Forest Perspectives

Seeing the woods for the trees: the history of woodlands and wood use revealed from archaeological excavations in the Irish Midlands

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Introduction

Wood has always been a key raw material in the manufacture of furniture, tools, containers and nearly all everyday items (O'Sullivan 1994). Wood and its byproduct charcoal, have been used as fuel for everyday use in Ireland in the past and have been extremely important raw materials both economically and culturally up to recent times. Consequently, the catchment area of woodlands surrounding a settlement were often exploited and managed in the past to provide essential raw materials for a community (Stuijts 2005).

The study described herein aimed to reconstruct past woodland landscapes of the midlands region, as well as the anthropogenic exploitation patterns of these woodlands. Reconstructions were based on the analysis of charcoal and wood samples from archaeological excavations which were dated from the Neolithic period (5,000 years ago) to later Medieval times. Pollen cores sampled from close to the archaeological excavations were also analysed and provided complementary proxy information that helped build a picture of the past woodland history of the midlands.

Study area

The construction of the M6 road improvement scheme, stretching for 64 km from Kinnegad to Athlone across Counties Offaly and Westmeath, provided an opportunity to piece together the origins and species of charcoal remains. Consequently charcoal, pollen and wood from archaeological excavations were used as proxies to reconstruct the vegetation type that existed at that time (Figure 1). Currently the landscape of the area is comprised of generally flat to undulating terrain dominated by an extensive suite of glacial and glaciofluvial depositional landforms (Delaney 1997). The underlying geology of the area is dominated by Carboniferous limestone, which is overlain by

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Figure 1: *Excavation in progress showing the type of landscape the M6 traverses (NRA).*

intermittent glacial features such as moraines and eskers. The area was once part of a low-lying lakeland region that had in the post-glacial period been part of a greater midland lake system (Grogan et al. 2007).

The vegetation is dominated by areas of poor-quality scrub and grassland while the brown-podzolic soils, interspersed with grey gleys, are prone to winter water-logging and flooding. Altitude along the study area varies from 76 m at Kinnegad to 60 m at Athlone.

Archaeological samples and pollen cores

Charcoal (18,000 fragments in total) and wood data (1,000 samples) were obtained from 56 archaeological excavations carried out between 2006 and 2009 in advance of the M6 Kinnegad to Athlone road scheme, as well as from excavations from Neolithic trackway sites at Mount Lucas bog in Co. Offaly (Figures 2a, b and 3). The range of archaeological sites from which the charcoal was extracted included some small–scale Neolithic activity, two Bronze Age settlement sites (Figure 4) and numerous burnt mounds (*fulachta fiadh*) (Figure 1), Iron Age metalworking sites and furnaces (Figure 5), industrial activity in the form of Medieval-dated kilns and Medieval charcoal pits (Figure 6), as well as an early Medieval ringfort (Figure 7). A *fulacht fiadh*, generally

dating from the Bronze Age, consists of a horseshoe-shaped mound of burnt stones, a hearth(s) and a trough(s). These sites were used to heat water for a variety of possible purposes. They are also known as ancient cooking places or burnt mounds (Egan 2007). Wood and charcoal identifications from *fulachta fiadh* have been shown to be excellent proxies or indicators of the local vegetation associated with their phase of use (OCarroll 2010). Over 1,000 wood samples were also identified from the Neolithic-dated wooden trackways at Mount Lucas and were used to identify the wood species, helping to cast light on the reasons for selecting wood as a working material and were also used as a basis for environment/woodland re-construction at the time the trackways were built.

The main palaeocological or pollen data used for this study were interpreted from a lake core in Cornaher Lough in Co. Westmeath. Cornaher Lough abuts the new M6 road on its eastern side. Consequently the Cornaher Lough diagram provides closely linked palaeoecological data for comparison with the archaeology and charcoal data and are used for comparative purposes in these discussions.

Methods and materials

During excavation, soil samples for flotation were systematically collected from each excavated feature on the archaeological site. The soil samples ranged in size from 0.1 to 65 L, but were on average 6 L in volume. Charcoal was then extracted from the floated material from the hydrated soil samples. Wood samples from the trackways excavated at Mount Lucas were taken from transects across the width of the site at regular intervals.

