0.01
298	470E420	Hallstatt	0.09	Organic Tar	Unidable	7	0.01
298	470E420	Hallstatt	0.09	Lollium	Lollium sp.	1	0.01
298	470E420	Hallstatt	0.09	Grain fragments	Poaceae sp.	5	0.03
298	470E420	Hallstatt	0.09	Grain whole	Poaceae sp.	2	0.03
316	470E420	Hallstatt	0.11	Grain fragments	Poaceae sp.	5	0.02
316	470E420	Hallstatt	0.11	Unidable	Unidable	8	0.03
316	470E420	Hallstatt	0.11	Millet	Panicum sp.	5	0.01
316	470E420	Hallstatt	0.11	Wheat	Triticum sp.	1	0.02
316	470E420	Hallstatt	0.11	Grass	Poaceae sp.	1	0.01
316	470E420	Hallstatt	0.11	Lollium	Lollium sp.	2	0.01
316	470E420	Hallstatt	0.11	Barley	Hordeum	1	0.01
170	470E420	Hallstatt	0.09	Grain fragments	Poaceae sp.	8	0.02
170	470E420	Hallstatt	0.09	Unidable	Unidable	16	0.03
170	470E420	Hallstatt	0.09	Dock	Rumex sp.	2	>.01
170	470E420	Hallstatt	0.09	Millet	Panicum sp.	6	0.01
170	470E420	Hallstatt	0.09	Wheat - fragments	Triticum sp.	2	0.02
170	470E420	Hallstatt	0.09	Lollium	Lollium sp.	1	0.01
83	468E421	Hallstatt	0.14	Grain fragments	Poaceae sp.	9	0.06
83	468E421	Hallstatt	0.14	Raspberry/Blackberry	Rubus sp.	1	>.01
83	468E421	Hallstatt	0.14	Unidable	Unidable	13	0.03
83	468E421	Hallstatt	0.14	Millet	Panicum sp.	8	0.01
83	468E421	Hallstatt	0.14	Knotweed	Polygonum sp.	2	>.01
83	468E421	Hallstatt	0.14	Unidable weed	Unidable	4	>.01
83	468E421	Hallstatt	0.14	Wheat	Triticum sp.	3	0.03
83	468E421	Hallstatt	0.14	Oat	Avena sp.	2	0.02
83	468E421	Hallstatt	0.14	Grain - whole	Unidable	1	>.01
157	469E420	Hallstatt	0.04	Millet	Panicum sp.	3	>.01
157	469E420	Hallstatt	0.04	Unidentifiable weeds	Weedy	3	>.01
157	469E420	Hallstatt	0.04	Grain fragments	Poaceae sp.	5	0.01
157	469E420	Hallstatt	0.04	Oat - fragment	Avena sp.	1	>.01

157	469E420	Hallstatt	0.04	Barley	Hordeum nudem	2	0.01
157	469E420	Hallstatt	0.04	Wheat	Triticum sp.	2	0.02
146	469E420	Hallstatt	0.06	Hazel	Corylus sp.	1	0.01
146	469E420	Hallstatt	0.06	Millet	Panicum sp.	6	>.01
146	469E420	Hallstatt	0.06	Bedstraw	Gallium sp.	1	>.01
146	469E420	Hallstatt	0.06	Plantain	Plantago sp.	1	>.01
146	469E420	Hallstatt	0.06	Unidable	Unidable	7	0.01
146	469E420	Hallstatt	0.06	Barley	Hordeum nudem	1	0.01
146	469E420	Hallstatt	0.06	Grain fragments	Poaceae sp.	8	0.02
97	469E420	Hallstatt	0.03	Unidable weed	Unidable	11	>.01
97	469E420	Hallstatt	0.03	Millet	Panicum sp.	5	>.01
97	469E420	Hallstatt	0.03	Wheat - Emmer	Triticum spelta	1	0.01
97	469E420	Hallstatt	0.03	Grain fragments	Poaceae sp.	12	0.02
179	468E421	Hallstatt	>.01	Daisy cf.	Compositae family	1	>.01
179	468E421	Hallstatt	>.01	Unidentifiable	Unidentifiable	4	>.01
297	468E421	Hallstatt	0.08	Grain fragments	Poaceae sp.	2	0.05
297	468E421	Hallstatt	0.08	Wheat - Bread	Triticum aestivum	1	0.02
297	468E421	Hallstatt	0.08	Unidentifable weed	Unidentifiable	11	>.01
297	468E421	Hallstatt	0.08	Millet	Panicum sp.	1	>.01
297	468E421	Hallstatt	0.08	Lollium	Lollium sp.	2	0.01
354	470E422	Hallstatt	>.01	Millet	Panicum sp.	2	>.01
354	470E422	Hallstatt	>.01	Weed - Grass	Poaceae sp.	3	>.01
385	470E422	Hallstatt	>.01	Unidentifiable	Unidentifiable	8	>.01
189	470E422	Hallstatt	0.01	Grain fragments	Poaceae sp.	5	0.01
189	470E422	Hallstatt	0.01	Millet	Panicum sp.	1	>.01
189	470E422	Hallstatt	0.01	Catchfly	Silene sp.	1	>.01
189	470E422	Hallstatt	0.01	Lollium	Lollium sp.	1	>.01
189	470E422	Hallstatt	0.01	Unidentifiable weeds	Unidentifiable	5	>.01
348	470E422	Hallstatt	>.01	Millet	Panicum sp.	2	>.01
348	470E422	Hallstatt	>.01	Unidentifiable	Unidentifiable	2	>.01
382	470E422	Hallstatt	>.01	Grain fragments	Poaceae sp.	2	>.01
110	471E420	La Tène 1	0.05	Grain fragments	Poaceae sp.	18	0.05
110	471E420	La Tène 1	0.05	Bedstraw	Gallium sp.	1	>.01

110	471E420	La Tène 1	0.05	Millet	Panicum sp.	3	>.01
110	471E420	La Tène 1	0.05	Unidentified weed	Unknown	4	>.04
110	471E420	La Tène 1	0.05	Lollium	Lollium sp.	1	>.01
132	471E420	La Tène 1	0.21	Grain fragments	Poaceae sp.	45	0.13
132	471E420	La Tène 1	0.21	Vetch/Mustard	Vicia/Brassicae sp.	1	0.01
132	471E420	La Tène 1	0.21	Oat	Avena sp.	1	>.01
132	471E420	La Tène 1	0.21	Bromus	Bromus sp.	1	>.01
132	471E420	La Tène 1	0.21	Wheat - Bread	Triticum aestivum	2	0.02
132	471E420	La Tène 1	0.21	Wheat - Emmer	Triticum diococcum	2	0.01
132	471E420	La Tène 1	0.21	Barley	Hordeum nudem	7	0.04
132	471E420	La Tène 1	0.21	Millet	Panicum sp.	3	>.01
132	471E420	La Tène 1	0.21	Unidentifiable weeds	Unknown	3	>.01
265	471E420	La Tène 1	0.38	Grain fragments	Poaceae sp.	110	0.23
265	471E420	La Tène 1	0.38	Barley	Hordeum nudem	6	0.04
265	471E420	La Tène 1	0.38	Rye CF	Seacle sp.	2	0.01
265	471E420	La Tène 1	0.38	Oat CF	Avena sp.	2	0.02
265	471E420	La Tène 1	0.38	Lollium	Lollium sp.	1	0.01
265	471E420	La Tène 1	0.38	Wheat - Bread	Triticum aestivum	2	0.02
265	471E420	La Tène 1	0.38	Wheat	Triticum sp.	2	0.02
265	471E420	La Tène 1	0.38	Raspberry/Blackberry	Rubus sp.	1	>.01
265	471E420	La Tène 1	0.38	Millet	Panicum sp.	6	>.01
265	471E420	La Tène 1	0.38	Field Wood Rush	Luzula sp.	1	>.01
265	471E420	La Tène 1	0.38	Unidentified weed	Unknown	5	>.01
265	471E420	La Tène 1	0.38	Vicia/Mustard	Vicia/Brassicae sp.	2	>.01
265	471E420	La Tène 1	0.38	Legumous	Fabaeceae sp.	2	0.02
72	471E420	La Tène 1	0.07	Grain fragments	Poaceae sp.	19	0.07
72	471E420	La Tène 1	0.07	Millet	Panicum sp.	10	>.01
72	471E420	La Tène 1	0.07	Unidentifiable weeds	Unknown	7	>.01
72	471E420	La Tène 1	0.07	Sedge type	Polygonum sp.	2	>.01
10	471E420	La Tène 1	0.05	Grain fragments	Poaceae sp.	14	0.02
10	471E420	La Tène 1	0.05	Barley - fragment	Hordeum nudem	1	0.01
10	471E420	La Tène 1	0.05	Bromus	Bromus sp.	1	0.01
10	471E420	La Tène 1	0.05	Millet	Panicum sp.	6	>.01

10	471E420	La Tène 1	0.05	Unidentified weed	Unknown	13	>.01
91	471E420	La Tène 1	0.11	Grass	Poa sp.	2	>.01
91	471E420	La Tène 1	0.11	Millet	Panicum sp.	9	>.01
91	471E420	La Tène 1	0.11	Unidentifiable	Unknown	28	>.01
91	471E420	La Tène 1	0.11	Chickweed	Chenopodia sp.	1	>.01
91	471E420	La Tène 1	0.11	Grain fragments	Poaceae sp.	31	0.05
91	471E420	La Tène 1	0.11	Wheat - Emmer	Triticum diococcum	1	0.01
91	471E420	La Tène 1	0.11	Wheat - Bread	Triticum aestivum	1	0.01
91	471E420	La Tène 1	0.11	Barley	Hordeum nudem	7	0.04
91	471E420	La Tène 1	0.11	Wild Barley	Hordeum sp.	1	>.01
91	471E420	La Tène 1	0.11	Lollium	Lollium sp.	1	>.01
353	470E421	La Tène 1	0.04	Millet	Panicum sp.	3	>.01
353	470E421	La Tène 1	0.04	Grain fragments	Unknown	9	0.01
353	470E421	La Tène 1	0.04	Barley	Hordeum nudem	3	0.01
353	470E421	La Tène 1	0.04	Sedge	Polygonum sp.	1	>.01
353	470E421	La Tène 1	0.04	Chenopodium	Chenopodia sp.	1	>.01
353	470E421	La Tène 1	0.04	Legumous	Unknown	2	>.01
353	470E421	La Tène 1	0.04	Wheat - Spelt	Triticum spelta	2	0.01
353	470E421	La Tène 1	0.04	Bromus	Bromus sp.	1	0.01
353	470E421	La Tène 1	0.04	Unidentifiable weeds	Unknown	4	>.01
105	470E421	La Tène 1	0.05	White mustard	Sinapsis alba	1	0.01
105	470E421	La Tène 1	0.05	Grain fragments	Poaceae sp.	13	0.04
105	470E421	La Tène 1	0.05	Lollium	Lollium sp.	1	>.01
105	470E421	La Tène 1	0.05	Grass	Poa sp.	1	>.01
105	470E421	La Tène 1	0.05	Millet	Panicum sp.	3	>.01
105	470E421	La Tène 1	0.05	Unidentifiable weeds	Unknown	6	>.01
197	470E421	La Tène 1	0.09	Wheat - Bread	Triticum aestivum	2	0.02
197	470E421	La Tène 1	0.09	Barley	Hordeum nudem	2	0.01
197	470E421	La Tène 1	0.09	Raspberry/Blackberry	Rubus sp.	1	>.01
197	470E421	La Tène 1	0.09	Lollium	Lollium sp.	1	>.01
197	470E421	La Tène 1	0.09	Barley - fragment	Hordeum nudem	1	>.01
197	470E421	La Tène 1	0.09	Unidentified weed	Unknown	4	>.01
197	470E421	La Tène 1	0.09	Millet	Panicum sp.	5	0.01

