Appendix X
The Environmental Remains: Archaeobotanical and Charcoal Analysis
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X.1 Introduction

This report discusses the analysis of the plant macrofossil (archaeobotanical) remains assemblage and charcoal remains recorded from the soil samples associated with three seasons of archaeological excavations at Bective Abbey, Co. Meath (Season 2010–12). The site was dated and phased using a combination of relative (stratigraphy and artefact analysis) and absolute (C14) dating techniques. Four main phases/divisions were identified:

- The Barn (high medieval)
- Pre-dissolution of the abbey (later medieval)
- Post-dissolution of the abbey
- Stratified garden layers

For the purpose of this report, the results of the plant remains and charcoal analysis will be discussed in line with these four main phases.

X.2. Sampling strategy

An on-site soil sampling strategy was implemented for the site during Season 2010, Season 2011 and Season 2012. Features and deposits deemed archaeologically significance were sampled in line with the specific research questions designed for the site. Bulk soil samples ranging in size from 5-10 litres were taken and were processed on-site using both a simple flotation method and a Siraf flotation tank, to accommodate larger soil samples (see below X.4. Methodology). A total of 69 soil samples from 29 features and deposits were taken during the 2010 excavation programme (Cutting 1-4). The majority of these samples represent deposits associated with medieval occupation layers and the remains of a barn/corn drying kiln recorded in Cutting 2 and Cutting 4 and garden layers in Cutting 3. A total of 32 soil samples from 10 recorded medieval layers were taken from the 2011 excavation programme. The soil samples primarily represent the barn/kiln deposits that were excavated in Cutting H and Cutting L. A small number of samples associated with the precinct in Cutting H were also selected for analysis. A total of 58 soil samples from 26 features and deposits were taken from the 2012 excavation programme (Cuttings P, Q, R, SN and SS). The majority of these samples represent deposits associated with the barn/kiln (Cutting P and Cuting SS), the pre-stoney layer (Cutting SN), the precinct (Cutting P and Cutting SN) and the garden layers (Cutting R). All soil samples from the Bective Abbey Project (2010–12) which were subjected to analysis are presented in table X.1. The results from all three seasons have been merged together to allow a formal discussion of the assemblage to take place.

3.3 Preservation of botanical remains on archaeological sites

Carbonized plant remains

Charred plant remains are those which have been heated to more than about 200° C, but where there is not enough oxygen to complete the burning process. Instead, the organic components are converted to a more carbon-rich resilient material or to carbon itself rather than to ash. Despite being subjected to high temperatures, many charred remains retain a morphology or exterior detail which can aid plant identification to genus or even species level. Some remains are found in the same place that they were charred (hearths, fires, kilns, ovens, burnt stores). More are found thinly spread and scattered across a wider area entering deposits such as occupational layers, pits and potholes for example. Over time, this material can move and be re-distributed due to disturbances such as soil movement, extreme climatic conditions, root penetration or worm/animal action.

During the carbonization process chaff and lighter, more brittle cereal components burn away quickly while the grains can deteriorate over time until they are no longer identifiable. Most chaff is destroyed, even in reduced conditions, between 300–350 °C after four or five hours, while grains were still identifiable in a reducing atmosphere at 450 °C after five hours (Boardman and Jones 1990, 5; Gustafsson 2000). Distortion and/or outright destruction of seeds and other plant components are dependent on a variety of factors, such as humidity, water content of seeds, etc., but primarily on temperature and time (Boardman and Jones 1990). Smaller seeds of wild taxa also burn at different rates. These seeds become fully charred but are still identifiable at temperatures of 300 °C for 50 minutes. Using temperatures of 700°C for 50 minutes all material is completely destroyed, while

Table X.1 – Features and deposits analysed from Bective Abbey (2010–12)

Feature number	No. of soil samples	Feature description
Garden: Phase1		
F205	1	Medieval garden: Upper fosse fill
F209	1	Medieval garden: Bank revetment
Garden: Phase 2		
R02	1	Garden use furrows
R03	4	Garden use furrows
F211	1	Garden use: charcoal surface
Garden: Phase 4		
F202	1	Unstratified
F206	1	Unstratified
F207	1	Unstratified
Barn: Phase 2		
F006	1	Charcoal and ash
F015	1	Drain
F141	1	Medieval layer
F144	1	Posthole 137
F148	1	Linear depression
F152	1	Kiln chamber
F156	1	Kiln
F159	1	Kiln
F160	1	Kiln
F161	1	Kiln
F164	1	Flue?
F165	1	Kiln
F171	1	Circular pit
F174	1	Kiln
F302	1	Charcoal
F307	1	Barn floor?
F312	1	Drain
H11	12	Kiln waste
H13	1	Kiln waste
H16	9	Drain
H23	1	Posthole?
J04	2	Medieval waste layer
J05	1	Western limit of burning
LF06	4	Drain
P11	2	Drain
P15	1	Drain
P16	1	Drain
P17	1	Drain
SS07	5	Burnt phase
SS10	2	Burnt phase
SS11	1	Burnt phase
Phase 5: Mortar layer		
L03	1	E/W Curved wall
SS13	1	Mortar layer
Phase 6: Robber trench		
F118	1	Robber trench
SS06	2	Assoc. with robber trench wall
Phase 7: Pre-stoney layer		
F128	1	Burnt layer in lay-brother's range
Q07	1	Ditch
SS14	1	Sump/drain
SN04	15	Topsoil
SS8	1	Burnt layer
SS9	1	Burnt layer
SS7	1	Burnt layer
SS11	1	Burnt layer
SS12	1	Burnt layer
SS13	1	Burnt layer
SS15	1	Burnt layer
Precinct: Phase 8		
F1	1	Stoney later: post-dissolution
F8	1	Stoney later: post-dissolution
F129	1	Stoney later: post-dissolution
F133	1	Stoney later: post-dissolution
H06	1	Stoney later: post-dissolution
P9	2	Stoney later: post-dissolution
P10	2	Stoney later: post-dissolution
P12	2	Stoney later: post-dissolution
SN01	1	Mortared stone blocks
SN02	1	Mortared stone blocks
Precinct: Phase 10		
P01	1	Topsoil
Q03	1	Modern post hole
Q04	1	Topsoil

the majority of seeds were completely disintegrated in temperatures of 500 °C unless only exposed for 5 minutes (Wright 2003, 578).

Consideration must therefore be given when interpreting plant remains, which have been charred. Cereals and weed seeds respond differently to heat. Factors such as the soils and vegetation in which these plants originally came from, as well as moisture, oil or starch content of the remains can have a significant effect on how the carbonisation process affects these materials (Wilson 1984, 202).

Interpretation The first stage of interpreting charred plant remains can be the presence of the various taxa. The most common carbonized remains are usually assemblages which are composed of cultivated plants (cereals and legumes) and cornfield weeds. The actual level of concentrations and importance of the various crops and associated weed seeds is difficult to assess because preservation depends on many variables, such as the chance of being charred. The carbonization process obviously affects different species and plant components in different ways,

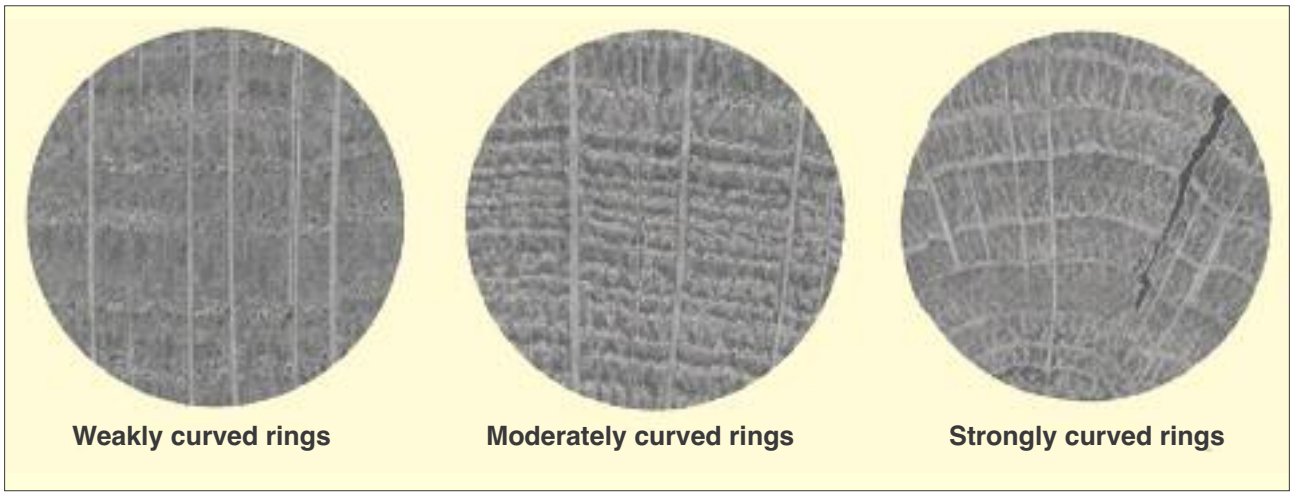

Fig. X.1 Ring curvature (after Marguerie and Hunot 2007, 1421, fig. 3).

where finer, lighter material can be destroyed more easily than larger elements. It most therefore be noted that the charred plant remains recovered from archaeological features can as much reflect the results of the carbonization process as how and what plant remains were used on a site.

The composition of crops and wild taxa may give some information about the farming practices that produced them. This relates more to the surroundings of the archaeological site rather than to the site itself. The local soil and climatic conditions come into effect here – examples include the preference of rye to sandy soils, and wheat to dry climatic conditions. The wild taxa communities associated with cultivated crops are developed and adapted to different conditions over many millennia, so it may be difficult when comparing them to modern weed assemblages.

Charcoal from archaeological sites

Charcoal is the product of chemical reactions that occur when wood is heated (i.e. thermal decomposition) (Smart and Hoffman 1988, 172). When analysing charcoal from archaeological sites, it is presumed that fuel would have been gathered close to the site, and therefore should represent local woodlands (Principle of Least Effort) (Shackleton and Prins 1992). It must be considered however that the charcoal recorded from archaeological sites represents only those wood species that a) were chosen to be burnt and b) that were preserved and not burnt away to ash. It is also likely that many of the species recorded were abandoned structural timbers or wood brought to the site for uses in construction works or other activities are later reused as firewood.

X.4 Methodology

Soil Sample Processing

Small samples (1-2 litres) were processed using both buckets and a bank of sieves (mesh size 2mm, 1mm, 500μm and 250μm), while larger samples were processed in a Siraf flotation tank (lined with a 1mm and 500μm sized-mesh). A simple flotation technique was employed, whereby each sample was soaked in water and agitated in order to suspend the carbonized material (charcoal and plant remains). The floated material was poured off and trapped in a bank of sieves a process that was repeated until all carbonized material was separated from the sediment. Each 'flot' (i.e. the floated material) was air-dried for further microscopic analysis. The heavy, non-floating, material ('retent') was then washed through a 1mm sieve mesh to rid it of all sediment. Retents can contain other archaeological material, such as small finds, animal bone, tile fragments, pottery sherds, shell and larger charcoal fragments, which are sorted for further specialist analysis. The flots and retents from each sample were subsequently sorted for the removal of carbonized plant remains and charcoal.