Wood and charcoal identifications

Charcoal and wood samples were analysed and identified to determine the species and selected structural function(s) on sites, i.e. post holes, firewood, pyre material and burnt remains of wattle. Specific trees such as *Quercus* spp. (oak) would have been selected and used in cremation at burial rites as well as in charcoal production pits to support metalworking activities (O'Donnell 2007, Kenny 2010). Site functionality could be determined in some cases from the analyses of wood and charcoal.

Each wood taxon has a distinct microstructure and this allows charcoal and wood fragments to be identified to species level under a microscope. When slivers of wood or charcoal are examined in this way the patterns in their microstructure are compared to known species or reference keys to identify the species (Figure 8). Charcoal identifications can be used for environmental reconstruction based on the premise that people probably gathered their fuel and building materials from the local area.

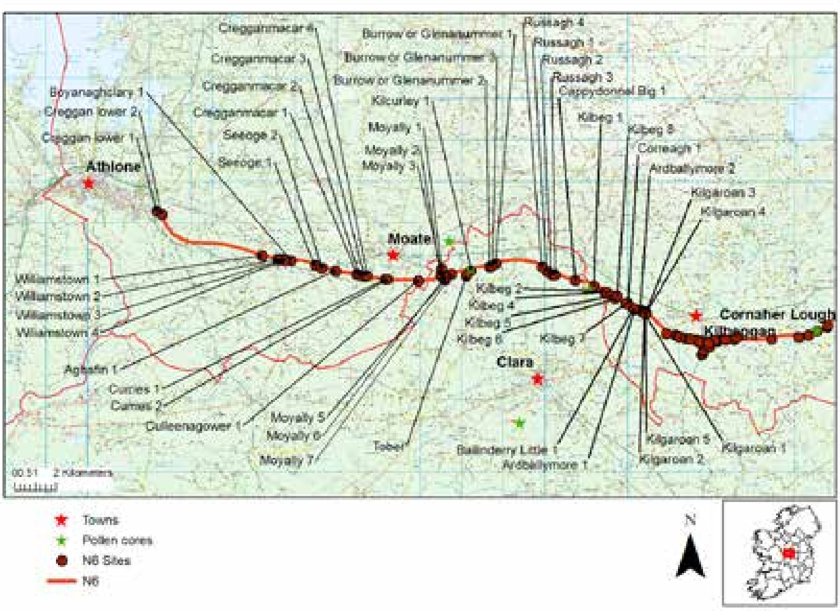

Figure 2 (a): *Map of study area and excavated archaeological sites along the M6 (western portion).*

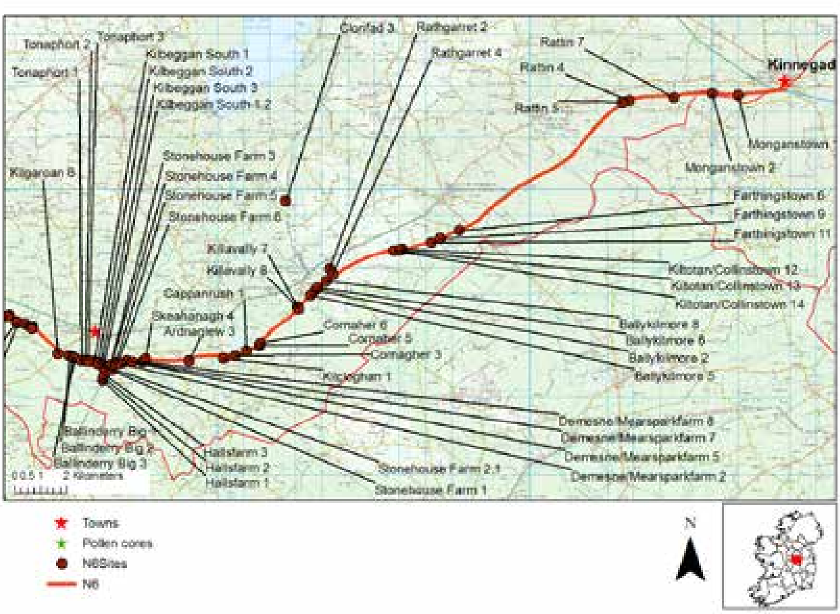

Figure 2 (b): *Study area showing the location of archaeological sites excavated as part of the N6 road scheme (eastern portion).*