197	470E421	La Tène 1	0.09	Grain fragments	Poaceae sp.	14	0.04
252	470E421	La Tène 1	0.11	Grain fragments	Poaceae sp.	21	0.06
252	470E421	La Tène 1	0.11	Millet	Panicum sp.	4	0.01
252	470E421	La Tène 1	0.11	Chenopodium	Chenopodia sp.	2	>.01
252	470E421	La Tène 1	0.11	Unidentified weed	Unknown	4	0.01
252	470E421	La Tène 1	0.11	Barley	Hordeum nudem	3	0.02
252	470E421	La Tène 1	0.11	Immature grain	Poaceae sp.	1	>.01
252	470E421	La Tène 1	0.11	Wheat - Emmer	Triticum diococcum	1	0.01
335	470E422	La Tène 1	>.01	Barley CF	Hordeum nudem	1	>.01
335	470E422	La Tène 1	>.01	Millet	Panicum sp.	1	>.01
335	470E422	La Tène 1	>.01	Unidentifiable	Unknown	2	>.01
331	470E422	La Tène 1	>.01	Grain fragments	Poaceae sp.	1	>.01
331	470E422	La Tène 1	>.01	Weed	Polygonum sp.	1	>.01
267	470E422	La Tène 1	0.01	Grain fragments	Poaceae sp.	2	0.01
267	470E422	La Tène 1	0.01	Millet	Panicum sp.	2	>.01
308	470E422	La Tène 1	0.01	Grain fragments	Poaceae sp.	4	0.01
301	470E422	La Tène 1	>.01	Grain fragments	Poaceae sp.	1	>.01
301	470E422	La Tène 1	>.01	Unidentified weed	Unknown	2	>.01
297	470E422	La Tène 1	0.01	Grain fragments	Poaceae sp.	2	0.01
297	470E422	La Tène 1	0.01	Millet	Panicum sp.	2	>.01
297	470E422	La Tène 1	0.01	Needle grass	Stipa sp.	1	>.01
280	470E422	La Tène 1	>.01	Chickweed	Chenopodium album	1	>.01
280	470E422	La Tène 1	>.01	Grain fragments	Poaceae sp.	1	>.01
294	470E422	La Tène 1	0.02	Millet	Panicum sp.	1	>.01
294	470E422	La Tène 1	0.02	Grass	Poa sp.	1	>.01
294	470E422	La Tène 1	0.02	Grain fragments	Poaceae sp.	13	0.02
120	470E420	La Tène 1	0.13	Millet	Panicum sp.	9	0.01
120	470E420	La Tène 1	0.13	Barley	Hordeum nudem	2	0.02
120	470E420	La Tène 1	0.13	Wheat	Triticum sp.	1	0.02
120	470E420	La Tène 1	0.13	Cherry/plum CF	Prunus sp.	1	0.01
120	470E420	La Tène 1	0.13	Grain fragments	Poaceae sp.	7	0.01
120	470E420	La Tène 1	0.13	Undentifiable weeds	Unknown	5	>.01
120	470E420	La Tène 1	0.13	Unidentifiable	Unknown	1	>.01

120	470E420	La Tène 1	0.13	Chenopodium	Chenopodium sp.	3	>.01
120	470E420	La Tène 1	0.13	Vetch/Mustard	Vicia/Brassicae sp.	3	0.02
120	470E420	La Tène 1	0.13	Vetch	Vicia sp.	1	0.02
118	470E420	La Tène 1	0.25	Grain fragments	Poaceae sp.	82	0.11
118	470E420	La Tène 1	0.25	Millet	Panicum sp.	6	>.01
118	470E420	La Tène 1	0.25	Lollium	Lollium sp.	2	0.01
118	470E420	La Tène 1	0.25	Cherry/plum CF	Prunus sp.	8	0.01
118	470E420	La Tène 1	0.25	Unidentifiable	Unknown	6	>.01
118	470E420	La Tène 1	0.25	Wheat - Bread	Triticum aestivum	2	0.02
118	470E420	La Tène 1	0.25	Barley	Hordeum nudem	9	0.06
118	470E420	La Tène 1	0.25	Wild Barley	Hordeum sp.	2	0.01
118	470E420	La Tène 1	0.25	Bromus	Bromus sp.	2	0.01
118	470E420	La Tène 1	0.25	Wheat - Einkorn	Triticum monococcum	1	0.01
118	470E420	La Tène 1	0.25	Grass pea	Lathyrus sp.	1.5	0.01
118	470E420	La Tène 1	0.25	Pulse/legume	Fabaeceae sp.	3	0.01
118	470E420	La Tène 1	0.25	Unidentified weed	Unknown	2	0.01
15	470E420	La Tène 1	0.33	Grain fragments	Poaceae sp.	112	0.2
15	470E420	La Tène 1	0.33	Millet	Panicum sp.	12	0.02
15	470E420	La Tène 1	0.33	Gold of Pleasure	Camelia satvia	1	0.01
15	470E420	La Tène 1	0.33	Barley	Hordeum nudem	11	0.06
15	470E420	La Tène 1	0.33	Vetch/Mustard	Vicia/Brassicae sp.	2	0.01
15	470E420	La Tène 1	0.33	Wheat - Bread	Triticum aestivum	2	0.01
15	470E420	La Tène 1	0.33	Wheat - Spelt	Triticum spelta	3	0.01
15	470E420	La Tène 1	0.33	Rye CF	Seacle sp.	5	0.03
15	470E420	La Tène 1	0.33	Oats	Avena sp.	8	0.04
15	470E420	La Tène 1	0.33	Bromus	Bromus sp.	2	>.01
15	470E420	La Tène 1	0.33	Grass	Poaceae sp.	1	>.01
15	470E420	La Tène 1	0.33	Chenopodium	Chenopodium sp.	2	>.01
15	470E420	La Tène 1	0.33	Unidentified weed	Unknown	3	>.01
15	470E420	La Tène 1	0.33	Purslane	Portulaca sp.	1	>.01
85	470E420	La Tène 1	0.2	Grain fragments	Poaceae sp.	68	0.12
85	470E420	La Tène 1	0.2	Millet	Panicum sp.	5	>.01
85	470E420	La Tène 1	0.2	Wheat	Triticum sp.	2	0.03

85	470E420	La Tène 1	0.2	Barley	Hordeum sp.	3	0.02
85	470E420	La Tène 1	0.2	Grain whole	Unknown	5	0.02
85	470E420	La Tène 1	0.2	Grass	Poaceae sp.	2	>.01
85	470E420	La Tène 1	0.2	Vetch/Mustard	Vicia/Brassicae sp.	7	0.02
85	470E420	La Tène 1	0.2	Unidentifiable weeds	Unknown	2	>.01
46	470E420	La Tène 1	0.13	Grain fragments	Poaceae sp.	22	0.06
46	470E420	La Tène 1	0.13	Lollium	Lollium sp.	1	>.01
46	470E420	La Tène 1	0.13	Unidentifiable	Unknown	18	0.01
46	470E420	La Tène 1	0.13	Pulse/legume	Fabaeceae sp.	1	>.01
46	470E420	La Tène 1	0.13	Pea CF	Pisum sativa	0.5	0.01
46	470E420	La Tène 1	0.13	Wild Barley	Hordeum sp.	1	>.01
46	470E420	La Tène 1	0.13	Wheat	Triticum sp.	2	0.01
46	470E420	La Tène 1	0.13	Oat - fragment	Avena sp.	1	0.01
46	470E420	La Tène 1	0.13	Barley	Hordeum nudem	3	0.03
47	470E420	La Tène 1	0.2	Wheat	Triticum sp.	2	0.02
47	470E420	La Tène 1	0.2	Grain whole	Poaceae sp.	1	0.01
47	470E420	La Tène 1	0.2	Grain fragments	Poaceae sp.	20	0.16
47	470E420	La Tène 1	0.2	Oat CF	Avena sp.	1	0.01
47	470E420	La Tène 1	0.2	Unidentified weed	Unknown	19	>.01
139	469E421	La Tène 1	0.41	Grain fragments	Poaceae sp.	94	0.24
139	469E421	La Tène 1	0.41	Unidentifiable	Unknown	20	>.01
139	469E421	La Tène 1	0.41	Cherry/plum CF	Prunus sp.	7	0.02
139	469E421	La Tène 1	0.41	Catchfly	Silene sp.	1	>.01
139	469E421	La Tène 1	0.41	Euphorbia sp. Cf	Euphorbia sp.	1	>.01
139	469E421	La Tène 1	0.41	Unidentifable weed	Unknown	3	>.01
139	469E421	La Tène 1	0.41	Millet	Panicum sp.	4	>.01
139	469E421	La Tène 1	0.41	Vetch	Vicia sp.	1	0.01
139	469E421	La Tène 1	0.41	Lollium	Lollium sp.	9	0.05
139	469E421	La Tène 1	0.41	Barley	Hordeum nudem	5	0.03
139	469E421	La Tène 1	0.41	Wheat	Triticum sp.	4	0.05
139	469E421	La Tène 1	0.41	Oat CF	Avena sp.	4	0.01
152	469E421	La Tène 1	0.05	Millet	Panicum sp.	2	>.01
152	469E421	La Tène 1	0.05	Grain fragments	Poaceae sp.	9	0.02

152	469E421	La Tène 1	0.05	Unidentifiable weeds	Unknown	2	>.01
152	469E421	La Tène 1	0.05	Barley	Hordeum nudem	1	>.01
152	469E421	La Tène 1	0.05	Wheat	Triticum	2	0.03
175	469E421	La Tène 1	0.11	Grain fragments	Poaceae sp.	31	0.08
175	469E421	La Tène 1	0.11	Oat	Avena sp.	1	0.01
175	469E421	La Tène 1	0.11	Wheat - Spelt	Triticum spelta	2	0.02
175	469E421	La Tène 1	0.11	Weed glumes	Unknown	2	>.01
175	469E421	La Tène 1	0.11	Millet	Panicum sp.	8	>.01
175	469E421	La Tène 1	0.11	Vetch/Mustard	Vicia/Brassicae sp.	1	>.01
175	469E421	La Tène 1	0.11	Chenopodium	Chenopodium sp.	1	>.01
175	469E421	La Tène 1	0.11	Purslane	Portulaca sp.	3	>.01
175	469E421	La Tène 1	0.11	Grass	Poa sp.	2	>.01
175	469E421	La Tène 1	0.11	Unidentifiable weeds	Unknown	6	>.01
365	469E421	La Tène 1	0.05	Plantain	Plantago sp.	1	>.01
365	469E421	La Tène 1	0.05	Unidentifable weed	Unknown	12	>.01
365	469E421	La Tène 1	0.05	Millet	Panicum sp.	9	>.01
365	469E421	La Tène 1	0.05	Grain fragments	Poaceae sp.	11	0.02
365	469E421	La Tène 1	0.05	Wheat	Triticum	1	0.01
365	469E421	La Tène 1	0.05	Barley	Hordeum sp.	1	0.02
365	469E421	La Tène 1	0.05	Unidentified weed	Unknown	2	>.01
326	469E421	La Tène 1	0.49	Celtic pea	Vicia faba	0.5	0.03
326	469E421	La Tène 1	0.49	Oat	Avena sp.	24	0.13
326	469E421	La Tène 1	0.49	Rye CF	Seacle sp.	2	0.02
326	469E421	La Tène 1	0.49	Barley	Hordeum nudem	9	0.04
326	469E421	La Tène 1	0.49	Wheat - Bread	Triticum aestivum	4	0.04
326	469E421	La Tène 1	0.49	Wheat - Spelt	Triticum spelta	2	0.01
326	469E421	La Tène 1	0.49	Lollium	Lollium sp.	1	0.01
326	469E421	La Tène 1	0.49	Catchfly	Setaria sp.	3	0.01
326	469E421	La Tène 1	0.49	Grain fragments	Poaceae sp.	49	0.19
326	469E421	La Tène 1	0.49	Millet	Panicum sp.	5	0.02
326	469E421	La Tène 1	0.49	Unidentifiable weeds	Unknown	4	>.01
357	469E421	La Tène 1	0.12	Grain fragments	Poaceae sp.	21	0.06
357	469E421	La Tène 1	0.12	Barley	Hordeum nudem	1	0.02