Archaeobotanical Analysis The carbonized plant remains were sorted under a low powered binocular microscope (Nikon C-PS) at magnification of x0.8 to x8. Where preservation allowed, all charred plant remains were identified to species level where applicable and the constituents quantified numerically. In some cases, where a very high volume of plant remains are present, the sample is sub-sampled using a riffle box, which randomly and evenly separates the sample into even proportions.

Plant remains which were fragmented or abraded, such as cereal chaff or indeterminate cereal grains, pulse crops and wild taxa were recorded using an abundance key (DAFOR scale) to highlight the concentrations of material identified from each sample; D = Dominant, ++++ = Abundant, +++ = Frequent, ++ = Occasional and + = Rare. The DAFOR scale is a

useful tool to visually assess the abundance of any species on a semi-quantitative level (Sutherland 1996).

All plant remains were separated out and sorted according to species, placed in glass vials and labelled for permanent archive. Nomenclature (Latin names) and taxonomy follows the *New Flora of the British Isles* (Stace 1997). Plant species for this study were made using reference to the author's seed collection and standard seed atlases and references; *Flora of the British Isles* (Clapham, Tutin and Warburg 1957), *Zadenatlas der Nederlandsche Flora* (Beijerinck, W.1976), *New Flora of the British Isles 2nd Edition* (Stace 1997) and *Digital Seed Atlas of the Netherlands* (Cappers, Bekker and Jans 2006). The term 'cf' denotes a tentative identification. The identifications refer to seeds unless otherwise stated.

Charcoal Identification Analysis Quantifying charcoal samples can be difficult as many wood species can be affected by heat in different ways and hence become fragmented into an arbitrary number of fragments. Due to the potential for a very high number of charcoal fragments from the samples, a representative sample of 50–100 charcoal fragments (O'Carroll 2012; Keepax 1988) were randomly chosen from larger samples for identification and analysis. In the case of smaller samples all charcoal fragments present were identified. The charcoal fragments of each species identified were counted, weighted (grams) and bagged according to species.

All dried flots and retents were sieved through a bank of sieves (2mm, 1mm and 0.5mm) to separate the larger charcoal samples from the much smaller charcoal fibres, which would prove more difficult to identify. The larger sized charcoal fragments (>3mm in width) were fractured to view the three planes [transverse, radial and tangential sections] necessary for microscopic wood identification. The wood species identifications were conducted under a metallurgical binocular microscope using incident light and viewed at magnifications of 100x, 200x and 400x where applicable.

Wood species identifications are made using wood reference slides and wood keys devised by Franklin and Brazier (1961), Schweingruber (1978), Hather (2000) and the International Association of Wood Anatomists (IAWA) wood identification manuals and (www.lib.ncsu/edu/insidewood) by Wheeler, Bass and Gasson (1989).

The ring curvature of the charcoal recorded was noted – for example weakly curved annual rings suggest the use of trunks or larger branches, while strongly curved annual rings indicate the burning of smaller branches or trees (fig. X.1). Insect infestation is usually recognised by round holes, and, is considered, to be caused by burrowing insects. Their presence normally suggests the use of decayed degraded wood, which may have been gathered from the woodland floor or stockpiled material.

X.5 Results

Carbonised plant remains

A total of 47,436 individual plant remains were identified to species level from the archaeological excavations at Bective Abbey, Co. Meath. The carbonized plant assemblage was dominated by cereal grains, which accounted for 94% of the material identified. Pulse crops (pea and bean), including vetches made up 5% of the assemblage, while a variety of wild taxa, including plant remains not classified as cereal or pulse crops/vetches, accounted for 1% of the plant remains recorded at the site (fig. X.2). Many of the samples contained a high proportion of vesicular and eroded cereal grains and these appear in the tables as indeterminate grain (Cerealia). Cereal grains can become eroded and abraded as a result of charring at high temperatures, the grain was damp when burnt or that this material had degraded due to re-deposition and/or exposure. Poor preservation made it difficult to quantify these components and as a result they are not included in any quantitative analysis.

Carbonized cereal remains (fig. X.2)

Wheat (*Triticum* L.) (pl. X.1)

Wheat (*Triticum* sp.) was the dominant cereal grain recorded, accounting for 67% of the assemblage. The wheat grain identified in most cases was that of the bread/club wheat type (*Triticum aestivo-compactum*), however a small proportion was tentatively identified as emmer wheat (*T. dicoccum*). Bread/club wheat is free-threshing wheat, which means it has fragile glumes or hulls. Upon threshing, this allows for the grain to be released easier from the hulls and

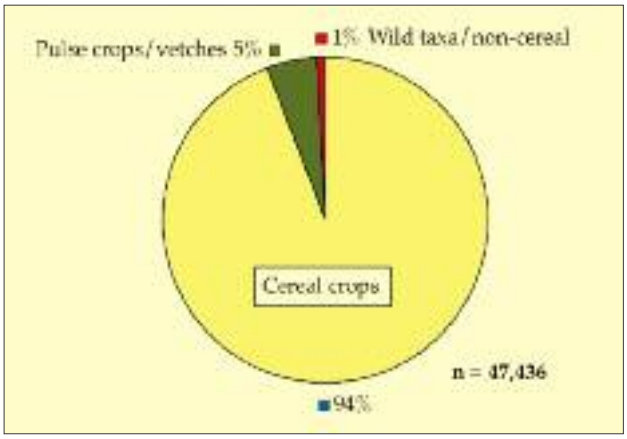

Fig. X.2 Total percentage of carbonised plant remains identified from Bective Abbey, Co. Meath, n = 47,436.

therefore requires fewer steps during crop processing (Renfrew 1973). Emmer is hulled wheat, whereby it has very tight glumes (hulls) encasing the grain, and requires a more laborious threshing process to separate the grain from the glumes (ibid.)

Oats (*Avena* L.) (pl. X.1)

Oat (*Avena* sp.) made up 17% of the identifiable remains. The majority of the grain was free of the palea/lemma (hulls), which are required in identifying between oat types. However, based on the size of the oat grain (caryopsis) and the absence of the large 'suckermouth'–type lemma bases it seems likely the common oat type (*A. sativa*) is the prominent species present in the assemblage. Cultivated oats (Avena *sativa*) are likely to have derived from wild oats (*A. fatua*) once a weed of agricultural crops and waste places (Renfrew 1973).

Barley *(Hordeum* L.) (pl. X.2)

Barley accounted for 16% of the grain identified from Bective Abbey with the hulled variety (*Hordeum vulgare*) of grain being the most common species recorded. Taking a sub-sample of approximately 500 grains, a ratio of 1:3 straight to twisted grain was recorded, which indicates that both two-row and six-rowed barley were present. Barley is seen as a companion to wheat (Zohary and Hopf 1993). It is noted in traditional farming communities the naked variety of barley is preferred for human consumption while the hulled variety is utilized for beer brewing and animal fodder (Zohary and Hopf 2001).

Rye (*Secale cereale* L.) (pl. X.2)

Rye made up <1% of the overall cereal assemblage. Only one cultivated rye species is known (Secale cereale). It has a more northerly range than other cereals and can grow in poorer soils. The earliest evidence for rye (Secale cereale) in Ireland has been

Pl. X.2 Carbonized barley and rye.

recorded from a pit feature at Tomb No. 27, Carrowmore, Co. Sligo (Helmquist 1980), returning a late Bronze Age/Early Iron Age date of C^{14} 530±55BC) (Helmquist 1980). The low occurrence of rye from Irish sites makes is difficult to fully interpret the use or importance of this crop in the absence of a larger cache of grain. In a European context, it has been suggested that rye originated as a weed of cultivation to barley and wheat during the prehistoric period (Hillman 1978) and became a crop in its own right independently over time (Jones 1984).

Cereal chaff (pl. X.3)

The evidence for fragmented charred cereal chaff (waste cereal debris) overall was recorded in low concentrations from Bective Abbey. The only sizeable cache of chaff remains was recorded from deposits associated with Phase 2: Kiln/Barn (F148, C152 and F156). Cereal chaff by its very nature is light and papery so fragments and separates quite easily as a result of threshing and can disintegrate during the carbonization process. Where chaff elements survived well, culm nodes and rachis internode fragments

Pl. X.1 Carbonized wheat and oat.

Pl. X.3 Carbonized cereal chaff.

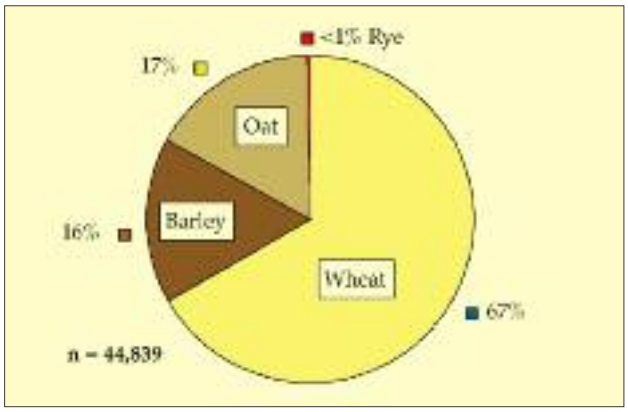

Fig. X.3 Percentage of total cereal crops identified from Bective Abbey, Co. Meath, n = 44,839.

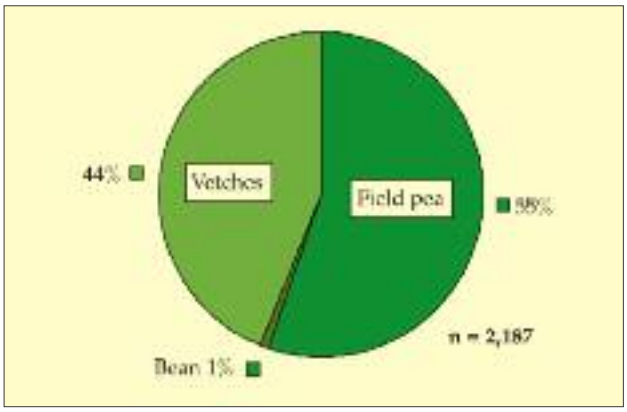

Fig. X.4 Percentage of total carbonised pulse crop/legumes from Bective Abbey, n = 2,187.

were identified, but due to the abraded nature of the material could not be further identified to genus or species level. Awns and palea/lemma fragments of oats were also recorded, although difficult to identify to species level due to the absence of the floret base. It is difficult to quantify chaff fragments as the exact intact elements are unknown and represent a multitude of cereal remains fragments.

Carbonized pulse crops/legumes/vetches (pls X.4–X.5) While the pulse crop/legume assemblage made up just 5% of the overall plant remains recorded from Bective Abbey, the majority of this material (55%) was identified as field pea (*Pisum sativum*). Peas were survived in seed form or seed fragments and were verified to species based on the presence of the distinctive hilum or hilum scar, a diagnostic feature of *Pisum sativum.* Vetches (*Vicia/Lathyrus* spp.) made up 44% of the assemblage. These legumes are made up of a variety of species and can be difficult to differentiate if the hilum is absent. Since vetch seeds are much smaller than pea or bean seed, this feature is easily burnt away during the carbonisation process. Horse/broad bean (*Vicia faba)* made up just 1% of the assemblage (fig. X.3). The majority of the pulse crops/legumes were recorded from deposits associate with Phase 2 (Kiln/Barn), Phase 7(burnt phase in lay brother's range) and Garden Phase 2 (furrow F3).