Figure 3: *Neolithic trackways under excavation at Mount Lucas, Co. Offaly (photograph by Dominic Delaney).*

Figure 4: *Excavation in progress at the Tober 1 site. This late Bronze Age round house had a large hearth in the centre and post holes can be seen around the exterior (photograph by Fintan Walsh).*

Figure 5: *An early Iron Age furnace at the Moyvalley 2 site.*

Figure 6: *A charcoal pit found in the Curries townland, was dated to the period AD 989–1148.*

Figure 7: *Excavations in progress at Habitation site showing early Medieval Ringfort ditches, Moyally 1 (Photograph curtesy of IAC Ltd. /NRA).*

Figure 8: Quercus *trees and wood microstructure.*

Pollen analysis

Most pollen grains are dispersed into the air from vegetation and can accumulate in sediments in lakes, peat bogs and waterlogged ditches, where it builds up sequentially. Sediments can then be extracted for study by coring to obtain a vertical sequence of sediments deposited at particular times. Samples can be taken from a core at 1 cm intervals and examined under a microscope. As the outer surface of a pollen grain or

exine is highly durable, pollen can be preserved in sediments for long periods so can be used for identification (Figure 9). Each grain is different in structure and shape, therefore by identifying the amount and variety of pollen grains at each level in the past, the population and types of vegetation that existed in any given area can be reconstructed (Moore et al. 1991). This analysis resulted in the creation of a pollen diagram, which is a graphical expression of the frequency of the different types of pollen over time. Radiocarbon dating of organic samples from the core was then used to provide a chronological framework for these data (Figure 12).

Results

Charcoal and wood

Figure 10a shows the results for the identification of the charcoal species type by time period while Figure 10b presents charcoal results by site/feature type associated with each archaeological site sampled. For comparative purposes, the archaeological sites from the M6 development were reclassified into five types based on function and date: *fulacht fiadh*, industrial (i.e. charcoal production pits, furnaces, metalworking activities and kilns), burial, occupation/habitation and pit types (Table 1). Figure 11 presents the results of wood identifications from the Neolithic trackways analysed from Mount Lucas bog, Co. Offaly.

Figure 9: *Pollen grains from alder (*Alnus glutinosa *(L.) Gaertn.; 25 µm diameter).*

Table 1: *Charcoal and wood samples (and their associated time periods) were excavated from sites along the M6 Kinnegad to Athlone stretch of dual carriageway.*

Site type	Number of samples	Time period
Fulachta fiadh	3	Neolithic
Fulachta fiadh	10	Neolithic/Bronze Age
Fulachta fiadh	19	Early Bronze Age
Fulachta fiadh	29	Early/Middle Bronze
Fulachta fiadh	43	Middle Bronze Age
Fulachta fiadh	21	Middle/Late Bronze Age
Fulachta fiadh	24	Late Bronze Age
Fulachta fiadh	2	Late Bronze Age/Iron Age
Industrial	2	Early Bronze Age
Industrial	1	Iron Age
Industrial	40	Early Medieval
Industrial	13	Medieval
Industrial	7	Late Medieval
Multi – function	7	Multi-period
Multi – function	8	Multi-period
Habitation site	19	Early Medieval
Habitation site	114	Late Bronze Age
Habitation site	108	Multi-period
Pit	2	Late Bronze Age
Pit	2	Neolithic
Pit	1	Post Medieval
Trackway – wood samples	1,000	Neolithic
Total	1,475	

Pollen

The pollen diagram from Cornaher Lough is essentially a series of side-by-side graphs (Figure 12). The x-axis shows the percentage of pollen types associated with a certain taxa at a given period in time. The graph's y-axis shows the depth of the sample, which corresponds to time, with the deepest and oldest deposits usually coming from the bottom of the core samples and the most shallow or recent deposits from the top. The total for all trees and shrubs (Figure 12, far right) provides a summary of the occurrence of these woodland types during any given time over the past 8,000 years.