357	469E421	La Tène 1	0.12	Wheat	Triticum sp.	1	0.02
357	469E421	La Tène 1	0.12	Lollium	Lollium sp.	2	0.01
357	469E421	La Tène 1	0.12	Millet	Panicum sp.	7	0.01
357	469E421	La Tène 1	0.12	Unidentified weed	Unknown	1	>.01
357	469E421	La Tène 1	0.12	Chenopodium	Chenopodia sp.	1	>.01
357	469E421	La Tène 1	0.12	Unidentifiable weeds	Unknown	4	>.01
174	469E421	La Tène 1	0.06	Glume base cf.	Poaceae sp.	1	>.01
174	469E421	La Tène 1	0.06	Grain fragments	Poaceae sp.	15	0.05
174	469E421	La Tène 1	0.06	Grass	Poaceae sp.	1	>.01
174	469E421	La Tène 1	0.06	Millet	Panicum sp.	11	0.01
174	469E421	La Tène 1	0.06	Millet cf.	Panicum sp.	7	>.01
192	469E421	La Tène 1	0.12	Wheat	Triticum sp.	1	0.01
192	469E421	La Tène 1	0.12	Grain fragments	Poaceae sp.	21	0.07
192	469E421	La Tène 1	0.12	Oat	Avena sp.	1	0.01
192	469E421	La Tène 1	0.12	Wheat - Bread	Triticum aestivum	1	0.02
192	469E421	La Tène 1	0.12	Lollium	Lollium sp.	1	>.01
192	469E421	La Tène 1	0.12	Millet	Panicum sp.	2	0.01
137	469E421	La Tène 1	0.07	Wheat	Triticum sp.	1	0.02
137	469E421	La Tène 1	0.07	Grain fragments	Poaceae sp.	13	0.03
137	469E421	La Tène 1	0.07	Legumous	Fabaeceae sp.	1	0.01
137	469E421	La Tène 1	0.07	Millet	Panicum sp.	5	>.01
137	469E421	La Tène 1	0.07	Vetch/Mustard	Vicia/Brassicae sp.	2	>.01
137	469E421	La Tène 1	0.07	Wheat - fragments	Triticum sp.	1	0.01
167	468E420	La Tène 1	0.03	Millet	Panicum sp.	2	>.01
167	468E420	La Tène 1	0.03	Polyganum	Polygonum sp.	2	>.01
167	468E420	La Tène 1	0.03	Elderberry	Sambucus sp	1	>.01
167	468E420	La Tène 1	0.03	Grain fragments	Poaceae sp.	9	0.03
159	468E420	La Tène 1	0.08	Grain fragments	Poaceae sp.	16	0.04
159	468E420	La Tène 1	0.08	Hulled Barley	Hordeum vulgare	2	0.03
159	468E420	La Tène 1	0.08	Grass - weeds	Poaceae sp.	2	0.01
159	468E420	La Tène 1	0.08	Weeds - unidentified	Unknown	6	>.01
159	468E420	La Tène 1	0.08	Polygonum sp.	Polygonum sp.	2	>.01
159	468E420	La Tène 1	0.08	Millet	Panicum sp.	11	>.01

317	468E420	La Tène 1	0.16	Grain fragments	Poaceae sp.	27	0.13
317	468E420	La Tène 1	0.16	Barley	Hordeum nudem	2	0.01
317	468E420	La Tène 1	0.16	Wheat	Triticum sp.	2	0.02
317	468E420	La Tène 1	0.16	Millet	Panicum sp.	7	>.01
317	468E420	La Tène 1	0.16	Grass - weeds	Poaceae sp.	2	>.01
317	468E420	La Tène 1	0.16	Unidentified weed	Unknown	3	>.01
135	468E420	La Tène 1	0.05	Millet	Panicum sp.	5	>.01
135	468E420	La Tène 1	0.05	Polygonum sp.	Polygonum sp.	2	>.01
135	468E420	La Tène 1	0.05	Raspberry/Blackberry	Rubus sp.	1	>.01
135	468E420	La Tène 1	0.05	Barley	Hordeum nudem	1	0.01
135	468E420	La Tène 1	0.05	Vetch	Vicia sp.	1	0.01
135	468E420	La Tène 1	0.05	Grain fragments	Poaceae sp.	8	0.03
135	468E420	La Tène 1	0.05	Weed - unidentifiable	Unknown	7	>.01
144	468E420	La Tène 1	0.01	Grain fragments	Poaceae sp.	5	0.01
144	468E420	La Tène 1	0.01	Millet	Panicum sp.	2	>.01
144	468E420	La Tène 1	0.01	Mallow	Malvaceae family	1	>.01
144	468E420	La Tène 1	0.01	Unidable weed	Unknown	6	>.01
89	468E420	La Tène 1	0.07	Grain fragments	Poaceae sp.	12	0.04
89	468E420	La Tène 1	0.07	Wheat	Triticum sp.	2	0.02
89	468E420	La Tène 1	0.07	Grass - weeds	Poaceae sp.	1	0.01
89	468E420	La Tène 1	0.07	Weed - unidentifiable	Unknown	2	>.01
89	468E420	La Tène 1	0.07	Vetch	Vicia sativa	1	>.01
89	468E420	La Tène 1	0.07	Cherry/plum CF	Prunus sp.	1	>.01
89	468E420	La Tène 1	0.07	Millet	Panicum sp.	9	>.01
356	468E420	La Tène 1	0.07	Grain fragments	Poaceae sp.	10	0.04
356	468E420	La Tène 1	0.07	Millet	Panicum sp.	11	0.01
356	468E420	La Tène 1	0.07	Vetch/Mustard	Vicia/Sinapsis	1	>.01
356	468E420	La Tène 1	0.07	Lollium	Lollium sp.	1	0.01
356	468E420	La Tène 1	0.07	Grass - weed	Poaceae sp.	1	0.01
356	468E420	La Tène 1	0.07	Weeds - unidentifiable	Unknown	5	>.01
356	468E420	La Tène 1	0.07	Polygonum sp.	Polygonum sp.	1	>.01
133	468E420	La Tène 1	0.01	Grain fragments	Poaceae sp.	2	0.01
133	468E420	La Tène 1	0.01	Millet	Panicum sp.	2	>.01

153	468E420	La Tène 1	0.04	Grain fragments	Poaceae sp.	7	0.02
153	468E420	La Tène 1	0.04	Wheat	Triticum sp.	2	0.02
153	468E420	La Tène 1	0.04	Polygonum sp.	Polygonum sp.	1	0.02
153	468E420	La Tène 1	0.04	Millet	Panicum sp.	2	>.01
153	468E420	La Tène 1	0.04	Vetch	Vicia sp.	1	>.01
150	468E420	La Tène 1	0.04	Wheat	Triticum sp.	2	0.02
150	468E420	La Tène 1	0.04	Barley	Hordeum nudem	1	>.01
150	468E420	La Tène 1	0.04	Grain fragments	Poaceae sp.	6	0.02
150	468E420	La Tène 1	0.04	Raspberry/Blackberry	Rubus sp.	6	0.02
150	468E420	La Tène 1	0.04	Millet	Panicum sp.	3	>.01
150	468E420	La Tène 1	0.04	Polygonum sp.	Polygonum sp.	1	>.01
150	468E420	La Tène 1	0.04	Weed - unidentifiable	Unknown	8	>.01
154	468E420	La Tène 1	0.05	Grain fragments	Poaceae sp.	12	0.02
154	468E420	La Tène 1	0.05	Barley	Hordeum nudem	1	>.01
154	468E420	La Tène 1	0.05	Wheat	Triticum sp.	3	0.03
154	468E420	La Tène 1	0.05	Grass - weed	Poaceae sp.	1	>.01
154	468E420	La Tène 1	0.05	Chenopodium	Chenopodia sp.	2	>.01
154	468E420	La Tène 1	0.05	Millet	Panicum sp.	4	>.01
?	468E420	La Tène 1	0.05	Grain fragments	Poaceae sp.	12	0.04
?	468E420	La Tène 1	0.05	Oat	Avena sp.	2	0.01
?	468E420	La Tène 1	0.05	Millet	Panicum sp.	8	>.01
?	468E420	La Tène 1	0.05	Chenopodium	Chenopodia sp.	2	>.01
?	468E420	La Tène 1	0.05	Unidentifiable weeds	Unknown	9	>.01
200	468E420	La Tène 1	0.11	Grain fragments	Poaceae sp.	30	0.08
200	468E420	La Tène 1	0.11	Oat	Avena sp.	2	0.01
200	468E420	La Tène 1	0.11	Barley	Hordeum nudem	2	0.02
200	468E420	La Tène 1	0.11	Millet	Panicum sp.	3	>.01
200	468E420	La Tène 1	0.11	Cherry/plum CF	Prunus sp.	6	>.01
200	468E420	La Tène 1	0.11	Chenopodium	Chenopodia sp.	1	>.01
200	468E420	La Tène 1	0.11	Vetch	Vicia sp.	2	>.01
200	468E420	La Tène 1	0.11	Unidentifiable	Unknown	5	>.01
251 - 115	468E420	La Tène 1	0.24	Oat	Avena sp.	4	0.02
251 - 115	468E420	La Tène 1	0.24	Barley	Hordeum nudem	5	0.03