Carbonized wild taxa (Fig. X.6) The wild taxa assemblage from Bective Abbey accounted for <1% of the overall plant remains recorded. The majority of the plant remains were confined to deposits associated with the barn (Phase 2), the lay-brother's range (Phase 7) and furrow F3 from the garden (Phase 2). The most notable species identified were knotgrass (*Polygonum aviculare),* curly dock (*Rumex crispus),* dock (*Rumex* sp.), bedstraw (*Galium aparine),* goosefoot (*Chenopodium* sp.) and wild radish/charlock (*Raphanus raphanistrum*) (pl. X.5). Lower occurrences of buttercup (*Ranunculus* sp.), mouse ears (*Cerastium* sp.), corn marigold (*Chyrstanthenum segetum*), celery-type (*Apium graveolens*), stinking chamomile (*Anthemis cotula*), onion/leek/garlic (*Allium* sp.), violet (*Viola* sp.), primrose (*Primula* sp.) and hawkbit (*Leontodon autumnalis*). This varied collection of plant communities have both natural and anthropogenic qualities and will be discussed in more detail below,

Pl. X.4 Carbonized field peas.

Pl. X.5 Carbonized horse/broad beans.

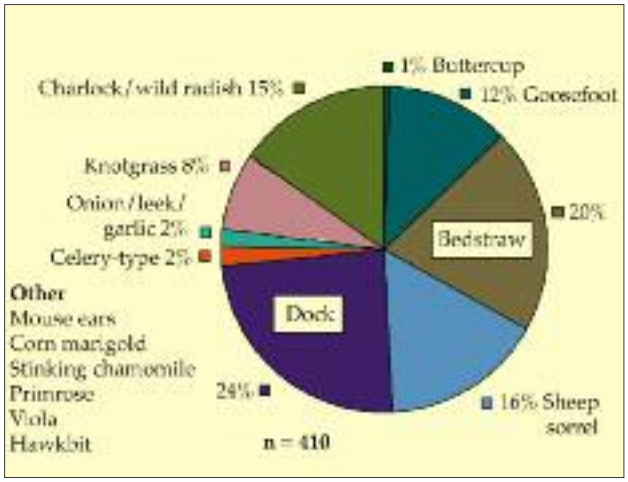

Fig. X.5 Percentage of total carbonised wild taxa from Bective Abbey, n = 410.

Pl. X.6 Carbonized *Raphanus raphanistrum* siliqua pods.

Charcoal Identifications

A total of 4,139 charcoal identifications, representing eleven wood species were undertaken from features and deposits associated with the archaeological excavations at Bective Abbey. The assemblage was dominated by ash (*Fraxinus excelsior*) (46%) and oak (*Quercus* sp.) (27%), followed by hazel (*Corylus avellana*) (15%). Lower occurrences of Maloideae spp. (pomaceous fruit woods) (8%) and willow (*Salix* sp.) (2%) were also identified. The pomaceous fruit wood group is made up of apple (*Malus* sp.), hawthorn (*Crataegus* sp.), pear (*Pyrus* sp.) and whitebeam/ rowan (*Sorbus* sp.). These wood species are anatomically very similar to each other and in the absence of bark, buds and leaves they can be very difficult to separate. Similarly, the willow species are also difficult to fully identify to species microscopically and as such are classified to genus only. A number of other species were also identified from the assemblage, making up just 1% of less of the total charcoal identified; blackthorn (*Prunus spinosa*), cherry-type (*Prunus* sp.), ELM (*Ulmus* sp.), holly *(Ilex aquilfolium*), purgin buckthorn (*Rhamnus cathartica*) and alder (*Alnus glutinosa*) were also recorded (fig. X.6).

The growth rings from approximately 30% of the oak, ash and hazel charcoal recorded particularly from Phase 2: kiln waste (H11) were strongly curved indicating they derived from small-medium branch wood (5mm-10mm diameter). Similar sized branch wood of ash, hazel, willow, blackthorn and cherry was also recorded from Phase 2: burnt phase (SS07, SS10 and SS11) and Phase 8: Precinct (P9, P10 and P12). The growth ring composition from the ash and oak samples was relatively even, which suggests that the wood was growing in a suitable environment, possibly in open clearings, where these species could growth without restriction. Hazel and pomaceous charcoal identified from Phase 8: Precinct (P9, P10 and P12) displayed a growth ring pattern indicative of possible coppicing. In a coppiced tree, the first two to three rings tend to be wide, with a subsequent fall in growth rates (O'Sullivan, 1998, 60). The remains of possible coppiced heels (i.e. the join between the stump or stool and the rod, which is generally a good indication of coppicing at a site (Coles et al. 1978) was also tentatively identified from three hazel fragments.

Small round/branch wood of cherrywood from Phase 8: Precinct (P12) and Phase 7 (SN11) showed signs of worked ends, where chisel marks (cut on one side) were present. These cut marks indicate the removal of small branch woods, which may be consistent with pruning, denoting some degree of woodland management or maintenance.

The charcoal identified was also largely free of any obvious insect holes or degradation, which suggests that the wood was not collected from the forest floor or in long-term storage, but burnt or used quickly after felling. The oak charcoal recorded was also free of fungal hyphae, which can be a diagnosis for decay in wood. Its absence here could tentatively suggest that wood was collected fresh and used quickly after felling or dried/seasonedprior to being burnt as fuel.

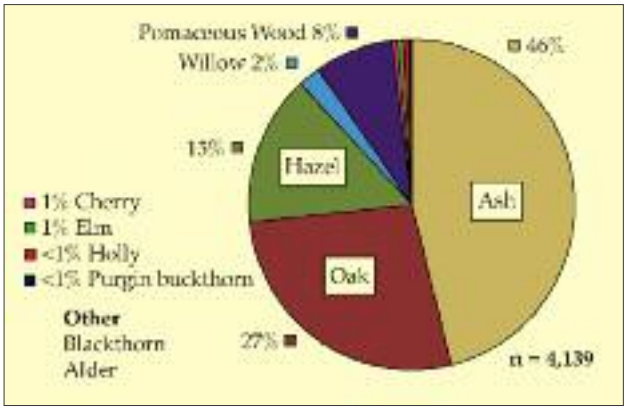

Fig. X.6 Percentage of total charcoal identification from Bective Abbey, n = 4,139.

X.6 Discussion

The environmental analysis carried out on soils samples from Bective Abbey represents the largest archaeobotanical and charcoal analytical study from a late medieval monastic site in Ireland. This study will not only provide valuable archaeological and palaeoecological information about the arable economy and diet of the Cistercian community who founded Bective Abbey, but will offer new insights into monastic life and the Cistercian Order in medieval Ireland.

The results of the analysis from Bective Abbey, Co. Meath will be discussed in line with the four major phases and divisions that have been assigned to the site:

- Phase 1/2: The Barn (high medieval)
- Phase 3/7: Pre-dissolution of the abbey (later z)
- Phase 8/9: Post-dissolution of the abbey
- Stratified garden layers

The archaeobotanical remains identified largely reflect domestic and industrial waste, in the form of cultivated crops (cereal and legumes) and associated arable weeds. A variety of plant species recorded also have a history of anthropogenic use and may have been growing in a more controlled environment at the site. These plant remains provide information about the local arable economy and the diet of the people who resided there. The wood species from the charcoal remains identified showed that certain woods were selected for building and fuel. Evidence for possible woodland management and the presence of fencing/boundary ditches and orchards were also recorded by analysing the growth rings and identifying cut marks and possible coppice heels.

Phase 1/2: The Barn (High medieval)

A total of 60 samples representing 31 features and deposits (Table X.2) were analysed from Phase 1/2: The Barn (High medieval). A quantitative list of all plant remains identified is presented in Table 3 and a list of all charcoal identifications is found in Table X.4.

The sheer volume of charred plant remains (13,637 identifications) together with the high charcoal content recorded from this phase indicates that features associated with the use of the barn, such as the recorded kiln, had experienced a major conflagration event. A radiocarbon date of from SS10 dates this phase to between 1268–1391. Here the barn and kiln structure where grain was most likely being stored for drying had collapsed and the remains left *in-situ*. The absence of oxygen in the smothered fire would have further promoted the charring of the grain.

Corn drying kilns were an integral part of the crop processing practice. During the medieval period, such kilns were constructed and used for a number of reasons (Scott 1951; Monk 1983):

- To dry the unthreshed crop prior to threshing
- To allow for the dehusking and removal of awns from hulled grain
- To harden the grain for grinding
- To kill the germinating grain after malting
- To improve the storage properties of the grain (killing pests and driving off excess moisture)

The kiln at Bective suggests the drying of crops in bulk to cater for the needs of the abbey as well as accommodating for the wetter climates. This type of activity would have required a level of management and technique, which would have, perhaps, been common in an organised community such as Bective. These sites may also have acted as economic centres, where large volumes of cereal grain would have been brought to the site for storage, trade, as tribute or as payment of rent. This may have been an industry on its own, where bulk crops were distributed to nearby urban centres for selling and trading.

The regular use of fire as part of the cereal processing would have increased the risks of accidental burning occurring in these barn/kiln structures (Fenton 1978, Evans 1957, 123). For this reason these features were located outside the main settlement, as stipulated in the medieval Irish laws tracts, where kilns had to be placed within so many paces of a dwelling (Evans, 1957). The fact that the grain was left *in situ* indicates that the kiln was not properly cleaned out and may have been abandoned. This kiln debris was subsequently raked out and spread over a wider area, most probably to the east (Cutting H), which would account for the high crop content from H11. The periodic cleaning of the kiln would have produced large quantities of charred grain, which would have been dumped into nearby open features, such as ditch fills F205 and F206 in Cutting 3 and drain H16 (Cutting H) and L06 (Cutting L).

The crop assemblage recorded from these destruction deposits were dominated by wheat, followed by oat, barley and much lesser rye. Pulse crops, such as pea and bean, vetches and wild species were also present, although only accounted for 3% of the archaeobotanical assemblage from this phase (fig. X.7).