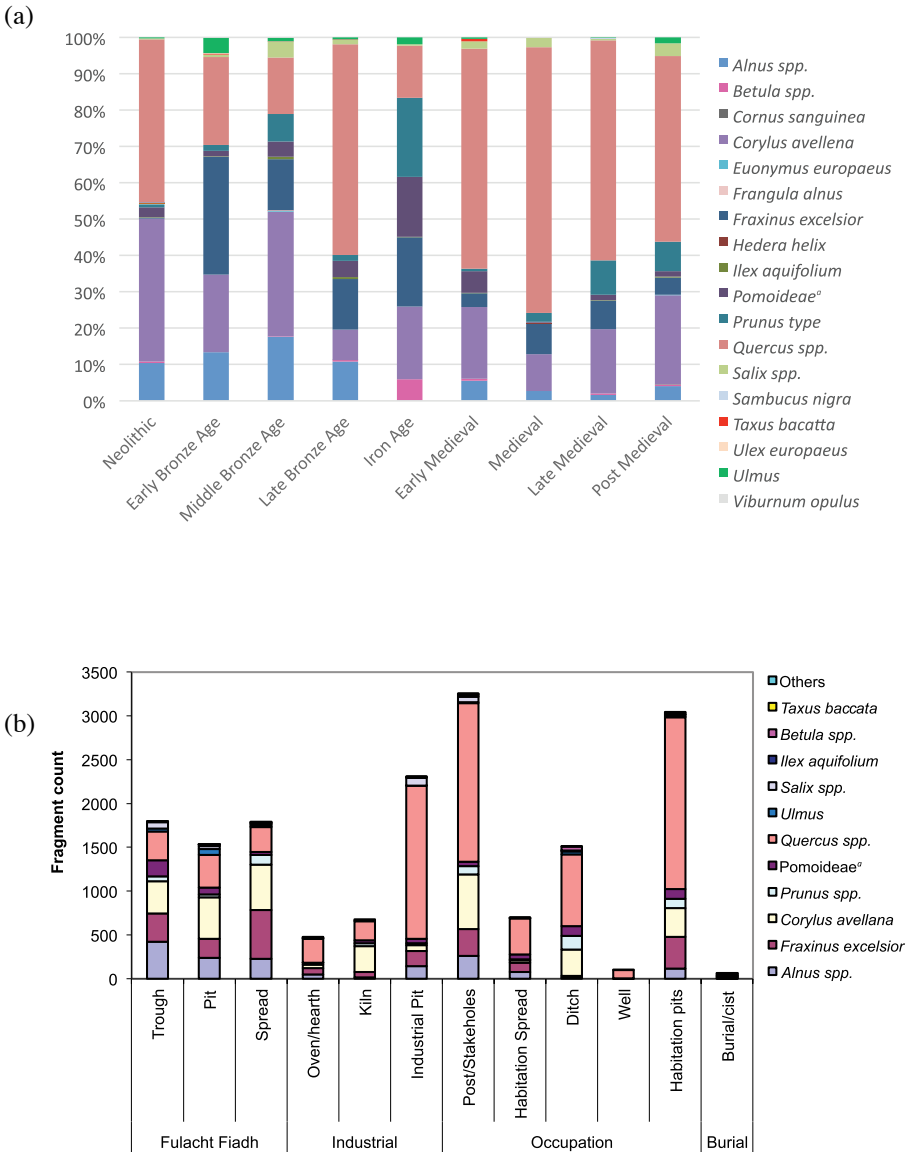

Figure 10: *Woody species identifications (a) per period and (b) by archaeological site/feature type (percentage frequency, n = 1,809) based on data from charcoal and wood samples excavated.*

[a] *Pomoideae includes apple (*Malus*), pear (*Pyrus*), hawthorn (*Crataegus*) and mountain ash (*Sorbus*). It is impossible to distinguish these wood species anatomically*