251 - 115	468E420	La Tène 1	0.24	Wheat	Triticum sp.	2	0.02
251 - 115	468E420	La Tène 1	0.24	Grain fragments	Poaceae sp.	51	0.14
251 - 115	468E420	La Tène 1	0.24	Millet	Panicum sp.	5	>.01
251 - 115	468E420	La Tène 1	0.24	Chenopodium	Chenopodia sp.	2	>.01
251 - 115	468E420	La Tène 1	0.24	Elderberry	Sambucus sp	1	>.01
251 - 115	468E420	La Tène 1	0.24	Vetch	Vicia sp.	3	0.02
251 - 115	468E420	La Tène 1	0.24	Lollium	Lollium sp.	1	>.01
251 - 115	468E420	La Tène 1	0.24	Bromus	Bromus sp.	1	0.01
251 - 115	468E420	La Tène 1	0.24	Cherry/plum CF	Prunus sp.	1	0.01
251 - 115	468E420	La Tène 1	0.24	Unidentified weed	Unknown	2	>.01
138	468E420	La Tène 1	0.21	Oat	Avena sp.	6	0.03
138	468E420	La Tène 1	0.21	Rye CF	Seacle sp.	1	>.01
138	468E420	La Tène 1	0.21	Barley	Hordeum nudem	6	0.03
138	468E420	La Tène 1	0.21	Wheat	Triticum sp.	3	0.03
138	468E420	La Tène 1	0.21	Lollium	Lollium sp.	1	>.01
138	468E420	La Tène 1	0.21	Grape fragments	Vitis sp.	2	>.01
138	468E420	La Tène 1	0.21	Grass - weeds	Poaceae sp.	2	>.01
138	468E420	La Tène 1	0.21	Millet	Panicum sp.	6	0.01
138	468E420	La Tène 1	0.21	Common vetch	Vicia sativa	1	0.01
138	468E420	La Tène 1	0.21	Unidentifiable weeds	Unknown	5	>.01
138	468E420	La Tène 1	0.21	Grain fragments	Poaceae sp.	37	0.09
140	468E420	La Tène 1	0.19	Grain fragments	Poaceae sp.	33	0.08
140	468E420	La Tène 1	0.19	Oat	Avena sp.	5	0.03
140	468E420	La Tène 1	0.19	Barley	Hordeum nudem	8	0.04
140	468E420	La Tène 1	0.19	Wheat	Triticum aestivum	2	0.01
140	468E420	La Tène 1	0.19	Millet	Panicum sp.	1	>.01
140	468E420	La Tène 1	0.19	Bromus	Bromus sp.	1	0.01
140	468E420	La Tène 1	0.19	Grass - weed	Poaceae sp.	2	>.01
140	468E420	La Tène 1	0.19	Common vetch	Vicia sativa	1	0.01
140	468E420	La Tène 1	0.19	Cherry/plum CF	Prunus sp.	1	>.01
140	468E420	La Tène 1	0.19	Unidentifiable weeds	Unknown	3	>.01
122 - 130	468E420	La Tène 1	0.12	Oat	Avena sp.	1	>.01
122 - 130	468E420	La Tène 1	0.12	Barley	Hordeum nudem	2	0.01

122 - 130	468E420	La Tène 1	0.12	Barley	Hordeum vulgare	1	0.01
122 - 130	468E420	La Tène 1	0.12	Wheat	Triticum sp.	2	0.03
122 - 130	468E420	La Tène 1	0.12	Millet	Panicum sp.	18	>.01
122 - 130	468E420	La Tène 1	0.12	Mallow	Malvaceae family	4	>.01
122 - 130	468E420	La Tène 1	0.12	Grass - weed	Poaceae sp.	3	>.01
122 - 130	468E420	La Tène 1	0.12	Unidentifiable	Unknown	3	>.01
122 - 130	468E420	La Tène 1	0.12	Unidentifiable weeds	Unknown	5	>.01
122 - 130	468E420	La Tène 1	0.12	Grain fragments	Poaceae sp.	27	0.07
372	469E420	La Tène 1	0.24	Barley	Hordeum nudem	6	0.04
372	469E420	La Tène 1	0.24	Oat	Avena sp.	1	0.01
372	469E420	La Tène 1	0.24	Rye CF	Seacle sp.	3	0.02
372	469E420	La Tène 1	0.24	Wheat - Bread	Triticum aestivum	2	0.03
372	469E420	La Tène 1	0.24	Grain fragments	Poaceae sp.	40	0.1
372	469E420	La Tène 1	0.24	Grass	Poaceae sp.	6	0.03
372	469E420	La Tène 1	0.24	Millet	Panicum sp.	4	>.01
372	469E420	La Tène 1	0.24	Dock	Polygonum sp.	2	>.01
372	469E420	La Tène 1	0.24	Cherry/plum CF	Prunus sp.	5	>.01
372	469E420	La Tène 1	0.24	Chenopodium	Chenopodia sp.	1	>.01
372	469E420	La Tène 1	0.24	Quackgrass	Poa sp.	1	>.01
372	469E420	La Tène 1	0.24	Legume fragments	Fabaeceae sp.	6	0.01
372	469E420	La Tène 1	0.24	unidentifiable	Unknown	4	>.01
49	469E420	La Tène 1	1.8	Raspberry/Blackberry	Rubus sp.	1	>.01
49	469E420	La Tène 1	1.8	Chenopodium	Chenopodia sp.	2	>.01
49	469E420	La Tène 1	1.8	Purslane	Portulaca sp.	4	>.01
49	469E420	La Tène 1	1.8	Fat Hen	Chenopodium album	1	>.01
49	469E420	La Tène 1	1.8	Rye	Seacle sp.	13	0.07
49	469E420	La Tène 1	1.8	Oat	Avena sp.	23	0.12
49	469E420	La Tène 1	1.8	Millet	Panicum sp.	50	0.05
49	469E420	La Tène 1	1.8	Grain fragments	Poaceae sp.	396	0.24
49	469E420	La Tène 1	1.8	Barley	Hordeum nudem	32	0.24
49	469E420	La Tène 1	1.8	Barley hulled	Hordeum vulgare	2	0.02
49	469E420	La Tène 1	1.8	Wheat	Triticum sp.	15	0.15
49	469E420	La Tène 1	1.8	Common vetch	Vicia sativa	1	0.12

49	469E420	La Tène 1	1.8	Vetch/Mustard	Sinapsis/Vicia sp	6	0.02
49	469E420	La Tène 1	1.8	Lollium	Lollium sp.	7	0.02
49	469E420	La Tène 1	1.8	Quackgrass	Poaceae sp.	6	>.01
49	469E420	La Tène 1	1.8	Grass - round	Poa sp.	1	>01
49	469E420	La Tène 1	1.8	Grass	Poaceae sp.	23	0.07
49	469E420	La Tène 1	1.8	Identifiable weeds	Unknown	2	>.01
49	469E420	La Tène 1	1.8	Unidentifiable weeds	Unknown	12	0.01
169	469E420	La Tène 1	0.06	Millet	Panicum sp.	9	0.01
169	469E420	La Tène 1	0.06	Barley	Hordeum nudem	1	>.01
169	469E420	La Tène 1	0.06	Oat	Avena sp.	1	0.01
169	469E420	La Tène 1	0.06	Grain fragments	Poaceae sp.	13	0.03
169	469E420	La Tène 1	0.06	Polyganum	Polygonum sp.	1	>.01
169	469E420	La Tène 1	0.06	Grass	Poaceae sp.	2	0.01
?	469E420	La Tène 1	0.13	Millet	Panicum sp.	17	0.01
?	469E420	La Tène 1	0.13	Polyganum	Polygonum sp.	1	>.01
?	469E420	La Tène 1	0.13	Unidentifiable weeds	Unknown	2	>.01
?	469E420	La Tène 1	0.13	Grain fragments	Poaceae sp.	33	0.12
190	469E420	La Tène 1	0.11	Barley	Hordeum nudem	5	0.02
190	469E420	La Tène 1	0.11	Wild Rye	Poaceae sp.	2	0.01
190	469E420	La Tène 1	0.11	Millet	Setaria sp.	6	0.01
190	469E420	La Tène 1	0.11	Grain fragments	Poaceae sp.	30	0.07
190	469E420	La Tène 1	0.11	Chenopodium	Chenopodium sp.	1	>.01
190	469E420	La Tène 1	0.11	Grass - small	Poaceae sp.	1	>.01
190	469E420	La Tène 1	0.11	Unidentifiable weeds	Unknown	6	>.01
131	469E420	La Tène 1	0.02	Grain fragments	Poaceae sp.	6	0.02
131	469E420	La Tène 1	0.02	Millet	Panicum sp.	9	>.01
131	469E420	La Tène 1	0.02	Bedstraw	Gallium sp.	1	>.01
131	469E420	La Tène 1	0.02	Polyganum	Polygonum sp.	1	>.01
131	469E420	La Tène 1	0.02	Unidentified weed	Unknown	2	>.01
131	469E420	La Tène 1	0.02	Vetch	Vicia sp.	1	>.01
164	469E420	La Tène 1	0.07	Grain fragments	Poaceae sp.	8	0.06
164	469E420	La Tène 1	0.07	Millet	Panicum sp.	10	0.01
164	469E420	La Tène 1	0.07	Dock	Rumex sp.	1	>.01

164	469E420	La Tène 1	0.07	Polyganum	Polygonum sp.	2	>.01
164	469E420	La Tène 1	0.07	Unidentified weed	Unknown	4	>.01
172	469E420	La Tène 1	0.05	Barley CF	Hordeum nudem	1	>.01
172	469E420	La Tène 1	0.05	Grain fragments	Poaceae sp.	13	0.05
172	469E420	La Tène 1	0.05	Grass	Poaceae sp.	1	>.01
172	469E420	La Tène 1	0.05	Dock	Rumex sp.	1	>.01
172	469E420	La Tène 1	0.05	Polygonum sp.	Polygonum sp.	1	>.01
172	469E420	La Tène 1	0.05	Millet	Panicum sp.	6	>.01
172	469E420	La Tène 1	0.05	Unidentifiable	Unknown	6	>.01
172	469E420	La Tène 1	0.05	Unidentifiable weeds	Unknown	1	>.01
354	469E420	La Tène 1	0.14	Barley hulled	Hordeum vulgare	1	0.01
354	469E420	La Tène 1	0.14	Barley	Hordeum nudem	1	0.01
354	469E420	La Tène 1	0.14	Wheat	Triticum sp.	1	0.01
354	469E420	La Tène 1	0.14	Grain fragments	Poaceae sp.	26	0.11
354	469E420	La Tène 1	0.14	Millet	Panicum sp.	14	>.01
354	469E420	La Tène 1	0.14	Polygonum sp.	Polygonum sp.	2	..01
354	469E420	La Tène 1	0.14	Grass	Poaceae sp.	1	>.01
124	469E420	La Tène 1	0.08	Bromus	Bromus lepidus	1	>.01
124	469E420	La Tène 1	0.08	Barley	Hordeum nudem	1	0.01
124	469E420	La Tène 1	0.08	Grain fragments	Poaceae sp.	9	0.07
124	469E420	La Tène 1	0.08	Millet	Panicum sp.	4	>.01
124	469E420	La Tène 1	0.08	Polyganum	Polygonum sp.	3	>.01
124	469E420	La Tène 1	0.08	Unidentifiable weeds	Unknown	2	>.01
173	469E420	La Tène 1	0.65	Unidable weed	Unknown	7	>.01
173	469E420	La Tène 1	0.65	Catchfly	Silene sp.	1	>.01
173	469E420	La Tène 1	0.65	Euphorb	Euphorbia exigua	1	>01
173	469E420	La Tène 1	0.65	Vetch/Mustard	Sinapsis/Vicia sp	1.5	0.01
173	469E420	La Tène 1	0.65	Millet	Panicum sp.	5	0.01
173	469E420	La Tène 1	0.65	Grain fragments	Poaceae sp.	112	0.39
173	469E420	La Tène 1	0.65	Rye	Seacle sp.	1	0.01
173	469E420	La Tène 1	0.65	Oat	Avena sp.	5	0.03
173	469E420	La Tène 1	0.65	Barley	Hordeum nudem	15	0.1
173	469E420	La Tène 1	0.65	Wheat	Triticum sp.	2	0.02