The composition of grain from the features directly associated with the kiln (F152, F156, F159, F160, F161, F164, F165 and F174), drain deposits (F15, F312, L06, P07, P11, P15, P16 and P17), waste debris (H11, H13 and J04), the barn floor (F307) and other postholes, pits and linear features (F144, F148, F171 and H23) all attest to a possible single destruction event (fig. X.8). The presence of wheat, oat and barley, especially from the kiln itself

Table X.2 – Samples analysed from Phase 1/2: The Barn

Feature number	Sample number	Feature description	Feature number	Sample number	Feature description
F006	2	Charcoal and ash	H16	3	Drain
F015	4	Drain	H16	5	Drain
F141	9	Medieval layer	H16	6	Drain
F144	10	Posthole 137	H16	7	Drain
F148	11	Linear depression	H16	8	Drain
F152	12	Kiln chamber	H16	9	Drain
F156	13	Kiln	H16	10	Drain
F159	14	Kiln	H16	11	Drain
F160	15	Kiln	H16	15	Drain
F161	16	Kiln	H23	1	Posthole?
F164	17	Flue?	J04	6	Medieval waste layer
F165	18	Kiln	J04	7	Medieval waste layer
F171	19	Circular pit	J05	8	Western limit of burning
F174	20	Kiln	LF06	1	Drain
F302	27	Charcoal	LF06	5	Drain
F307	28	Barn floor?	LF06	6	Drain
F312	29	Drain	LF06	2	Drain
H11	12	Kiln waste	P11	5	Drain
H11	13	Kiln waste	P11	6	Drain
H11	14	Kiln waste	P15	1	Drain
H11	15	Kiln waste	P16	1	Drain
H11	16	Kiln waste	P17	1	Drain
H11	17	Kiln waste	SS07	1	Burnt phase
H11	18	Kiln waste	SS07	2	Burnt phase
H11	19	Kiln waste	SS07	3	Burnt phase
H11	23	Kiln waste	SS07	4	Burnt phase
H11	24	Kiln waste	SS07	5	Burnt phase
H11	21	Kiln waste	SS10	1	Burnt phase
H11	22	Kiln waste	SS10	2	Burnt phase
H13	2	Kiln waste	SS11	1	Burnt phase

suggests that these cereals were being dried together as an admixture. Wheat and oat clearly made up the bulk of this particular drying episode, with barley lesser so. It is possible that rye and legumes (pea/bean/vetches) were also dried in this kiln at one point, based on the remnants found from the drain (H06, H16 and P15) and kiln deposits, but not on this occasion.

For the volume of grain recorded from the barn/kiln features, cereal chaff and weed seeds were relatively low. This suggests that the material dried at the site was essentially a clean crop. The absence of chaff from a carbonized cereal assemblage can indicate that cereals were either being prepared for long-term storage, transport or for grinding and milling. The gathered crop would require full processing (removal of chaff and weeds) prior to storage to prevent spoilage of the crop. After a harvest, the crop goes through a series of processing procedures where the product (grain) and the various by-products (chaff, straw and weed seeds) are separated from each other (van der Veen 1989). This process would have left behind a higher concentration of chaff remains and weed seeds and therefore suggests that either crops were being processed and prepared for drying at another location. The only exception was a relatively high occurrence of oat awns and palea/lemma from linear (F148). These remains indicate that an oat crop may have been specifically

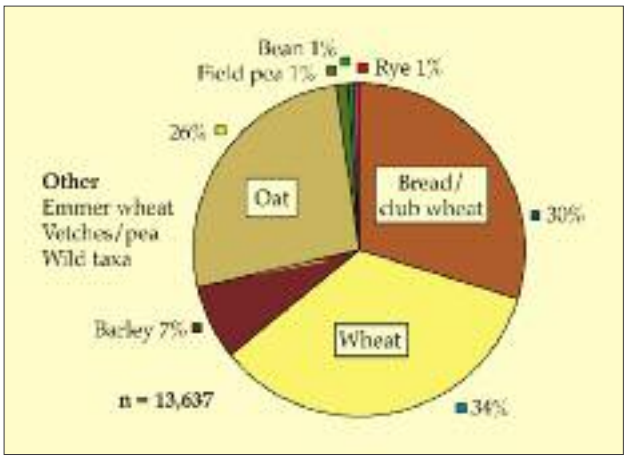

Figure X.7 Total plant remains identified from Phase 2: Barn.

Table 2.3 – Charcoal from Phase 2: The Barn

Context number	Sample number	Flot volume (grams)	Wood species identifications	No. of fragments	Charcoal weights (grams)
006	2	226.9	*Maloideae* spp. (pomaceous woods)	36	3.9
			Quercus sp. (oak)	7	0.6
			Salix sp. (willow)	3	0.3
			Prunus sp. (cherry-type)	1	0.2
015	4	4.1	No charcoal for ID		
141	9	30.8	*Fraxinus excelsior* (ash)	84	7.7
			Quercus sp. (oak)	9	2.9
			Corylus avellana (hazel)	2	0.4
144	10	5.2	*Quercus* sp. (oak)	8	0.5
			Salix sp. (willow)	3	0.3
148	11	10.4	*Fraxinus excelsior* (ash)	58	4.5
			Quercus sp. (oak)	13	0.9
			Corylus avellana (hazel)	11	1.0
152	12	23.0	*Fraxinus excelsior* (ash)	20	1.3
156	13	13.8	No charcoal for ID		
159	14	31.0	*Fraxinus excelsior* (ash)	29	2.5
160	15	8.9	*Fraxinus excelsior* (ash)	78	6.2
			Corylus avellana (hazel)	22	2.7
161	16	24.6	*Corylus avellana* (hazel)	23	2.3
			Fraxinus excelsior (ash)	19	2.1
			Quercus sp. (oak)	8	1.5
			Prunus cf spinosa (blackthron)	3	0.3
164	17	2.0	*Fraxinus excelsior* (ash)	5	0.4
			Corylus avellana (hazel)	2	0.2
165	18	11.3	*Fraxinus excelsior* (ash)	5	0.5
			Corylus avellana (hazel)	5	0.4
171	19	21.8	*Quercus* sp. (oak)	38	1.7
174	20	6.7	*Corylus avellana* (hazel)	7	0.5
302	27	21.3	*Fraxinus excelsior* (ash)	63	2.9
			Quercus sp. (oak)	29	2.1
			Corylus avellana (hazel), young wood (<10 years)	8	0.8
307	28	20.0	*Quercus* sp. (oak)	27	3.7
			Fraxinus excelsior (ash)	25	7.2
			Maloideae spp. (pomaceous woods)	18	5.0
			Corylus avellana (hazel)	5	2.2
312	29	24.1	*Corylus avellana* (hazel)	33	3.2
			Fraxinus excelsior (ash)	11	1.3
			Maloideae spp. (pomaceous woods)	6	0.5
H11		304.0	*Fraxinus excelsior* (ash)	584	48.9
			Quercus sp. (oak)	296	24.1
			Corylus avellana (hazel)	71	6.9
			Maloideae spp. (pomaceous woods)	35	3.0
			Salix sp. (willow)	13	2.4
H13	2	31.0	*Quercus* sp. (oak)	82	6.9
			Fraxinus excelsior (ash)	10	2.2
			Maloideae spp. (pomaceous woods)	5	0.5
			Prunus sp. (cherry-type)	3	0.3
H16		168.6	*Quercus* sp. (oak)	394	30.1
			Fraxinus excelsior (ash)	187	14.8
			Corylus avellana (hazel)	91	8.1
			Maloideae spp. (pomaceous woods)	15	0.9
			Salix sp. (willow)	12	1.0
J04	6	17.0	*Fraxinus excelsior* (ash)	20	1.1
	7	24.2	*Corylus avellana* (hazel)	11	0.9

Table 2.3 (continued) – Charcoal from Phase 2: The Barn

Context number	Sample number	Flot volume (grams)	Wood species identifications	No. of fragments	Charcoal weights (grams)
L06	1	47.7	*Quercus* sp.(oak)	36	4.0
			Fraxinus excelsior (ash), small roundwoods	28	3.0
			Corylus avellana (hazel)	25	3.2
			Maloideae spp. (pomaceous woods)	6	0.8
			Salix sp. (willow)	5	0.6
P11	5	0.1	No charcoal for ID		
P11	6	2.2	*Fraxinus excelsior* (ash)	15	1.3
P15	1	18.4	*Fraxinus excelsior* (ash)	25	3.4
			Corylus avellana (hazel)	16	2.2
			Salix sp. (willow)	9	1.2
P16	1	75.0	*Fraxinus excelsior* (ash)	28	3.6
			Quercus sp. (oak)	13	2.2
			Corylus avellana (hazel)	8	0.9
			cf *Prunus* sp. (cherry-type)	1	0.2
P17	1	18.0	*Corylus avellana* (hazel)	21	4.0
			Fraxinus excelsior (ash)	15	2.1
			Quercus sp. (oak)	14	1.3
SS7	1	8.0	*Maloideae* spp. (pomaceous woods), small roundwoods	3	1.0
			Prunus sp. (cherry-type), small roundwoods	2	0.8
SS7	2	16.5	*Maloideae* spp. (pomaceous woods), small roundwoods	15	1.3
			Corylus avellana (hazel), small roundwoods	15	2.0
			Fraxinus excelsior (ash), small roundwoods	12	1.2
			Prunus sp. (cherry-type), small roundwoods	8	0.7
SS10	2	42.0	*Maloideae* spp. (pomaceous woods)	19	2.4
			Corylus avellana (hazel)	15	2.0
			Quercus sp. (oak)	10	1.4
			Fraxinus excelsior (ash)	4	0.7
			Prunus sp. (cherry-type)	2	0.2
SS11	1	6.7	*Fraxinus excelsior* (ash)	14	1.0
			Maloideae spp. (pomaceous woods)	9	0.5
			Prunus cf *avium/padus* (wild/bird cherry)	4	0.4

dried for the purpose of removing the hulls. Alternatively, such debris, along with various wild plants, such as dock and cleavers were being used as tinder to fuel the kiln, which was a common practice to help ignite the kiln fire (Hillman 1981).

The charcoal remains from the barn (Phase 2) were dominated by ash, followed by oak. Lesser occurrences of hazel and pomaceous woods were also identified, with trace elements of willow, cherry-type and blackthorn (fig. X.9). It was noted that the majority of small branch/roundwoods recorded (<10 years) from the assemblage were of ash, hazel, pomaceous woods and willow. This could represent the remains of a light structure or wattling, possibly the kiln superstructure, associated drying platforms and other internal divisions within the barn itself. Ash, hazel and willow have pliable but strong wood, and commonly used in wattling from the prehistoric period (Pilcher and Hall 2001; Caseldine 1996). Hazel and willow also have a history of being coppiced, which refers to the regular harvesting of brushwood and lighter roundwoods from managed strands (Rackham 1980). Willow also responds well to pollarding, another form of woodland management, which produces shoots suitable for wattle work, basketry and barrel hoops (Culter and Gale 2000). While oak charcoal was recorded from many of the deposits within the barn, the highest concentration was identified from medieval waste layers (J04), the drain (H16 and L06) and the western limit of burning (J05). Based on the ring curvature of this material, this is likely to be larger oak branches or heartwood. Since oak was favoured for construction works during the medieval period, it is most probable that the oak recorded here are the charred remains of the barn structure.