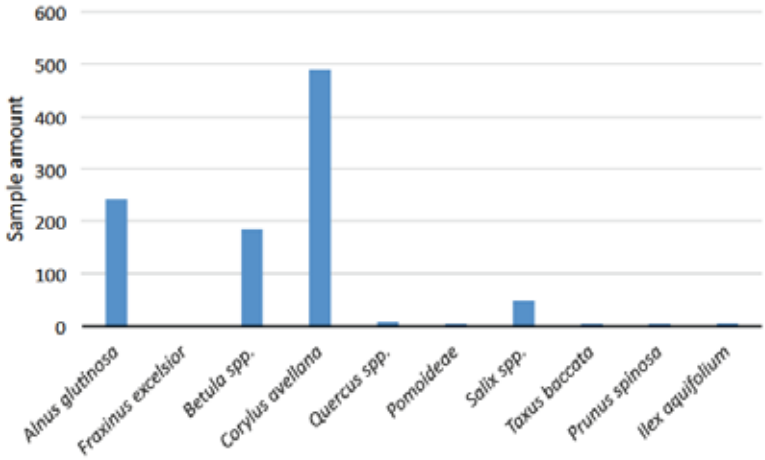

Figure 11: *Total wood identifications (n = 1,000) from the trackways at Mount Lucas which were dated to the Neolithic period.*

A changing landscape – evidence from archaeological charcoal and wood studies

With the exception of the *Ulmus* (elm) decline around 5,840 years ago and the decrease in *Pinus* (pine) cover that occurred about 4,000 years ago, there has been little change in the range of tree species growing on the island of Ireland (Hall 2011). Invariably woodland composition changed apace with anthropogenic activities, as well as being influenced by environmental factors such as climate and soil types. These changes can be traced through the study of both charcoal and the identification of wood and pollen associated with archaeological excavations, as discussed below.

Mesolithic 8,000-4,000 BC (c. 10,000-6,000 cal. BP[1])

There was little evidence for human occupation and woodland depletion during the Mesolithic period along the M6 route apart from a flint flake uncovered and attributed to the late Mesolithic and early Neolithic populations of the area near Rochfordbridge in Co. Westmeath (Egan 2007). Pollen evidence from the Mesolithic period in the midlands shows the development of large canopy-forming trees, such as *Quercus* and *Ulmus* spp. and towards the end of the Mesolithic period the study area would have been dominated by a dense canopy of these and *Corylus avellana* L. cover (Figure 12). *Betula* spp, which had previously been the main constituent of the woodlands in the midlands, declined dramatically once other trees with thicker canopies established themselves (Hall 2011). *Pinus* was also a component of this woodland but was more prolific in the peatland areas than in areas of mineral soils, as shown by pollen sources from lakes and bogs (Heery 1998, Connolly 1999).

[1] The cal prefix shows that the dates result from radiocarbon calibration determination from tree ring data and indicate the number of years before present (BP).