173	469E420	La Tène 1	0.65	Wheat - Bread	Triticum aestivum	3	0.02
173	469E420	La Tène 1	0.65	Chenopodium	Chenopodium sp.	1	>.01
173	469E420	La Tène 1	0.65	Grass	Fescua sp.	2	>.01
173	469E420	La Tène 1	0.65	Grass small	Poaceae sp.	2	>.01
173	469E420	La Tène 1	0.65	Lollium	Lollium sp.	6	0.02
173	469E420	La Tène 1	0.65	Grass	Poaceae sp.	5	0.02
173	469E420	La Tène 1	0.65	Bromus	Bromus sp.	4	0.02
171	469E420	La Tène 1	0.06	Millet	Panicum sp.	16	0.01
171	469E420	La Tène 1	0.06	Grain fragments	Poaceae sp.	15	0.05
171	469E420	La Tène 1	0.06	Dock	Rumex sp.	1	>.01
128	469E420	La Tène 1	0.05	Barley	Hordeum nudem	1	0.01
128	469E420	La Tène 1	0.05	Grain fragments	Poaceae sp.	14	0.04
128	469E420	La Tène 1	0.05	Millet	Panicum sp.	6	>.01
143	469E420	La Tène 1	0.53	Millet	Panicum sp.	14	0.02
143	469E420	La Tène 1	0.53	Wheat - Emmer	Triticum diococcum	1	0.01
143	469E420	La Tène 1	0.53	Barley	Hordeum nudem	10	0.05
143	469E420	La Tène 1	0.53	Catchfly	Silene sp.	1	>.01
143	469E420	La Tène 1	0.53	Raspberry/Blackberry	Rubus sp.	1	>.01
143	469E420	La Tène 1	0.53	Oat - fragments	Avena sp.	3	0.01
143	469E420	La Tène 1	0.53	Oat	Avena sp.	2	0.01
143	469E420	La Tène 1	0.53	Grain fragments	Poaceae sp.	101	0.31
143	469E420	La Tène 1	0.53	Common vetch	Vicia sativa	2	0.03
143	469E420	La Tène 1	0.53	Vetch/Mustard	Sinapsis/Vicia sp	8	0.01
143	469E420	La Tène 1	0.53	Wheat - Bread	Triticum aestivum	6	0.06
143	469E420	La Tène 1	0.53	Chenopodium	Chenopodium sp.	4	>.01
143	469E420	La Tène 1	0.53	Unidable weed	Unknown	4	>.01
143	469E420	La Tène 1	0.53	Grass	Fescua sp.	1	>01
143	469E420	La Tène 1	0.53	Bromus	Bromus sp.	7	0.02
143	469E420	La Tène 1	0.53	Grass	Poaceae sp.	1	>.01
136	469E420	La Tène 1	0.52	Millet	Panicum sp.	13	0.02
136	469E420	La Tène 1	0.52	Grass - tiny	Poaceae sp.	2	>.01
136	469E420	La Tène 1	0.52	Grain fragments	Poaceae sp.	101	0.3
136	469E420	La Tène 1	0.52	Chenopodium	Chenopodium sp.	4	>.01

136	469E420	La Tène 1	0.52	Unidentifiable weeds	Unknown	11	>.01
136	469E420	La Tène 1	0.52	Bromus	Bromus sp.	3	0.02
136	469E420	La Tène 1	0.52	Wheat	Triticum sp.	1	0.01
136	469E420	La Tène 1	0.52	Barley fragments	Hordeum nudem	8	0.04
136	469E420	La Tène 1	0.52	Barley	Hordeum nudem	5	0.08
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Oat	Avena sp.	1	>.01
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Rye	Seacle sp.	3	0.02
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Barley - Hulled	Hordeum vulgare	2	0.02
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Unidentifiable weed	Unidentified weed	9	0.01
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Millet	Panicum sp.	4	>.01
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Chenopodium	Chenopodium sp.	1	>.01
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Grass	Poaceae sp.	7	0.01
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Common vetch	Vicia sativa	2	0.02
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Grain fragments	Poaceae sp.	124	0.35
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Barley - Naked	Hordeum nudem	21	0.14
151 - 162 - 157 - 164	470E423	La Tène 3	0.71	Wheat	Triticum sp.	14	0.15
149 - 139	470E423	La Tène 3	1.71	Raspberry/Blackberry	Rubus sp.	1	>.01
149 - 139	470E423	La Tène 3	1.71	Rye	Seacle sp.	5	0.02
149 - 139	470E423	La Tène 3	1.71	Oat	Avena sp.	10	0.04
149 - 139	470E423	La Tène 3	1.71	Barley - Hulled	Hordeum vulgare	4	0.02
149 - 139	470E423	La Tène 3	1.71	Barley - Naked	Hordeum nudem	49	0.35
149 - 139	470E423	La Tène 3	1.71	Grain fragments	Poaceae sp.	225	0.78
149 - 139	470E423	La Tène 3	1.71	Millet	Panicum sp.	11	0.01
149 - 139	470E423	La Tène 3	1.71	Grass pea	Lathyrus sp.	2	0.02
149 - 139	470E423	La Tène 3	1.71	Mustard/Vetch	Sinapsis/Vicia	7	0.02
149 - 139	470E423	La Tène 3	1.71	Lollium sp.	Lollium sp.	2	>.01
149 - 139	470E423	La Tène 3	1.71	Wheat	Triticum sp.	36	0.44
149 - 139	470E423	La Tène 3	1.71	Grass	Poaceae sp.	9	0.01
149 - 139	470E423	La Tène 3	1.71	Corncockle CF	Agrostemma githago CF	1	>.01
133 - 136	470E423	La Tène 3	0.38	Millet	Panicum sp.	3	>.01
133 - 136	470E423	La Tène 3	0.38	Wheat	Triticum sp.	5	0.05
133 - 136	470E423	La Tène 3	0.38	Barley - Naked	Hordeum nudem	12	0.08
133 - 136	470E423	La Tène 3	0.38	Grain fragments	Poaceae sp.	70	0.25

133 - 136	470E423	La Tène 3	0.38	Chickweed	Chenopodium alba	1	>.01
133 - 136	470E423	La Tène 3	0.38	Vetch/Mustard	Sinapsis/Vicia	2	>.01
133 - 136	470E423	La Tène 3	0.38	Lollium sp.	Lollium sp.	1	>.01
133 - 136	470E423	La Tène 3	0.38	Grass	Poaceae sp.	1	>.01
153 - 165	470E423	La Tène 3	1.15	Barley - Hulled	Hordeum vulgare	4	0.02
153 - 165	470E423	La Tène 3	1.15	Rye	Seacle sp.	6	0.04
153 - 165	470E423	La Tène 3	1.15	Oat	Avena sp.	3	0.02
153 - 165	470E423	La Tène 3	1.15	Oat - fragment	Avena sp.	1	0.01
153 - 165	470E423	La Tène 3	1.15	Grain fragments	Poaceae sp.	116	0.34
153 - 165	470E423	La Tène 3	1.15	Millet	Panicum sp.	4	>.01
153 - 165	470E423	La Tène 3	1.15	Vetch/Mustard	Sinapsis/Vicia	10	0.04
153 - 165	470E423	La Tène 3	1.15	Barley - Naked	Hordeum nudem	42	0.28
153 - 165	470E423	La Tène 3	1.15	Grass	Poaceae sp.	15	0.02
153 - 165	470E423	La Tène 3	1.15	Unidentifiable weed	Unidentified weed	5	0.01
153 - 165	470E423	La Tène 3	1.15	Wheat	Triticum sp.	37	0.37
134 - 129	470E423	La Tène 3	0.06	Millet	Panicum sp.	1	>.01
134 - 129	470E423	La Tène 3	0.06	Lollium sp.	Lollium sp.	1	>.01
134 - 129	470E423	La Tène 3	0.06	Grass	Poaceae sp.	1	>.01
134 - 129	470E423	La Tène 3	0.06	Grain fragments	Poaceae sp.	13	0.03
134 - 129	470E423	La Tène 3	0.06	Wheat - fragments	Triticum sp.	1	0.01
134 - 129	470E423	La Tène 3	0.06	Barley - Naked fragments	Hordeum nudem	2	0.02
117 - 127	470E423	La Tène 3	0.01	Grain fragments	Poaceae sp.	10	0.01
58 - 82 - 67	468E420	La Tène 3	1.43	Raspberry/Blackberry	Rubus sp.	1	>.01
58 - 82 - 67	468E420	La Tène 3	1.43	Millet	Panicum sp.	14	0.02
58 - 82 - 67	468E420	La Tène 3	1.43	Chenopodium	Chenopodium sp.	1	>.01
58 - 82 - 67	468E420	La Tène 3	1.43	Grass	Poaceae sp.	4	>.01
58 - 82 - 67	468E420	La Tène 3	1.43	Oat - fragment	Avena sp.	4	0.01
58 - 82 - 67	468E420	La Tène 3	1.43	Oat	Avena sp.	15	0.08
58 - 82 - 67	468E420	La Tène 3	1.43	Barley - naked	Hordeum nudem	50	0.29
58 - 82 - 67	468E420	La Tène 3	1.43	Barley - hulled CF	Hordeum vulgare CF	2	0.02
58 - 82 - 67	468E420	La Tène 3	1.43	Grain fragments	Poaceae sp.	336	0.92
58 - 82 - 67	468E420	La Tène 3	1.43	Grass	Poaceae sp.	30	0.09
58 - 82 - 67	468E420	La Tène 3	1.43	Wheat	Triticum sp.	28	0.31

58 - 82 - 67	468E420	La Tène 3	1.43	Mustard	Sinapsis alba	1	>.01
58 - 82 - 67	468E420	La Tène 3	1.43	Common vetch	Vicia sativa	3	0.01
58 - 82 - 67	468E420	La Tène 3	1.43	Garden pea	Pisum sativa	2	0.02
58 - 82 - 67	468E420	La Tène 3	1.43	Polyganum sp.	Polyganum sp.	2	>.01
58 - 82 - 67	468E420	La Tène 3	1.43	Chickweed	Chenopodium alba	2	>.01
58 - 82 - 67	468E420	La Tène 3	1.43	Corncockle CF	Agrostemma githago CF	6	0.01
58 - 82 - 67	468E420	La Tène 3	1.43	Unidentifiable weed	Unidentified weed	18	0.01
155 - 310	468E420	La Tène 3	0.96	Grain fragments	Poaceae sp.	183	0.49
155 - 310	468E420	La Tène 3	0.96	Whole grain unidentifiable	Poaceae sp.	4	0.03
155 - 310	468E420	La Tène 3	0.96	Oat - fragment	Avena sp.	6	0.02
155 - 310	468E420	La Tène 3	0.96	Oat	Avena sp.	13	0.08
155 - 310	468E420	La Tène 3	0.96	Barley - naked	Hordeum nudem	16	0.11
155 - 310	468E420	La Tène 3	0.96	Millet	Panicum sp.	24	0.04
155 - 310	468E420	La Tène 3	0.96	Raspberry/Blackberry	Rubus sp.	1	>.01
155 - 310	468E420	La Tène 3	0.96	Common vetch	Vicia sativa	1	0.02
155 - 310	468E420	La Tène 3	0.96	Grass pea	Lathyrus sp.	2	0.03
155 - 310	468E420	La Tène 3	0.96	Wheat - emmer	Triticum dioccocum	2	0.02
155 - 310	468E420	La Tène 3	0.96	Wheat - bread	Triticum aestivum	10	0.08
155 - 310	468E420	La Tène 3	0.96	Chickweed	Chenopodium alba	1	>.01
155 - 310	468E420	La Tène 3	0.96	Lollium sp.	Lollium sp.	2	>.01
155 - 310	468E420	La Tène 3	0.96	Grass	Poaceae sp.	6	0.01
155 - 310	468E420	La Tène 3	0.96	Grass - Quackgrass	Poa sp.	1	>.01
155 - 310	468E420	La Tène 3	0.96	Vetch/Mustard	Sinapsis/Vicia	3.5	0.02
155 - 310	468E420	La Tène 3	0.96	Dock	Polyganum sp.	2	>.01
155 - 310	468E420	La Tène 3	0.96	Unidentifiable	Unidentified	8	0.01
51	468E420	La Tène 3	1.87	Barley - hulled	Hordeum vulgare	4	0.02
51	468E420	La Tène 3	1.87	Oat	Avena sp.	17	0.07
51	468E420	La Tène 3	1.87	Barley - naked	Hordeum nudem	49	0.29
51	468E420	La Tène 3	1.87	Grain fragments	Poaceae sp.	435	1.21
51	468E420	La Tène 3	1.87	Garden pea	Pisum sativa	5	0.06
51	468E420	La Tène 3	1.87	Millet	Panicum sp.	18	0.01
51	468E420	La Tène 3	1.87	Lollium sp.	Lollium sp.	2	0.01
51	468E420	La Tène 3	1.87	Grass	Poaceae sp.	2	>.01