While is it possible that all wood recorded from Phase 2 deposits are a mix of both structural and fuel wood, cherry, pomaceous woods and blackthorn may have formed part of the fuel stock, since their

Table X.4 – Plant remains from Phase 2: Barn

CEREALS: CARBONISED

Latin name	Common name		Total
Triticum aestivo-compactum	bread/club wheat	grain	3,435
Triticum diccocum	emmer wheat	grain	6
Triticum sp.	wheat	grain	3,967
Hordeum vulgare	barley	grain	842
Avena sativa	cultivated oat	grain	3,033
Avena sp.	oat	grain	1,813
Secale cereale	rye	grain	11
Cerealia	indeterminate cereals	frag.	+

CEREAL CHAFF: CARBONISD

Latin name	Common name		Total
Oat	palae & lemma		+
Oat	awns		+
Cereal indet	internode	frag.	+
Cereal indet	rachis	frag.	+

Legumes: CARBONISED

Latin name	Common name		Total
Pisum sativum	field pea	seed	111
Pisum sp.	field pea	frag.	13
Vicia faba	horse bean	seed	7
Vicia faba	horse bean	frag.	3
Vicia hirusta	hairy vetch	seed	3
Vicia	vetch	seed	59
Vicia/Lathyrus	vetches/pea-type	indeterminate	257

WILD TAXA: CARBONISED

Latin name	Common name		Total
Ranunculus cf *acris*	meadow buttercup	seed	1
Chenopodium album	goosefoot	seed	5
Galium aparine	bedstraw	seed	18
Rumex acetosella	sheep sorrel	seed	10
Rumex cf *crispus*	curly dock	seed	14
Rumex sp.	dock	seed	3
Chyrstanthenum ≈ *compactum*	corn marigold	seed	3
Apium graveolens	celery	seed	3
Allium sp.	onion/garlic/leek	seed	2
Polygonum aviculare	knotgrass	seed	2
Polygonum sp.	knotgrass	seed	4
Raphanus cf *raphanistrum*	wild radish	siliqua	12
Total counts of identified plant parts (only)			**77**

wood burning qualities exceed their structural uses (Culter and Gale 2000) (fig. X.10).

Phase 3/7: Pre-dissolution of the abbey (later medieval)

A total of 30 samples representing 15 features and deposits (table X.5) were analysed from Phase 3/7: Pre-dissolution of the abbey (Later medieval). A quantitative list of all plant remains identified is presented in table X.6 and a list of all charcoal identifications is found in table X.7.

The only features to contain any significant archaeobotanical assemblage from phases associated

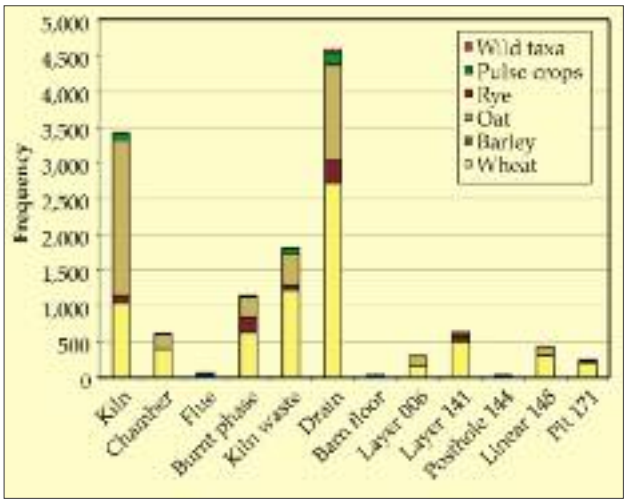

Fig. X.8 Distribution of plant remains from Phase 2: The barn.

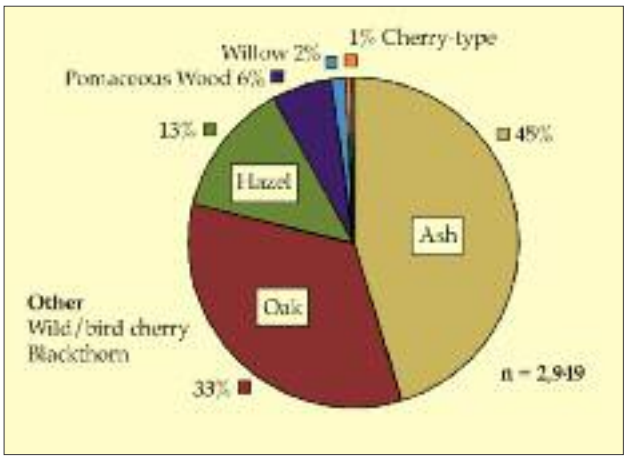

Fig. X.9 Percentage of wood species identified from Bective Abbey, n = 2,949.

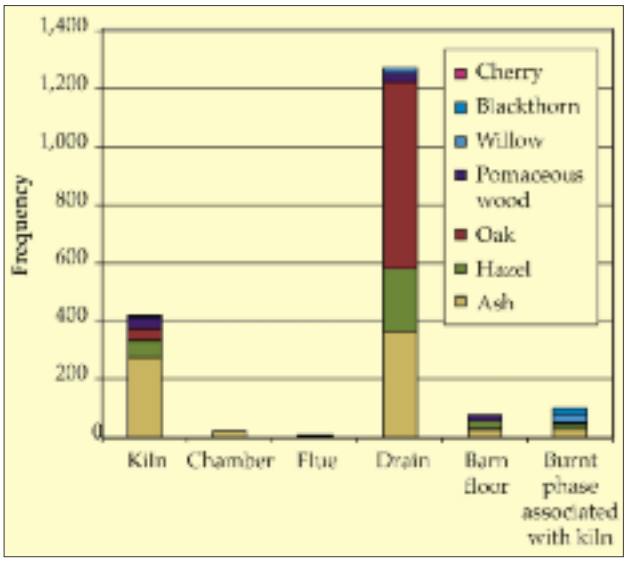

Fig. X.10 Distribution of wood species from Phase 2: The Barn.

Table X.5 Samples analysed from Phase 3/7: Pre-dissolution of the abbey

Feature number	Sample number	Feature description
Phase 5: Mortar layer		
L03	5	E/W Curved wall
SS13	1	Mortar layer
Phase 6: Robber trench		
F118	5	Robber trench
SS06	5	Assoc. with robber trench wall
SS06	6	Assoc. with robber trench wall
Phase 7: Pre-stoney layer		
F128	6	Burnt layer in lay-brother's range
Q07	1	Ditch
SS14	1	Sump/drain
SN04	1	Topsoil
SN04	2	Burnt layer
SN04	3	Burnt layer
SN04	4	Burnt layer
SN04	5	Burnt layer
SN04	6	Burnt layer
SN04	7	Burnt layer
SN04	8	Burnt layer
SN04	9	Burnt layer
SN04	10	Burnt layer
SN04	11	Burnt layer
SN04	12	Burnt layer
SN04	13	Burnt layer
SN04	14	Burnt layer
SN04	15	Burnt layer
SS8	4	Burnt layer
SS9	2	Burnt layer
SS7	1	Burnt layer
SS11	1	Burnt layer
SS12	4	Burnt layer
SS13	1	Burnt layer
SS15	1	Burnt layer

with the pre-dissolution of the abbey were from Phase 7 (pre-stoney layer/burnt phase in lay-brother's range). A low archaeobotanical assemblage was present from F128 (Cutting 2) and Q7 (Cutting Q), however, it was the extensive charred layer SN4 and drain SN14 (Cutting SN) which contains the most significant plant remains and will which will dominate this discussion. Drain SN14 and charred layer of SN4 was made up almost exclusively of charred cereal grains. Wheat is again the dominant crop identified making up 65% of the plant remains, followed by barley, with lesser oat. Pulse crops (pea and bean) and legumes account for 10% of the assemblage, with vetches making up almost half of this. Rye is once again under-represented in this phase and wild taxa account for just 1% of the identified remains (fig. X.11).

Table X.6 – Phase 7, Pre-stoney layer

CEREALS: CARBONISED

Latin name	Common name		Total
Triticum aestivo-compactum	bread/club wheat	grain	10,086
Triticum cf *diccocum*	emmer wheat	grain	19
Triticum sp.	wheat	grain	2,054
Triticum/Hordeum	wheat/barley	grain	284
Hordeum vulgare	barley	grain	3,040
Avena sativa	cultivated oat	grain	927
Avena sp.	oat	grain	1,069
Secale cereale	rye	grain	47
Cerealia	indeterminate	frag.	558

CEREAL CHAFF: CARBONISD

Latin name	Common name		Total
Oat	palae & lemma	frag.	+
Oat	awns	frag.	+
Wheat	spikelets	frag.	+
Cereal indet	internode	frag.	+
Cereal indet	rachis	frag	+
Straw	fragments	frag	+++

Legumes: CARBONISED

Latin name	Common name		Total
Pisum sativum	field pea	seed	1,061
Pisum sp.	field pea	frag.	91
Vicia faba	horse bean	seed	2
Vicia faba	horse bean	frag.	11
Vicia hirusta	hairy vetch	seed	4
Vicia sp.	vetch	seed	51
Vicia/Lathyrus	vetches/pea-type	indeter-minate	785

WILD TAXA: CARBONISED

Latin name	Common name		Total
Ranunculus cf *acris*	meadow buttercup	seed	1
Chenopodium album	goosefoot	seed	20
Galium aparine	bedstraw	seed	46
Rumex acetosella	sheep sorrel	seed	7
Rumex cf *crispus*	curly dock	seed	8
Rumex sp.	dock	seed	27
Cerastium sp.	mouse-ears	seed	4
Apium graveolens	celery	seed	8
Anthemis cotula	stinking chamomile	seed	1
Allium sp.	onion/garlic/leek	seed	7
Viola sp.	violet	seed	3
Primula sp.	primrose	seed	1
Agrostemma githago	corn cockle	seed	2
cf *Leontodon autumnalis*	hawkbit	seed	2
Polygonum aviculare	knotgrass	seed	3
Polygonum sp.	knotgrass	seed	23
Raphanus cf *raphanistrum*	wild radish	siliqua	9
Charcoal			+
Peat (burnt)			+
Total counts of identified plant parts (only)			172

Table 7 – Phase 7: Charcoal identifications from the pre-dissolution phase of the Abbey

Context number	Sample number	Flot volume (grams)	Wood species identifications	No. of fragments	Charcoal weights (grams)
F128	6	12.0	*Fraxinus excelsior* (ash)	67	3.1
			Quercus sp. (oak)	12	1.0
			Corylus avellana (hazel)	6	0.5
			Maloideae spp. (pomaceous woods)	6	0.4
Q07	4	4.0	Burnt peat		
SN01	1	<1.0	*Fraxinus excelsior* (ash)	3	0.4
SN02	1	3.4	*Fraxinus excelsior* (ash)	4	0.4
SN04	1–15	78.0	*Fraxinus excelsior* (ash), burnt peat	86	5.6
			Ulmus sp. (elm)	19	2.3
			Corylus avellana (hazel)	15	2.0
			Ilex aquifolium (holly)	14	2.0
			Rhamnus cathartica (purgin buckthorn)	9	1.4
			Quercus sp. (oak)	7	1.0
			Salix spp. (willow)	4	0.8
			Maloideae spp. (pomaceous woods)	3	0.4
			Prunus cf *spinosa* (blackthorn)	1	0.3
SN07	1	6.0	*Quercus* sp. (oak)	21	2.3
			Fraxinus excelsior (ash)	13	1.7
SN08	1	0.4	Charcoal fibres only		
SN09	2	2.1	*Fraxinus excelsior* (ash)	7	0.5
			Salix spp. (willow)	3	0.3
SN11	1	4.0	*Ulmus* sp. (elm), small roundwood/cut mark present	1	4.0
SN12	4	6.3	*Corylus avellana* (hazel), Small roundwoods/twigs	23	3.0
			Fraxinus excelsior (ash)	11	1.3
			Ulmus sp. (elm)	2	0.3
SN13	1	3.3	*Salix* spp. (willow), small roundwoods/twigs	13	2.0
			Fraxinus excelsior (ash)	11	1.4
			Maloideae spp. (pomaceous woods)	4	0.7
SN14	1	44.0	*Fraxinus excelsior* (ash), Small roundwoods/twigs	33	3.5
			Quercus sp. (oak)	7	1.0
			Corylus avellana (hazel)	4	0.8
			Salix spp. (willow)	4	0.8
			Ilex aquifolium (holly)	1	0.2
			Prunus cf *spinosa* (blackthorn)	1	0.4
SN15	1	0.3	Charcoal fibres only		