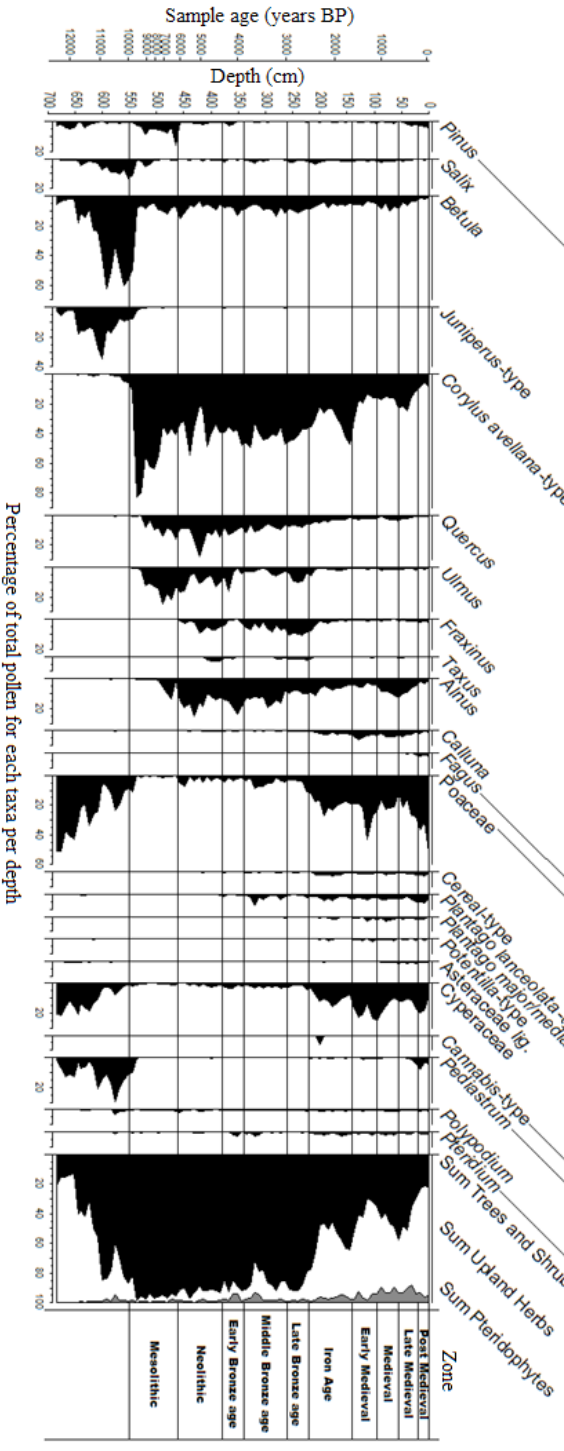

Figure 12: *Cornaher pollen percentage diagram (redrawn with data from Heery 1998) showing selected taxa.*

Neolithic 4,000-2,400 BC (c. 6,000-4,400 cal. BP)

The amount of archaeological data collected in the area during the Neolithic period was also scarce, thus providing limited evidence about tree cover during this period. The dense woodland cover of *C. avellana*, *Quercus*, *Ulmus* and *Pinus* spp., as evidenced in the pollen diagram (Figure 12), coupled with the presence of a large lake system and thin, poorly drained soils, may all have contributed to a dearth in human populations during the Neolithic period. The area was obviously unattractive to the earliest farmers when compared with the western seaboard areas around the Ceide fields in Mayo (Verrill and Tipping 2010), areas of Sligo (Danaher 2007) and Tullahedy in Co. Tipperary (OCarroll 2011). Neolithic remains in the study area comprised of enigmatic pits and trackways at Derrygreenagh and Mount Lucas bogs (Figure 3) in Co. Offaly. Charcoal identifications from the archaeological excavations indicated that woodlands exploited in the area included *C. avellana* and *Quercus* spp., while the low occurrence of *Fraxinus excelsior* L. (common ash) is noteworthy and defined Neolithic woodlands as closed woodlands with little open spaces or clearings, as can been seen during the Bronze and Iron Age periods (Figure 10a). Wood identifications from the Neolithic trackways at Mount Lucas show that *Corylus avellana*, *Alnus glutinosa* (L.) Gaertn. and *Betula* spp. were the most common species used in construction (Figure 11). *Alnus glutinosa* and *Betula* spp. are adapted to a wetter growing environment than most of the other species and would have grown in the marginal woodlands in fen areas close to where the trackway sites were constructed (Lipscome and Stokes 2008). Consequently, wood used in the composition of the trackways would never have been carried far from their source area.

Other wood types identified less frequently were *Quercus* spp., *F. excelsior,* Pomoideae (apple, pear, hawthorn and mountain ash), *Ilex aquifolium* L. (common holly) and *Taxus baccata* L. (common yew) which indicate these woodlands existed, possibly further afield in the dryland and upland areas. Primeval woodlands are also shown to have been present, evidence for which is supported by the insect analysis and may have been relatively intact during the Neolithic period in the midlands. Insects identified from the Mount Lucas excavation, such as *Rhyncolus ater* and *Colydium elongatum,* which are now extinct in Ireland, offer a picture of the Neolithic woodland landscape during the time of the construction of these sites. The now extinct beetles suggest the presence of primary or sub-primary forest cover (Rossi 2014[2], Reilly 2005). In particular, their presence in the late Neolithic trackways, at a time when woodland cover clearance was varied but well underway (Cooney 2000), suggests that primary woodland remained an important element of the landscape at this time in Ireland's midlands. Pollen data from Cornaher Lough show a decrease in *C. avellana* woodlands during the period when the trackways at Mount Lucas were in

[2]Unpublished technical report for Dominic Delaney by Julie Rossi on excavations carried out at Mount Lucas Bog, Co. Offaly.

use, indicating some woodland clearance, albeit not wholescale and only in relation to certain species types.