51	468E420	La Tène 3	1.87	Chickweed	Chenopodium alba	2	>.01
51	468E420	La Tène 3	1.87	Vetch	Vicia tetra sperma	10	0.02
51	468E420	La Tène 3	1.87	Wheat	Triticum sp.	19	0.18
201	470E422	La Tène 3	0.05	Oat	Avena sp.	1	0.01
201	470E422	La Tène 3	0.05	Wheat - fragment	Triticum sp.	1	0.01
201	470E422	La Tène 3	0.05	Grain fragments	Poaceae sp.	9	0.03
201	470E422	La Tène 3	0.05	Chenopodium	Chenopodium sp.	2	>.01
201	470E422	La Tène 3	0.05	Crab/Quack Grass	Poa sp.	1	>.01
217 - 219	470E422	La Tène 3	0.17	Barley - naked	Hordeum nudem	6	0.02
217 - 219	470E422	La Tène 3	0.17	Oat	Avena sp.	7	0.04
217 - 219	470E422	La Tène 3	0.17	Wheat - bread	Triticum aestivum	2	0.02
217 - 219	470E422	La Tène 3	0.17	Grain whole	Poaceae sp.	1	>.01
217 - 219	470E422	La Tène 3	0.17	Grain fragments	Poaceae sp.	1	>.01
217 - 219	470E422	La Tène 3	0.17	Grass	Poaceae sp.	44	0.08
217 - 219	470E422	La Tène 3	0.17	Millet	Panicum sp.	3	>.01
217 - 219	470E422	La Tène 3	0.17	Chenopodium	Chenopodium sp.	3	>.01
217 - 219	470E422	La Tène 3	0.17	Unidentified weed	Unknown	3	>.01
154 - 161	470E422	La Tène 3	0.05	Barley - naked	Hordeum nudem	4	0.02
154 - 161	470E422	La Tène 3	0.05	Wheat - bread	Triticum aestivum	1	0.01
154 - 161	470E422	La Tène 3	0.05	Grain fragments	Poaceae sp.	15	0.02
154 - 161	470E422	La Tène 3	0.05	Weed - unidentified	Unknown	1	>.01
22 - 23 OR 72 - 73	470E422	La Tène 3	0.09	Grain fragments	Poaceae sp.	23	0.05
22 - 23 OR 72 - 73	470E422	La Tène 3	0.09	Barley - naked	Hordeum nudem	4	0.02
22 - 23 OR 72 - 73	470E422	La Tène 3	0.09	Barley - Naked fragments	Hordeum nudem	5	0.02
22 - 23 OR 72 - 73	470E422	La Tène 3	0.09	Wheat cf.	Triticum sp.	1	>.01
22 - 23 OR 72 - 73	470E422	La Tène 3	0.09	Millet	Panicum sp.	7	>.01
22 - 23 OR 72 - 73	470E422	La Tène 3	0.09	Grass	Poaceae sp.	1	>.01
22 - 23 OR 72 - 73	470E422	La Tène 3	0.09	Unidentifiable weed	Unknown	5	>.01
22 - 23 OR 72 - 73	470E422	La Tène 3	0.09	Internode cf.	Poaceae sp.	1	>.01
24 - 23	470E422	La Tène 3	0.11	Grain fragments	Poaceae sp.	21	0.06
24 - 23	470E422	La Tène 3	0.11	Barley - naked	Hordeum nudem	1	0.01
24 - 23	470E422	La Tène 3	0.11	Barley - Naked fragments	Hordeum nudem	3	0.01
24 - 23	470E422	La Tène 3	0.11	Wheat - bread	Triticum aestivum	3	0.03

24 - 23	470E422	La Tène 3	0.11	Poa sp.	Poaceae sp.	3	>.01
24 - 23	470E422	La Tène 3	0.11	Vetch/Mustard	Sinapsis/Vicia	2	>.01
24 - 23	470E422	La Tène 3	0.11	Chenopodium	Chenopodium sp.	1	>.01
227	470E422	La Tène 3	0.04	Grain fragments	Poaceae sp.	8	0.02
227	470E422	La Tène 3	0.04	Barley - naked CF	Hordeum nudem	2	0.01
227	470E422	La Tène 3	0.04	Wheat - bread	Triticum aestivum	1	0.01
223	470E422	La Tène 3	>.01	Grain fragments	Poaceae sp.	1	>.01
223	470E422	La Tène 3	>.01	Poa sp.	Poaceae sp.	2	>.01
22	470E422	La Tène 3	0.28	Wheat - emmer	Triticum dioccocum	1	>.01
22	470E422	La Tène 3	0.28	Wheat - bread	Triticum aestivum	4	0.02
22	470E422	La Tène 3	0.28	Barley - naked	Hordeum nudem	10	0.05
22	470E422	La Tène 3	0.28	Rye	Seacle sp.	2	0.01
22	470E422	La Tène 3	0.28	Oat	Avena sp.	2	0.01
22	470E422	La Tène 3	0.28	Grain fragments	Poaceae sp.	61	0.17
22	470E422	La Tène 3	0.28	Garden pea	Pisum sativa	1	0.02
22	470E422	La Tène 3	0.28	Poa sp.	Poaceae sp.	3	>.01
22	470E422	La Tène 3	0.28	Millet	Panicum sp.	2	>.01
22	470E422	La Tène 3	0.28	Dock	Carex sp.	2	>.01
22	470E422	La Tène 3	0.28	Unidentified weed	Unknown	3	>.01
52	470E422	La Tène 3	1.73	Oat - fragment	Avena sp.	7	0.03
52	470E422	La Tène 3	1.73	Oat	Avena sp.	8	0.04
52	470E422	La Tène 3	1.73	Rye	Seacle sp.	7	0.04
52	470E422	La Tène 3	1.73	Barley - hulled	Hordeum vulgare	1	>.01
52	470E422	La Tène 3	1.73	Whole grain unidentifiable	Poaceae sp.	10	0.06
52	470E422	La Tène 3	1.73	Chickweed	Chenopodium alba	4	>.01
52	470E422	La Tène 3	1.73	Millet	Panicum sp.	18	>.01
52	470E422	La Tène 3	1.73	Vetch/Mustard	Sinapsis/Vicia	6	0.02
52	470E422	La Tène 3	1.73	Wheat - bread	Triticum aestivum	19	0.21
52	470E422	La Tène 3	1.73	Chenopodium	Chenopodium sp.	1	>.01
52	470E422	La Tène 3	1.73	Sedge	Rumex sp.	1	>.01
52	470E422	La Tène 3	1.73	Lollium sp.	Lollium sp.	1	>.01
52	470E422	La Tène 3	1.73	Grass	Poaceae sp.	11	0.03
52	470E422	La Tène 3	1.73	Unidentified weed	Unknown	20	0.03

52	470E422	La Tène 3	1.73	Poa sp.	Poaceae sp.	6	0.03
52	470E422	La Tène 3	1.73	Grain fragments	Poaceae sp.	339	0.97
23	470E420	La Tène 3	2.04	Grain fragments	Poaceae sp.	428	1.05
23	470E420	La Tène 3	2.04	Millet	Panicum sp.	28	0.03
23	470E420	La Tène 3	2.04	Wheat - bread	Triticum aestivum	15	0.19
23	470E420	La Tène 3	2.04	Barley - naked	Hordeum nudem	74	0.37
23	470E420	La Tène 3	2.04	Rye CF	Seacle sp.	3	0.02
23	470E420	La Tène 3	2.04	Oat	Avena sp.	15	0.09
23	470E420	La Tène 3	2.04	Oat fragments	Avena sp.	8	0.04
23	470E420	La Tène 3	2.04	Whole grain unidentifiable	Poaceae sp.	22	0.15
23	470E420	La Tène 3	2.04	Grape seed fragment	Vitis vinifera	2	>.01
23	470E420	La Tène 3	2.04	Garden pea	Pisum sativa	1	0.01
23	470E420	La Tène 3	2.04	Poa sp.	Poaceae sp.	7	>.01
23	470E420	La Tène 3	2.04	Lollium sp.	Lollium sp.	4	>.01
23	470E420	La Tène 3	2.04	Fescue	Poa sp.	15	0.03
23	470E420	La Tène 3	2.04	Sedge	Polyganum sp.	1	>.01
23	470E420	La Tène 3	2.04	Mallow	Malvaceae family	1	>.01
23	470E420	La Tène 3	2.04	Corncockle	Agrostemma githago	1	>.01
23	470E420	La Tène 3	2.04	Vetch/Mustard	Sinapsis/Vicia	6	0.01
23	470E420	La Tène 3	2.04	Chenopodium	Chenopodium sp.	4	>.01
23	470E420	La Tène 3	2.04	Weed - unidentified	Unknown	13	>.01
23	470E420	La Tène 3	2.04	Grass pea	Lathyrus sp.	13	>.01
269	471E420	La Tène 3	1.47	Millet	Panicum sp.	12	0.02
269	471E420	La Tène 3	1.47	Wheat - compact	Triticum compactum	1	0.01
269	471E420	La Tène 3	1.47	Wheat - emmer	Triticum dioccocum	2	0.01
269	471E420	La Tène 3	1.47	Wheat - bread	Triticum aestivum	11	0.11
269	471E420	La Tène 3	1.47	Rye CF	Seacle sp.	4	0.03
269	471E420	La Tène 3	1.47	Oat	Avena sp.	13	0.07
269	471E420	La Tène 3	1.47	Oat fragments	Avena sp.	5	0.01
269	471E420	La Tène 3	1.47	Barley - naked	Hordeum nudem	5	0.26
269	471E420	La Tène 3	1.47	Whole grain unidentifiable	Poaceae sp.	7	0.05
269	471E420	La Tène 3	1.47	Grain fragments	Poaceae sp.	300	0.77
269	471E420	La Tène 3	1.47	Garden pea	Pisum sativa	1	0.02