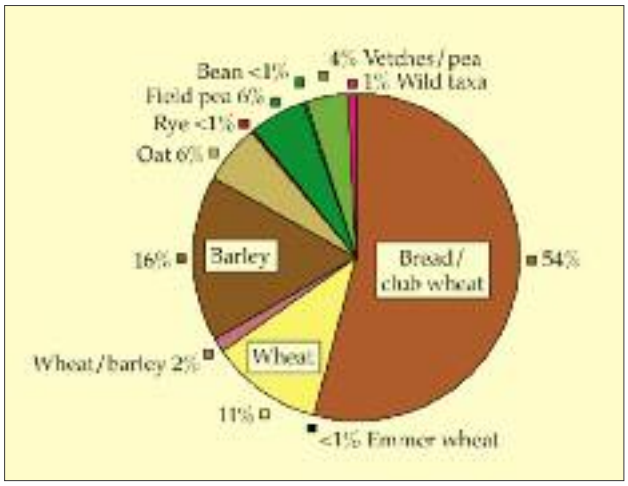

Fig. X.11 Percentage of charred plant remains from Phase 3/7, Bective Abbey.

It is most likely that SN4 represents the charred remains of a storage facility or granary where both cereal and pulse crops were being kept. The presence of straw and burnt peat from SN4 may be the remains of building materials or roof packing from a structure. There was a distinct lack of *in situ* burning deposits and postholes however from SN4, suggesting that SN4 was instead a re-deposited layer of grain debris from a nearby crop drying event. The preservation quality of these remains was very good, suggesting that they were sealed quickly after being dumped and the site abandoned thereafter. The composition of plant remains from SN4 and SN14 were not dissimilar, the latter also potentially functioning as a dumping ground for this charred debris.

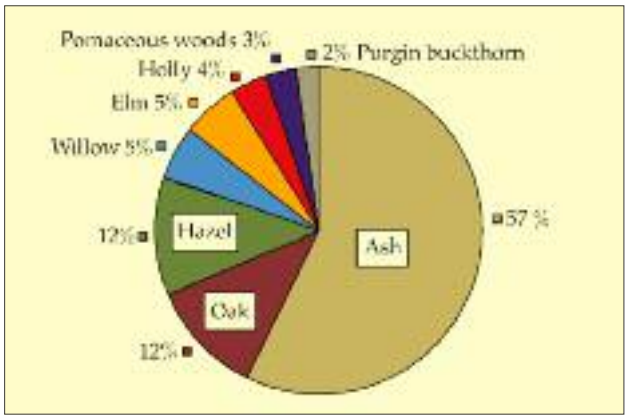

Fig. X.12 Charcoal identifications from Phase3/7, Bective Abbey.

The majority of the charcoal remains from the pre-dissolution phase of the abbey were confined to Cutting 1(F128) and Cutting SN (SN4, SN7, SN9, SN11, SN12, SN13 and SN14). Ash was the main wood identified from all deposits, with a lower frequency if oak and hazel. Almost equal proportions of willow, elm, holly, pomaceous woods and purgin buckthorn were also identified (fig. X.12). Holly and purgin buckthorn were recorded from SN4, while elm was recovered from SN11 and SN12. While it is difficult to classify structural woods from this assemblage, small roundwoods (elm, ash, willow, oak, hazel and holly) of similar size and displaying even growth patterns were noted from SN11, SN13 and SN14.

Phase 8/9: Post-dissolution of the abbey

A total of 13 samples representing 10 features and deposits (table X.8) were analysed from Phase Phase 8/9: Post-dissolution of the abbey. A quantitative list of all plant remains identified is presented in table X.9 and a list of all charcoal identifications is found in table X.10.

The highest plant remains recorded from the post-dissolution phase of the abbey was recorded from Cutting P (P9, P10 and P11). Wheat is again the main crop recorded from this later phase, with a slight increase in oat values and a decrease in barley. Rye remains low and pulse crops/legumes values are distinctively lower than in earlier phases. Evidence for wild taxa is also very low, with P10 the only feature to contain dock and wild charlock/radish (fig. X.13).

The charcoal identified was also largely confined to Cutting P (P9, P10 and P11), where hazel and pomaceous woods dominated the assemblage. Ash values are significantly lower than before, as is oak, while willow and blackthorn are slightly higher than in earlier phases at the site (fig. X.14) 13). The majority of the charcoal from Cutting P were recorded as small roundwood/branches, where an even growth ring pattern was noted. In some cases, the pattern followed the coppice arrangement of ring growth and contained between 5 and 10 rings. It is most probable that this assemblage represents the remains of a small structure, such as a fence or wattle wall which had burnt down.

Table X.8 – Samples analysed from precinct, Phase 8/9: Post-dissolution of the abbey

Feature number	Sample number	Feature description
F1	1	Stoney later: post-dissolution
F8	1	Stoney later: post-dissolution
F129	7	Stoney later: post-dissolution
F133	8	Stoney later: post-dissolution
H06	5	Stoney later: post-dissolution
P9	7	Stoney later: post-dissolution
P9	8	Stoney later: post-dissolution
P10	3	Stoney later: post-dissolution
P10	4	Stoney later: post-dissolution
P12	1	Stoney later: post-dissolution
P12	2	Stoney later: post-dissolution
SN01	8	Mortared stone blocks
SN02	1	Mortared stone blocks

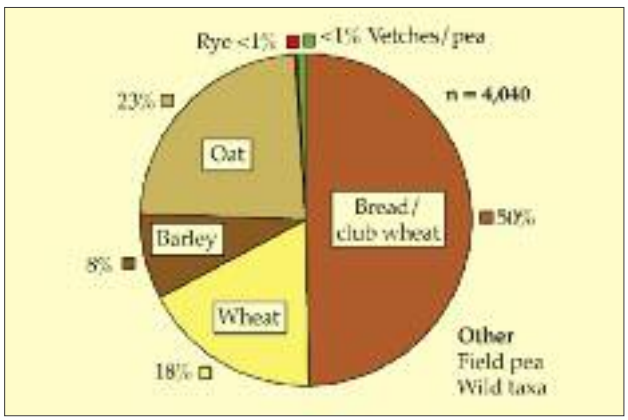

Fig. X.13 Percentage of charred plant remains from Phase 8/9, Bective Abbey, n = 4,040.

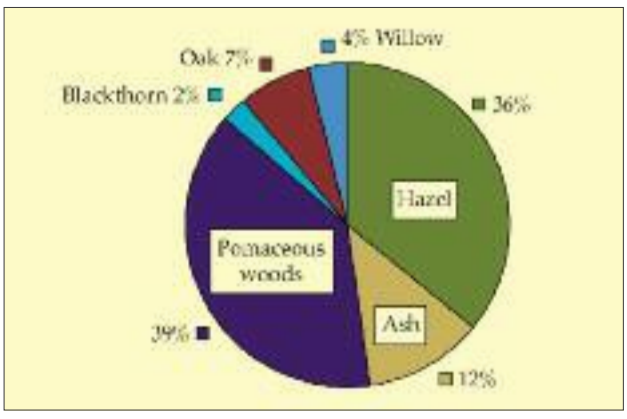

Fig. X.14 Charcoal identifications from Phase 8/9, Bective Abbey, n = 178.

Table X.9 – Plant remains from Phase 8, Precinct

CEREALS: CARBONISED

Latin name	Common name		Total
Triticum aestivo-compactum	bread/club wheat	grain	1,720
Triticum sp.	wheat	grain	605
Hordeum vulgare	barley	grain	282
Avena sativa	cultivated oat	grain	156
Avena sp.	oat	grain	623
Secale cereale	rye	grain	8
Cerealia	indeterminate cereals	frag.	606
CEREAL CHAFF: CARBONISD			1,674
Cereal indet	internode	frag.	

Legumes: CARBONISED

Latin name	Common name		Total
Pisum sativum	field pea	seed	1
Pisum sp.	field pea	frag.	2
Vicia faba	horse bean	seed	1
Vicia/Lathyrus	vetches/pea-type	indeterminate	25

WILD TAXA: CARBONISED

Latin name	Common name		Total
Rumex cf *crispus*	curly dock	seed	2
Raphanus cf *raphanistrum*	wild radish	siliqua	2

Garden Phase

A total of 11 samples representing 7 features and deposits (table X.11) were analysed from the garden phase of the abbey. A quantitative list of all plant remains identified is presented in table X.12 and a list of all charcoal identifications is found in table X.13.

While evidence for charred plant remains were recorded from all features associated with the garden phases at the abbey, the highest volume of material was undoubtedly from Cutting R (R03) (fig X.15) and which will form most of the discussion for this phase. This phase of activity was radiocarbon dated to between 1042 and 1218.

The plant remains composition from R03 followed a similar trend to that already identified from other phases at the site; wheat was the dominant crop identified, followed by barley then oat. Rye and pulse crops/legumes made up <1% of the identified plant species, with a slight but distinctive increase in the number of weed seeds recorded (fig. X.16). A number of wild species were present, most notable dock, sheep sorrel, charlock, celery, onion/garlic/leek, goosefoot, bedstraw and a cherry stone. This deposit also contained animal bone, fish bone and pottery, all indicative of domestic rubbish. Whether it was deposited deliberately as compost or simply as waste

Table X.10 – Charcoal identifications from Phase 8: Precinct

Context number	Sample number	Flot volume (grams)	Wood species identifications	No. of fragments	Charcoal weights (grams)
F1	2	1.5	No charcoal for ID		
F8	3	5.0	*Corylus avellana* (hazel)	7	0.5
			Quercus sp. (oak)	5	0.3
H06	1	2.0	*Quercus* sp. (oak)	3	0.4
			Fraxinus excelsior (ash)	1	0.1
P9	7	10.4	No charcoal for ID		
P9	8	16.2	*Corylus avellana* (hazel)	3	0.7
			(Small roundwoods; strong even growth rings)		
P10	3	3.1	*Quercus* sp. (oak)	5	4.5
P10	4	62.5	*Maloideae* spp. (pomaceous woods)	32	4.7
			(Small roundwoods; strong even growth rings)		
			Corylus avellana (hazel)	18	2.5
P12	1	8.2	*Maloideae* spp. (pomaceous woods)	19	2.8
			(Small roundwoods; strong even growth rings)		
			Corylus avellana (hazel)	11	1.6
			Fraxinus excelsior (ash)	3	0.5
P12	2	6.6	*Maloideae* spp. (pomaceous woods)	18	3.0
			(Small roundwoods; strong even growth rings)		
			Corylus avellana (hazel)	18	2.0
			Salix spp. (willow)	7	1.1
			Prunus cf *spinosa* (blackthorn)	4	0.5
			Fraxinus excelsior (ash)	3	0.4
SN1	1	2.6	*Fraxinus excelsior* (ash)	3	0.6
SN2	1	3.4	*Fraxinus excelsior* (ash)	11	1.4
			Corylus avellana (hazel)	7	0.8