269	471E420	La Tène 3	1.47	Vetch/Mustard	Sinapsis/Vicia	4.5	0.02
269	471E420	La Tène 3	1.47	Lollium sp.	Lollium sp.	5	0.02
269	471E420	La Tène 3	1.47	Fescue	Poa sp.	17	0.06
269	471E420	La Tène 3	1.47	Sedge	Rumex sp.	1	>.01
269	471E420	La Tène 3	1.47	Weed - unidentified	Unknown	9	>.01
4	469E420	La Tène 3	3.06	Grain fragments	Poaceae sp.	652	1.73
4	469E420	La Tène 3	3.06	Millet	Panicum sp.	34	0.02
4	469E420	La Tène 3	3.06	Plum/Cherry pit fragment	Prunus sp.	2	0.01
4	469E420	La Tène 3	3.06	Garden pea	Pisum sativa	3	0.01
4	469E420	La Tène 3	3.06	Common vetch	Vicia sativa	1	>.01
4	469E420	La Tène 3	3.06	Grass pea	Lathyrus sp.	1	>.01
4	469E420	La Tène 3	3.06	Unidentifiable	Unknown	1	>.01
4	469E420	La Tène 3	3.06	Vetch/Mustard		4	>.01
4	469E420	La Tène 3	3.06	Poa sp.	Poa sp.	15	>.01
4	469E420	La Tène 3	3.06	Chenopodium	Chenopodium sp.	4	>.01
4	469E420	La Tène 3	3.06	Unidentified weed	Unknown	11	>.01
4	469E420	La Tène 3	3.06	Lollium sp.	Lollium sp.	5	>.01
4	469E420	La Tène 3	3.06	Grass	Poaceae sp.	6	>.01
4	469E420	La Tène 3	3.06	Oat	Avena sp.	28	0.23
4	469E420	La Tène 3	3.06	Barley - hulled	Hordeum vulgare	2	0.01
4	469E420	La Tène 3	3.06	Wheat - bread	Triticum aestivum	39	0.35
4	469E420	La Tène 3	3.06	Rye CF	Seacle sp.	9	0.05
4	469E420	La Tène 3	3.06	Whole grain unidentifiable	Poaceae sp.	14	0.06
4	469E420	La Tène 3	3.06	Barley - naked	Hordeum nudem	84	0.55
4	469E420	La Tène 3	3.06	Pulse fragments	Fabaceae sp.	6	>.01
103	469E420	La Tène 3	5.97	Raspberry/Blackberry	Rubus sp.	2	0.01
103	469E420	La Tène 3	5.97	Grain fragments	Poaceae sp.	1100	2.86
103	469E420	La Tène 3	5.97	Millet	Panicum sp.	67	0.08
103	469E420	La Tène 3	5.97	Insect Gall	Insect Gall	1	>.01
103	469E420	La Tène 3	5.97	Vetch/Mustard	Sinapsis/Vicia	34	0.1
103	469E420	La Tène 3	5.97	Barley	Hordeum nudem	186	1.13
103	469E420	La Tène 3	5.97	Barley fragments	Hordeum nudem	45	0.23
103	469E420	La Tène 3	5.97	Hulled barley cf.	Hordeum vulgare	6	0.02

103	469E420	La Tène 3	5.97	Wheat - bread	Triticum aestivum	49	0.5
103	469E420	La Tène 3	5.97	Wheat - fragments	Triticum sp.	10	0.08
103	469E420	La Tène 3	5.97	Oat	Avena sp.	48	0.25
103	469E420	La Tène 3	5.97	Oat - fragment	Avena sp.	18	0.08
103	469E420	La Tène 3	5.97	Rye CF	Seacle sp.	2	0.01
103	469E420	La Tène 3	5.97	Grain	Unknown	11	0.08
103	469E420	La Tène 3	5.97	Garden pea	Pisum sativa	6	0.1
103	469E420	La Tène 3	5.97	Legume fragments	Fabaceae sp.	13	0.09
103	469E420	La Tène 3	5.97	Polyganum sp.	Polyganum sp.	1	>.01
103	469E420	La Tène 3	5.97	Oraganic Tar	Unknown	4	0.01
103	469E420	La Tène 3	5.97	Common vetch	Vicia sativa	1	0.01
103	469E420	La Tène 3	5.97	Grass pea	Lathyrus sp.	4	0.02
103	469E420	La Tène 3	5.97	Lollium sp.	Lollium sp.	12	0.03
103	469E420	La Tène 3	5.97	Grass - Quackgrass	Poaceae sp.	14	>.01
103	469E420	La Tène 3	5.97	Grass	Poaceae sp.	37	0.12
103	469E420	La Tène 3	5.97	Chenopodium	Chenopodium sp.	10	>.01
103	469E420	La Tène 3	5.97	Unidentifiable weeds	Unknown	35	0.06
50	469E420	La Tène 3	0.58	Grain fragments	Poaceae sp.	127	0.3
50	469E420	La Tène 3	0.58	Barley	Hordeum nudem	14	0.08
50	469E420	La Tène 3	0.58	Barley fragments	Hordeum nudem	3	0.02
50	469E420	La Tène 3	0.58	Immature grains cf.	Poaceae sp.	4	0.02
50	469E420	La Tène 3	0.58	Grain	Poaceae sp.	5	0.03
50	469E420	La Tène 3	0.58	Oat	Avena sp.	5	0.03
50	469E420	La Tène 3	0.58	Wheat - emmer	Triticum dioccocum	1	0.02
50	469E420	La Tène 3	0.58	Wheat - bread	Triticum aestivum	2	0.02
50	469E420	La Tène 3	0.58	Wheat	Triticum sp.	2	0.02
50	469E420	La Tène 3	0.58	Violet	Viola sp.	1	>.01
50	469E420	La Tène 3	0.58	Weed - unidentified	Unknown	13	>.01
50	469E420	La Tène 3	0.58	Millet	Panicum sp.	11	0.01
50	469E420	La Tène 3	0.58	Plantain	Plantago sp.	2	0.01
50	469E420	La Tène 3	0.58	Poa sp.	Poaceae sp.	2	>.01
50	469E420	La Tène 3	0.58	Wild oat	Avena fatua	2	0.01
50	469E420	La Tène 3	0.58	Fescue	Festuca pratensis	6	0.02

50	469E420	La Tène 3	0.58	Vetch/Mustard	Vicia/sinapsis	2	>.01
94	469E420	La Tène 3	4.87	Grain fragments	Poaceae sp.	979	2.92
94	469E420	La Tène 3	4.87	Barley	Hordeum nudem	113	0.77
94	469E420	La Tène 3	4.87	Oat	Avena sp.	75	0.41
94	469E420	La Tène 3	4.87	Vetch/Mustard	Sinapsis/Vicia	27.5	0.06
94	469E420	La Tène 3	4.87	Millet	Panicum sp.	49	0.07
94	469E420	La Tène 3	4.87	Garden pea	Pisum sativa	3	0.05
94	469E420	La Tène 3	4.87	Common vetch	Vicia sativa	3	0.04
94	469E420	La Tène 3	4.87	Grass pea	Lathyrus sp.	1	0.01
94	469E420	La Tène 3	4.87	Glume base	Poaceae sp.	2	0.01
94	469E420	La Tène 3	4.87	Field poppy	Agrostemma githago	6	0.02
94	469E420	La Tène 3	4.87	Chenopodium	Chenopodium sp.	5	>.01
94	469E420	La Tène 3	4.87	Lollium	Lollium sp.	11	0.03
94	469E420	La Tène 3	4.87	Grape seed fragment CF	Vitis vinifera	1	>.01
94	469E420	La Tène 3	4.87	Needle grass	Stipa sp.	1	>.01
94	469E420	La Tène 3	4.87	Grass	Poaceae sp.	23	0.07
94	469E420	La Tène 3	4.87	Unidable	Unknown	3	0.02
94	469E420	La Tène 3	4.87	Unidable weeds	Unknown	16	0.01
94	469E420	La Tène 3	4.87	Wheat - bread	Triticum aestivum	39	0.4
94	469E420	La Tène 3	4.87	Wheat - emmer	Triticum dioccocum	12	0.12
456	467E422	La Tène 3	0.23	Grain fragments	Poaceae sp.	41	0.13
456	467E422	La Tène 3	0.23	Barley	Hordeum nudem	6	0.04
456	467E422	La Tène 3	0.23	Wheat - bread	Triticum aestivum	1	0.01
456	467E422	La Tène 3	0.23	Oat	Avena sp.	1	0.01
456	467E422	La Tène 3	0.23	Legume	Unknown	3	0.03
456	467E422	La Tène 3	0.23	Unidentifiable	Unknown	3	0.01
456	467E422	La Tène 3	0.23	Glume base - weed	Unknown	1	>.01
473	467E422	La Tène 3	0.4	Grain fragments	Poaceae sp.	66	0.13
473	467E422	La Tène 3	0.4	Barley	Hordeum nudem	8	0.05
473	467E422	La Tène 3	0.4	Wheat	Triticum sp.	6	0.05
473	467E422	La Tène 3	0.4	Wheat - emmer	Triticum dioccocum	4	0.05
473	467E422	La Tène 3	0.4	Wheat - bread	Triticum aestivum	2	0.02
473	467E422	La Tène 3	0.4	Oat	Avena sp.	6	0.05

473	467E422	La Tène 3	0.4	Oat - fragment	Avena sp.	4	0.02
473	467E422	La Tène 3	0.4	Barley cf.	Hordeum nudem	1	0.01
473	467E422	La Tène 3	0.4	Grass	Poaceae sp.	1	>.01
473	467E422	La Tène 3	0.4	Millet	Panicum sp.	1	>.01
473	467E422	La Tène 3	0.4	Weed - unidentified	Unknown	6	0.01
473	467E422	La Tène 3	0.4	Grain	Poaceae sp.	2	0.01
467	467E422	La Tène 3	0.22	Grain fragments	Poaceae sp.	37	0.11
467	467E422	La Tène 3	0.22	Barley	Hordeum nudem	8	0.04
467	467E422	La Tène 3	0.22	Wheat fragments	Triticum sp.	5	0.02
467	467E422	La Tène 3	0.22	Wheat - bread	Triticum aestivum	21	0.02
467	467E422	La Tène 3	0.22	Oat	Avena sp.	4	0.03
467	467E422	La Tène 3	0.22	Millet	Panicum sp.	3	>.01
467	467E422	La Tène 3	0.22	Vetch/Mustard	Sinapsis/Vicia	1	>.01
467	467E422	La Tène 3	0.22	Weed - unidentified	Unknown	4	>.01
467	467E422	La Tène 3	0.22	Grass	Unknown	3	>.01
481	467E422	La Tène 3	0.25	Grain fragments	Poaceae sp.	84	0.16
481	467E422	La Tène 3	0.25	Legume fragments	Fabaceae sp.	9	0.03
481	467E422	La Tène 3	0.25	Grass	Poaceae sp.	1	>.01
481	467E422	La Tène 3	0.25	Barley	Hordeum nudem	5	0.03
481	467E422	La Tène 3	0.25	Bromus sp.	Bromus sp.	1	>.01
481	467E422	La Tène 3	0.25	Wheat fragments	Triticum sp.	2	0.02
481	467E422	La Tène 3	0.25	Wheat - emmer	Triticum dioccocum	1	0.01
481	467E422	La Tène 3	0.25	Millet	Panicum sp.	1	>.01
481	467E422	La Tène 3	0.25	Undentifiable	Unknown	1	>.01
65	468E420	La Tène 3	1.91	Millet	Panicum sp.	35	0.04
65	468E420	La Tène 3	1.91	Rye	Seacle sp.	9	0.04
65	468E420	La Tène 3	1.91	Oat	Avena sp.	25	0.13
65	468E420	La Tène 3	1.91	Barley	Hordeum nudem	50	0.28
65	468E420	La Tène 3	1.91	Grain fragments	Poaceae sp.	392	1.13
65	468E420	La Tène 3	1.91	Chickweed	Chenopodium sp.	4	>.01
65	468E420	La Tène 3	1.91	Grape fragment cf.	Vitis vinifera	1	>.01
65	468E420	La Tène 3	1.91	Lollium	Lollium sp.	3	>.01
65	468E420	La Tène 3	1.91	Grass	Poaceae sp.	3	>.01

65	468E420	La Tène 3	1.91	Grass small	Poaceae sp.	6	>.01
65	468E420	La Tène 3	1.91	Wheat bread	Triticum aestivum	29	0.26
65	468E420	La Tène 3	1.91	Chaff	Unknown	1	>.01
65	468E420	La Tène 3	1.91	Chenopodium	Chenopodium sp.	2	>.01
65	468E420	La Tène 3	1.91	Vetch/Mustard	Sinapsis/Vicia	7	0.03
65	468E420	La Tène 3	1.91	Mustard	Sinapsis alba	1	>.01
65	468E420	La Tène 3	1.91	Glume base fragment	Unknown	1	>.01
65	468E420	La Tène 3	1.91	Plum/Cherry pit fragment	Prunus sp.	1	>.01
65	468E420	La Tène 3	1.91	Dock	Rumex sp.	1	>.01
65	468E420	La Tène 3	1.91	Weed - unidentified	Unknown	3	>.01
65	468E420	La Tène 3	1.91	Unidentifiable	Unknown	4	>.01
65	468E420	La Tène 3	1.91	Oraganic Tar	Unknown	1	>.01
65	468E420	La Tène 3	1.91	Barley - hulled	Hordeum vulgare	1	>.01

APPENDIX 2

CORRESPONDENCE ANALYSIS FACTOR TABLES

Factor table etc. for grain correspondence analysis

The categorical values encountered during processing are

Variables	Levels				
C1$ (3 levels)	Hallstatt	La Tene 1	La Tene 3		
C2$ (8 levels)	Barley	Barley - hulled	Grain	Immature grain	Millet
	Oat	Rye	Wheat		

Simple Correspondence Analysis

Chi-square : 40.025
df : 14.000
Probability : 0.000

Eigenvalues and Percent Inertia

Factor	Eigenvalue	Percent	Cumulative Percent	
1	0.077	91.041	91.041	- . .
2	0.008	8.959	100.000	- - - . .

Sum : 0.084 (Total Inertia)

Row Variable Coordinates

Name	Mass	Quality	Inertia	Factor 1	Factor 2
Hallstatt	0.120	1.000	0.034	-0.498	0.176
La Tene 1	0.511	1.000	0.010	-0.120	-0.076
La Tene 3	0.369	1.000	0.041	0.328	0.048

Row Variable Contributions to Factors

Name	Factor 1	Factor 2
Hallstatt	0.388	0.492
La Tene 1	0.096	0.394
La Tene 3	0.517	0.114

Row Variable Squared Correlations with Factors

Name	Factor 1	Factor 2
Hallstatt	0.889	0.111
La Tene 1	0.712	0.288
La Tene 3	0.979	0.021

Column Variable Coordinates					
Name	Mass	Quality	Inertia	Factor 1	Factor 2
Barley	0.156	1.000	0.009	0.167	-0.179
Barley - hulled	0.025	1.000	0.016	0.779	0.197
Grain	0.262	1.000	0.007	-0.157	0.029
Immature grain	0.004	1.000	0.001	0.375	-0.161
Millet	0.209	1.000	0.028	-0.365	0.012
Oat	0.112	1.000	0.012	0.318	0.098
Rye	0.036	1.000	0.010	0.518	-0.035
Wheat	0.196	1.000	0.001	0.081	0.020

Column Variable Contributions to Factors		
Name	Factor 1	Factor 2
Barley	0.057	0.664
Barley - hulled	0.200	0.130
Grain	0.084	0.029
Immature grain	0.008	0.015
Millet	0.362	0.004
Oat	0.147	0.143
Rye	0.125	0.006
Wheat	0.017	0.010

Column Variable Squared Correlations with Factors		
Name	Factor 1	Factor 2
Barley	0.465	0.535
Barley - hulled	0.940	0.060
Grain	0.967	0.033
Immature grain	0.844	0.156
Millet	0.999	0.001
Oat	0.913	0.087
Rye	0.995	0.005
Wheat	0.945	0.055

Factor tables etc. for weed correspondence analysis

The categorical values encountered during processing are

Variables	Levels				
C1$ (3 levels)	Hallstatt	La Tene 1	La Tene 3		
C2$ (33 levels)	Bedstraw	Bromus	Bullrush/spurge	Catchfly	Chenopodium
	Corncockle	Daisy	Dock	Euphorb	Fescue
	Field Wood Rush	Glume base - weed	Grass	Knotweed	Legume
	Lollium	Mallow	Millet	Needle grass	Plantain
	Poa sp.	Polygonum	Pulse/legume	Quackgrass	Sedge
	Sedge/dock	Unidentifiable weed	Vetch	Vetch/Mustard	Violet
	Wild Barley	Wild Rye	Wild oat		

Simple Correspondence Analysis

Chi-square : 123.766
df : 64.000
Probability : 0.000

Eigenvalues and Percent Inertia

Factor	Eigenvalue	Percent	Cumulative Percent	
1	0.235	53.896	53.896	- . .
2	0.201	46.104	100.000	- . .

Sum : 0.436 (Total Inertia)

Row Variable Coordinates

Name	Mass	Quality	Inertia	Factor 1	Factor 2
Hallstatt	0.095	1.000	0.210	-1.427	0.414
La Tene 1	0.567	1.000	0.087	0.032	-0.391
La Tene 3	0.338	1.000	0.139	0.347	0.539

Row Variable Contributions to Factors

Name	Factor 1	Factor 2
Hallstatt	0.824	0.081
La Tene 1	0.003	0.431
La Tene 3	0.174	0.488

Row Variable Squared Correlations with Factors

Name	Factor 1	Factor 2
Hallstatt	0.922	0.078
La Tene 1	0.007	0.993
La Tene 3	0.293	0.707

Column Variable Coordinates

Name	Mass	Quality	Inertia	Factor 1	Factor 2

Column Variable Coordinates					
Name	**Mass**	**Quality**	**Inertia**	**Factor 1**	**Factor 2**
Bedstraw	0.007	1.000	0.015	-1.439	0.026
Bromus	0.039	1.000	0.019	0.126	-0.683
Bullrush/spurge	0.004	1.000	0.034	-2.944	0.923
Catchfly	0.018	1.000	0.010	-0.536	-0.513
Chenopodium	0.092	1.000	0.011	0.341	0.006
Corncockle	0.014	1.000	0.028	0.717	1.202
Daisy	0.004	1.000	0.034	-2.944	0.923
Dock	0.035	1.000	0.017	-0.642	0.289
Euphorb	0.007	1.000	0.005	0.066	-0.872
Fescue	0.011	1.000	0.021	0.717	1.202
Field Wood Rush	0.004	1.000	0.003	0.066	-0.872
Glume base - weed	0.004	1.000	0.007	0.717	1.202
Grass	0.180	1.000	0.004	0.144	0.047
Knotweed	0.004	1.000	0.034	-2.944	0.923
Legume	0.007	1.000	0.005	0.066	-0.872
Lollium	0.113	1.000	0.007	-0.160	0.186
Mallow	0.011	1.000	0.001	0.283	-0.180
Millet	0.004	1.000	0.007	0.717	1.202
Needle grass	0.007	1.000	0.001	0.391	0.165
Plantain	0.011	1.000	0.007	-0.720	0.418
Poa sp.	0.025	1.000	0.048	0.717	1.202
Polygonum	0.053	1.000	0.020	0.153	-0.595
Pulse/legume	0.007	1.000	0.005	0.066	-0.872
Quackgrass	0.018	1.000	0.006	0.456	0.373
Sedge	0.021	1.000	0.005	-0.110	0.464
Sedge/dock	0.004	1.000	0.034	-2.944	0.923
Unidentifiable weed	0.250	1.000	0.010	-0.023	-0.194
Vetch	0.021	1.000	0.015	-0.829	0.072
Vetch/Mustard	0.011	1.000	0.001	0.283	-0.180
Violet	0.004	1.000	0.007	0.717	1.202
Wild Barley	0.011	1.000	0.008	0.066	-0.872
Wild Rye	0.004	1.000	0.003	0.066	-0.872
Wild oat	0.004	1.000	0.007	0.717	1.202

Column Variable Contributions to Factors		
Name	**Factor 1**	**Factor 2**
Bedstraw	0.062	0.000
Bromus	0.003	0.090
Bullrush/spurge	0.130	0.015
Catchfly	0.022	0.023
Chenopodium	0.045	0.000
Corncockle	0.031	0.101
Daisy	0.130	0.015
Dock	0.062	0.015
Euphorb	0.000	0.027
Fescue	0.023	0.076
Field Wood Rush	0.000	0.013

Column Variable Contributions to Factors		
Name	**Factor 1**	**Factor 2**
Glume base - weed	0.008	0.025
Grass	0.016	0.002
Knotweed	0.130	0.015
Legume	0.000	0.027
Lollium	0.012	0.019
Mallow	0.004	0.002
Millet	0.008	0.025
Needle grass	0.005	0.001
Plantain	0.023	0.009
Poa sp.	0.054	0.177
Polygonum	0.005	0.093
Pulse/legume	0.000	0.027
Quackgrass	0.016	0.012
Sedge	0.001	0.023
Sedge/dock	0.130	0.015
Unidentifiable weed	0.001	0.047
Vetch	0.062	0.001
Vetch/Mustard	0.004	0.002
Violet	0.008	0.025
Wild Barley	0.000	0.040
Wild Rye	0.000	0.013
Wild oat	0.008	0.025

Column Variable Squared Correlations with Factors		
Name	**Factor 1**	**Factor 2**
Bedstraw	1.000	0.000
Bromus	0.033	0.967
Bullrush/spurge	0.911	0.089
Catchfly	0.522	0.478
Chenopodium	1.000	0.000
Corncockle	0.262	0.738
Daisy	0.911	0.089
Dock	0.831	0.169
Euphorb	0.006	0.994
Fescue	0.262	0.738
Field Wood Rush	0.006	0.994
Glume base - weed	0.262	0.738
Grass	0.903	0.097
Knotweed	0.911	0.089
Legume	0.006	0.994
Lollium	0.425	0.575
Mallow	0.711	0.289
Millet	0.262	0.738
Needle grass	0.849	0.151
Plantain	0.748	0.252
Poa sp.	0.262	0.738

Column Variable Squared Correlations with Factors		
Name	**Factor 1**	**Factor 2**
Polygonum	0.062	0.938
Pulse/legume	0.006	0.994
Quackgrass	0.600	0.400
Sedge	0.053	0.947
Sedge/dock	0.911	0.089
Unidentifiable weed	0.014	0.986
Vetch	0.992	0.008
Vetch/Mustard	0.711	0.289
Violet	0.262	0.738
Wild Barley	0.006	0.994
Wild Rye	0.006	0.994
Wild oat	0.262	0.738

APPENDIX 3

SOFTWARE PACKAGES USED

The following software packages were used in this study:
For graphics editing, Adobe Photoshop CS
For data management, some statistics and writing, Microsoft Office 2000, 2003 (Access, Excel, and Word)
For some statistics, Systat 12

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