Table X.11 – Samples analysed from the garden phases of the abbey

Feature number	Sample number	Feature description
Garden: Phase 1		
F205	22	Medieval garden: Upper fosse fill
F209	25	Medieval garden: Bank revetment
Garden: Phase 2		
R02	1	Garden use furrows
R03	1	Garden use furrows
R03	2	Garden use furrows
R03	3	Garden use furrows
R03	8	Garden use furrows
F211	26	Garden use: charcoal surface
Garden: Phase 4		
F202	21	Unstratified
F206	23	Unstratified
F207	24	Unstratified

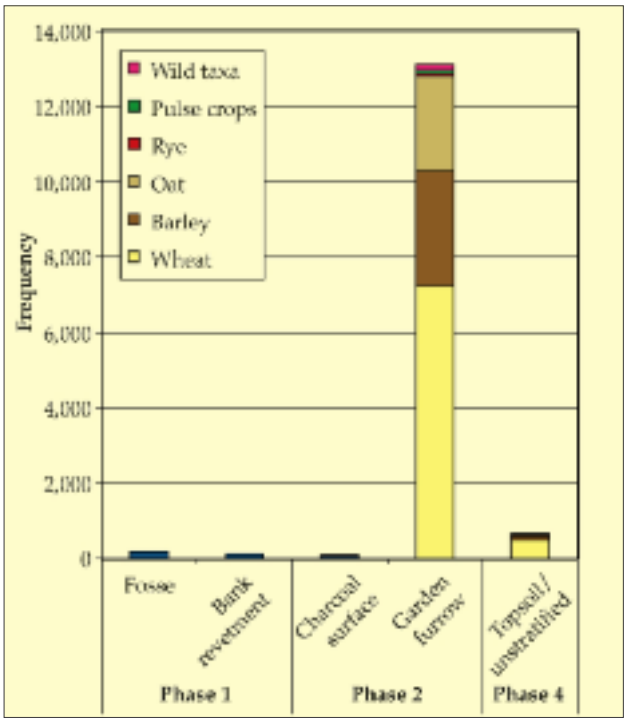

Fig. X.15 Distribution of plant remains from garden phases at Bective Abbey.

Table X.12 – Bective Abbey: Identified plant remains, all garden phases

Latin name	Common name		Phase 1	Phase 2	Phase 4	Totals
CEREALS: CARBONISED						
Triticum aestivo-compactum	bread/club wheat	grain	25	7,202	19	**7,246**
Triticum sp.	wheat	grain	231	287	462	**980**
Hordeum vulgare	barley	grain	0	3,047	119	**3,166**
Avena sativa	cultivated oat	grain	10	1,522	35	**1,567**
Avena sp.	oat	grain	19	1,031	8	**1,058**
Secale cereale	rye	grain		64		**64**
Cerealia	indeterminate cereals	fragment	+	300	++	**300+**
CEREAL CHAFF: CARBONISD						
Cereal indet	internode	fragment	+			**+**
Cereal indet	rachis	fragment			+	**+**
Legumes: CARBONISED						
Pisum sativum	field pea	seed	1	23	2	**26**
Pisum sp.	field pea	fragment	3	7	2	**12**
Vicia faba	horse bean	seed		3		**3**
Vicia/Lathyrus	vetches/pea-type	indeterminate	5	78	5	**88**
WILD TAXA: CARBONISED						
Ranunculus cf *acris*	meadow buttercup	seed		1		**1**
Chenopodium album	goosefoot	seed		19		**19**
Galium aparine	bedstraw	seed		32		**32**
Rumex acetosella	sheep sorrel	seed		25		**25**
Rumex cf *crispus*	curly dock	seed		2		**2**
Rumex sp.	dock	seed		36		**36**
Apium graveolens	celery-type	seed		3		**3**
Allium sp.	onion/garlic/leek	seed		3		**3**
Prunus cf *avium/padus*	wild/bird cherry	fruitstone		1		**1**
Polygonum aviculare	knotgrass	seed		12		**12**
Raphanus cf *raphanistrum*	wild radish	siliqua		24		**24**
Total counts of identified plant parts (only)			**294**	**13,722**	**652**	**158**

Table X.13 – Bective Abbey: Charcoal Identifications: Garden, all phases

Context number	Sample number	Flot volume (grams)	Wood species identifications	No. of fragments	Charcoal weights (grams)
Garden phase 1, Cutting 3					
F209	24	5.5	*Fraxinus excelsior* (ash)	17	1.0
Garden phase 2, Cutting 3					
F211	25	4.5	cf *Faxinus excelsior* (ash), mineralised	9	2.0
			Alnus glutinosa/Corylus avellana, mineralised	5	0.6
Garden phase 2, Cutting R					
R03	3	12.0	*Quercus* sp. (oak), mineralised	9	1.6
			Corylus avellana (hazel), mineralised	1	1.0
Garden phase 4, Cutting 3					
F202	20	2.0	*Fraxinus excelsior* (ash)	79	5.2
			Quercus sp. (oak)	21	3.0
F205	21	4.7	*Salix* sp. (willow)	9	1.2
F206	22	33.2	*Corylus avellana* (hazel)	13	1.1
F207	23	6.0	*Corylus avellana* (hazel)	15	0.9
			Quercus sp. (oak)	6	0.4

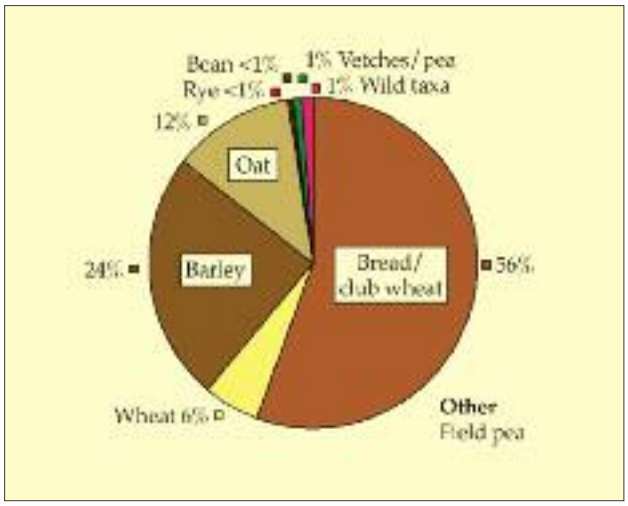

Fig. X.16 Percentage of charred plant remains from the garden phase of Bective Abbey.

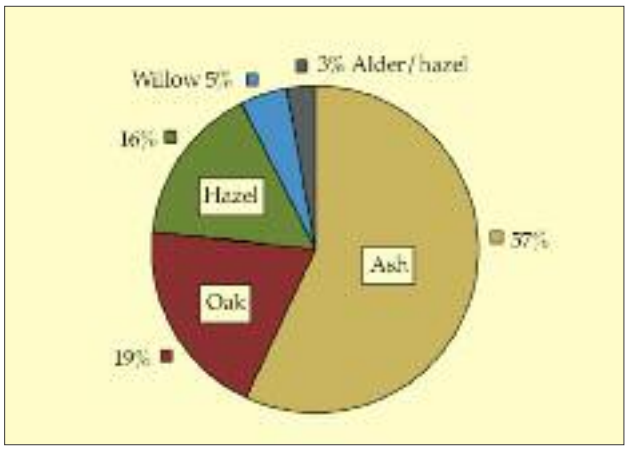

Fig. X.17 Charcoal identifications from the garden phases of Bective Abbey, n = 184.

disposal is difficult to fully ascertain. The plant remains are a mix of crops, cultivars, wild plants and species potentially used as herbs and vegetables and give some insight into the botanical remains used by the inhabitants of the abbey.

The charcoal recorded from the garden phases at Bective Abbey was predominantly identified as ash. Equal quantities of oak and hazel were also recorded, with lower values for willow and alder (fig. 17). The charcoal displayed high brilliance, which suggests that the wood was exposed to very high temperatures becoming glass-like and difficult to section for identification.

X.7 Arable agriculture and site economy at Bective

The Cistercians monasteries required a good supply of arable lands to produce two stables of the monastic diet; bread and ale (Lynch 2010 78). Several grades of bread were produced by the Cistercians; the highest quality, made of wheaten flour, was consumed by the abbot and his guests; then the infirmary; a brown variety was eaten as a stable of the monks themselves, while a coarser variety made of oatmeal, rye or barley flour was given to the lay brothers and labourers (ibid). Ale production preferably required malting barley, although oat and wheat were also used as an admixture (Lynch 2010, 83).

Wheat flour was of superior quality and was used to produce luxury bread, which was lighter than the coarser darker breads of oat and barley (Sexton 1998, 79). Wheat was also known to be used in ale production. At Clonken (now Dean's Grange), Co.

Dublin in 1344, wheat for malting was paid to workers in return for working through a harvest (Mills 1890–1, 62). At Bective Abbey, many of the wheat grains showed signs of sprouting. Sprouting grain indicates germination, and this occurs as a result of increased moisture (Van Der Veen 1989, 303). It is possible that the wheat grains were part of a wet harvest which was dried to prevent spoilage from continuing germination (ibid). The process of germinating grain in a controlled environment is also indicative of malting or brewing practices (Van Der Veen 1989, 304; McCormick et al. 2011, 23), where the grain is soaked in water and quickly dried thereafter to promote the production of malt (Brown 1983). It is difficult to ascertain however if brewing was being undertaken at Bective Abbey or if the cereal assemblage recorded was being dried for brewing activities elsewhere.

The dominance of wheat at Bective Abbey is not unusual in the context of the site as it helps to confirm its status as a high profile site during the twelfth to fourteenth centuries. Wheat was seen as a luxury crop during the medieval period and its importance is documented in the medieval law-text *Bretha Déin Chécht* (Binchy 1966) and the twelfth-century satirical tale *Aislinge Meic Con Glinne* (Jackson (ed.) 1990, xxvi; Kelly 1997, 220). During the medieval, period wheat cultivation was very labour intensive and not as economically viable as oat or barley (McClatchie 2003, 398). The cultivation of wheat sees an increase in the twelfth and thirteenth centuries, with the arrival of the Anglo-Normans (Monk, 1986, 34). While wheat was documented as being grown by the Irish population during this period, it rarely became part of their own diet, instead being used as a payment of a tithe or rent to local landlords (Clarke 1991, 170–1). Where large wheat assemblages are recorded from later medieval sites, they are generally in the east and south-east, such as Kilferagh, Co. Kilkenny (Monk 1987, 86), Marshes Upper, Co. Louth (Geraghty 1992, 119), Fleminstown, Co. Dublin (Lyons 2009), Kilmainham, Co. Meath (Lyons 2010) and Carrickmines Castle, Co. Dublin (Lyons, 2011) to name but a few. This could be attributed to the fertile-rich soils in the east of the country together with a drier and warmer climate, which would have suited the growing of wheat crops.

Wheat was a commonly cultivated crop of the Cistercian community as a whole. Evidence from thirteenth-century account records for the monastery at Bonnefont in Southern France mentions that wheat was widely cultivated along with rye (Hoffman-Bergman 1986, 76). The thirteenth and fourteenth account rolls for Beaulieu Abbey, Hampshire in England also details wheat, oat and barley as among its favourable crops (Hockey 1975, 26). In Ireland, lists of grain supplies were documented in the dissolution extents of the sixteenth century, giving valuable information about the type of grain each abbey was producing (Lynch 2010, 92). Oats and wheat were popular crop types recorded from Irish Cistercian houses at Baltinglass Abbey, Duiske Abbey and St. Mary's Abbey, while reference is made of hay and turf from Bective Abbey at this time (Lynch 2010, 96). Wheat and oats take priority over barley at Kells Priory in the thirteenth century and there is an early reference to using peas at the site, suggesting a shift to using a system of crop rotation (ibid.). This emphasis on wheat and oat from Kells is interestingly in the context of the thirteenth century phase of Bective Abbey since these were the main crops recorded from the archaeobotanical analysis.

Oat was the second dominant crop recorded at Bective Abbey, especially the cultivated variety. Oat, along with barley grows well in the humid, wet Irish climate and will tolerate poorer soils (Monk *et al.* 1998; Clarke 1991, 173). During the medieval period, this crop was classed as the least valued cereal where a bushel of barley was given twice the value of a bushel of oat (Kelly 1997, 226). Oat and barley produce dark, coarse bread and are often combined with wheat and rye to form a maslin mix (Sexton 1998, 79). Oat was also well referenced from many Cistercian houses at the time of dissolution (Lynch 2010). Oat, along with pulse crops and legumes were dried for both human and animal consumption (ibid).

The low occurrence of rye from the site is not unusual within the context of the medieval period in Ireland. It could represent a low level of contamination within a different crop i.e. growing as a weed. Other explanations for its presence on site would be that it was grown on marginal areas where it would be out competed by other cereals (particularly on saline or acidic soils). It was also commonly used in thatching, rather than consumption, which may account for its absence on the site.

Pulse crops/Legumes/Wild taxa

The presence of pulse crops (peas and beans) at Bective is not unusual in the context of a monastic site. The pulse crop/legume assemblage recorded, indicates that these species were been part of the local arable economy. Their emergence in medieval Ireland coincided with the arrival of the Anglo-Norman, probably as part of their crop rotation agriculture (Monk 1986, 34). These plants have the ability to increase soil quality, through nitrogen-fixing, which improves crop yields, suppresses weed growth and prevents soil erosion. They are documented as being used primarily for animal

fodder (horse and poultry) along with oat and as a foodstuff in times of famine or a bad harvest (Murphy and Potterton 2010, 314). Monastic orders often used them in pottage with vegetables and herbs such as leeks, onions, shallots, parsley and oatmeal for thickening (Lynch 2010, 103). Bean or wheat flour was often ground down and to make a poultice, a paste used to soothe aching muscles or ease swelling. Based on a recent archaeobotanical project on pulse crops in medieval and post-medieval Ireland (Lyons and McClatchie 2012) the Bective Abbey assemblage represents one of the largest assemblages of peas in a medieval Irish context. Cultivated field pea is recorded most prominently from later medieval sites in Ireland and more often associated with enclosed sites or those of high status (ibid) most likely growing in gardens or as mixed crops with other cereal crops.

Interestingly, some of the wild taxa identified from the site, albeit low, may be construed as possible herb or garden produce. Knotgrass, curly dock, goosefoot and bedstraw would have all been references from the medieval period as condiments or flavouring (McClatchie 2003, 401). Species of dock (*Rumex* sp.) are said to have been used to flavor meat and fish (Moloney 1919, 39) and to have been used in salads (Lucas 1959, 137). Certain species were also used as a setting agent in dyeing garments (Moloney 1919, 39), while bedstraw was a source of red dye (Hall et al, 1984, 59). Knotgrass and charlock seeds have been recorded from faecal deposits at Fishamble Street, Dublin (Geraghty 1992, 120) and Dundalk (Geraghty 1992, 119–20), indicating consumption. Wild radish/charlock was also recorded in Viking Dublin and was possibly used to flavour food (Mitchell 1987, 26). Onion/leek/garlic seeds (*Allium* sp.) and celery (*Apium* sp.) were recorded from the garden deposits (R03) at Bective Abbey, suggesting they were growing in this controlled environment.

The pulse crop/legume assemblage recorded at Bective Abbey indicates that these species were an important component of the arable economy. Their presence at the site, together with historical accounts and primary documentary evidence form monastic accounts is evident that they were being dried possibly for consumption or animal feed. (Greig, 1991, 323). Vetches would have aalso been consumed during times of famine (Green, 1984, 107) in medieval Ireland and even more so to substitute peas and beans for animal fodder.

Chaff and wild taxa

An interesting observation from the plant assemblage is the general absence of cereal chaff, pulse crop chaff (pods and bracts) and weed seeds from the samples, especially considering the volume of crops recorded. This suggests that the material dried at the site was essentially a clean crop. The absence of chaff from a carbonized cereal assemblage can indicate that cereals were either being prepared for long-term storage, transport or for grinding and milling. The gathered crop would require full processing (removal of chaff and weeds) prior to storage to prevent spoilage of the crop. After a harvest, the crop goes through a series of processing procedures where the product (grain) and the various by-products (chaff, straw and weed seeds) are separated from each other (van der Veen 1989). This process would have left behind a higher concentration of chaff remains and weed seeds and therefore suggests that this activity was carried out at another location and that the material being brought to the site was already processed.

X.8 Wood use at Bective

The charcoal recorded as part of this project has revealed a distinct use of specific wood species at Bective Abbey during the medieval period. Ash and oak and to a lesser extent hazel are undoubtedly the woods of choice being selected and used at the site. All three species were commonly used in construction works and as fuel in specialized activities from the prehistoric period (O'Donnell 2007). Ash timber is easily felled and split to produce long posts (Culter and Gale 2000), suitable for building. The wood is hard and elastic, which is used in making agricultural implements and furniture (ibid.). Whether fresh or dry, ash is considered the best firewood and its charcoal is highly regarded (ibid.). Oak is traditionally the main wood of choice used in construction works in medieval Ireland. This species is easy to cleave and its heartwood timber is renowned for its durability and strength (ibid.). Like ash, oak produces good quality charcoal which would have been an important component of the kilning process.

Both hazel, ash and willow are likely to have been managed or coppiced at Bective to be used for making light structures, frames, drying platforms and kitchen utensils and garden equipment. The high number of hazel and ash small roundwoods recorded from the barn (Phase 2) and deposits in Phase 7 (Cutting SN) could represent boundary walls or fencing made of wattle. Interestingly the only evidence for elm, holly and purgin buckthorn came from SN04 (Phase 7). These were all recorded as small roundwood and potentially used as structural wood also. The other woods identified at Bective Abbey (pomaceous fruit woods, blackthorn and cherry-type) all produce good quality charcoal and are likely to have been collected as part of the fuel stock.

Charcoal-rich layers are generally interpreted as the remains of fuel debris, however the charcoal assemblage recorded from Bective is likely to be a mix of fuel remains and structural wood. A portion of the ash and oak charcoal were noted as being small to medium roundwoods, which would reflect the burnt remains of a wooden structure. This would also support the interpretation put forward from the plant remains analysis (Part A), where the kiln in Cutting 2 had experienced a conflagration event and burnt down. Whether the charcoal recorded represents the remains of the kiln structure itself, or a larger building is difficult to fully ascertain. Since no definite structural features (postholes and slot trenches) were recorded from this area of this site, it is difficult to ascertain if a barn or granary was present. Instead these could be the remains of wooden boundary walls, divisions or wind breakers that were erected to enclose the kiln and kiln activities. Upon destruction, these charred remains seem to have been spread across the site and dumped into many open features, similar to the cereal grain debris. The charcoal may have also been used as a form of fertilizer and spreading these charred remains may have been a deliberate action. Charcoal in and of itself isn't a fertilizer but an absorption medium. Due to its extremely high surface area, nutrients like nitrogen and phosphorus stick to the charcoal producing a slow release fertilizer which can help to alter the pH of soils. Charcoal would therefore have been extremely useful in maintaining and developing the Bective gardens.

The wood selection recorded would therefore suggest that ash, oak and hazel were specifically chosen primarily because of their timber quality. This selection would also imply that these species were readily available or accessible in the local woodland. A premise of wood analysis from archaeological sites is the theory that structural wood will probably be gathered from as near to the site as possible, for convenience. The weight and density of large trees would have prohibited them being carried long distances, presuming there was suitable material in the local vicinity.

This oak-ash-hazel woodland at Bective would have been a valuable local resource in the context of the medieval period. Documentary evidence and pollen analysis has revealed that there was extensive woodland clearance during the medieval period in Ireland as a response to an increase in farming and population pressure (Ryan 2000, 32; Mitchell and Ryan 2001, 284). The depletion in this natural resource inevitably increased the economic value of local woodland during the medieval period (Mac Níocaill 1971, 85; Tierney 1998, 53). By the tenth century AD, medieval law tracts document the need for regulated woodland management and protection in order to provide a continuous supply of building materials (O'Sullivan 1994). Another medieval tract discusses the value of certain tree species and classifies them on their economic importance (Mitchell and Ryan 2001, 284). Oak, ash and hazel were all considered to be high status species based on their timber quality or fruit production. The inhabitants at Bective Abbey would have known the economic value of these species and may even have had jurisdiction over local managed woodland or priority to use certain woods.

X.9 Summary

The analysis carried out on soil samples from Bective Abbey, Co. Meath has revealed that arable farming, in the form of crop drying, was being undertaken at the site during the medieval period. A clean crop of wheat and oat were primarily being dried potentially for grinding/milling or long-term storage or transport. It is possible that the preponderance for wheat was associated with the high status of Bective since this was the crops of choice for superior quality breads. Pulse crops and legumes were also being dried at the site, possibly for consumption or as animal feed or for feeding the poorer classes. This suggests that Bective may have had working animals or were supplying the wider community with food stuffs. The kiln and barn at Bective seem to have burnt down or was destroyed possibly on just one occasion, which accounts for the high charred grain and charcoal recovered from the site. Kiln waste was left *in situ* for the most part but seems to have been periodically dumped into many open pits, ditch and drain features nearby. The quantity and composition of crops recorded suggests that crop drying was a significant part of the Bective Abbey economy. They may have specialized in bulk crop drying, storage or distribution during the medieval period and may have facilitated a larger rural community. While there was no obvious evidence for vegetables or other garden plants, the presence of an onion/garlic/leek and celery seed could potentially indicate the type of vegetable being cultivated at Bective. The preponderance of oak, ash, willow and hazel at the site suggests that these species were in plentiful supply in the local woodland and most likely part of a managed forest. These species were selected for their timber quality and used as fuel and in construction works at the site.

X.10. Recommendations

All flot samples and sorted plant remains associated with Bective Abbey should be permanently retained

by the National Museum of Ireland in accordance with the National Monuments Act 1930 (Section 2) and the National Monuments Act 1994 (Section 9) for future archaeobotanical and charcoal research studies to be carried out

X.11. Acknowledgements

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