On the basis of the palynological evidence, it was concluded that there were no major Neolithic *Landnam*[3] phases or woodland clearance in the study area. This contrasts sharply with the evidence for widespread woodland clearance in other parts of the country, such as on the western seaboards at the Ceide fields and the southern portions of Ireland (O'Connell and Molloy 2001).

Bronze Age 2,400-500 BC (c. 4,400-2,500 cal. BP)

Archaeological evidence from early and middle Bronze Age material was also sparse and mainly related to *fulachta fiadh* activity along the M6 routeway, corresponding to a low settlement density. One late Bronze Age settlement site was uncovered along the routeway at Tober in Co. Offaly (Figure 4). Plank tracks were also in use throughout the midland peat bogs during the late Bronze Age period (OCarroll and Whitaker 2009). These tracks were invariably constructed from *Quercus* trees (Ibid. 2009).

A wide range of woody taxa was collected as kindling or for firewood use at the *fulachta fiadh* sites, however *C. avellana* was most dominant. *Quercus* spp. occurred more frequently in the late Bronze Age occupation sites at Tober, Co. Offaly and were used as posts and structural features. By comparison, *F. excelsior* was identified in higher amounts in the hearth and pit features at the occupation sites, suggesting the gathering of wood in previously cleared woods where *F. excelsior* may have grown as secondary regenerated woodland. The overall increase in *F. excelsior* wood throughout the whole of the Bronze Age suggests the opening up of the woodland in the midlands. Heightened *F. excelsior* curves often appear in pollen diagrams in the wake of woodland disturbance and this has been shown in many pollen studies throughout Ireland (Stefanini 2008). The higher occurrence of Pomoideae in the later Bronze Age and Iron Age periods possibly reflect cleared woodlands or scrubland nearby. During periods of clearance Pomoideae types are known to colonise cleared areas in a similar fashion to F. excelsior.

The quantities of *Alnus glutinosa* in the charcoal increased from the Neolithic to the middle Bronze Age periods, highlighting a greater link with and selection of woody taxa from a wetter area, particularly in association with *fulachta fiadh* sites. *Fulachta fiadh* were generally located on the interface between dryland and wetland areas.

The pollen records from the area during the early to late Bronze Age periods show a steady, but still small, reduction in arboreal taxa throughout these periods. All profiles show multiple (albeit not synchronous) *Ulmus* declines during these periods,

[3] *Landnám* is an Old Norse word (roughly translated as "land take") which refers to the Viking style of land management practices from the 9th and 10th Centuries AD.

most likely related to small woodland clearance phases. The Cornaher pollen cores also showed a heavy presence of *C. avellana* in the landscape during the Bronze Age periods, which compared well to charcoal results from this study, which demonstrated a consistent use of *C. avellana* at the *fulachta fiadh* sites during the Bronze Age (Figure 12).

Fraxinus excelsior contributed to over 30% of the woodland taxa identified from the charcoal associated with the Bronze Age periods. This compares well to other studies which show that this species replaced certain woodlands cleared by the first farmers (Caseldine and Hatton 1996). Indeed the *F. excelsior* curve in the pollen diagram (Figure 12) is more pronounced from the later Neolithic period through to the late Bronze Age. It was also in these clearings, created by their Neolithic predecessors, that the Bronze Age peoples invariably occupied. *Ulmus* was also present in higher frequencies in the early Bronze Age and almost completely disappeared from the pollen data set by the Iron Age periods. This is recorded from many pollen diagrams from the area (Figure 12).

Quercus spp. wood dominated the charcoal identifications from the late Bronze Age excavations, indicating the high frequency of use of this tree species, which must be attributed to the woodland clearance noted in the pollen diagram in the latter parts of the Bronze and Iron Age periods. Supporting this observation, there was a reduction in *Quercus* spp, *Ulmus* and *C. avellana* pollen at the end of the late Bronze Age (Figure 12). A possible effect this change had on Irish woodlands can be seen in the charcoal graph for the Early Iron Age as well as the pollen data which indicated regenerated woodlands (Figure 12).

Iron Age 500 BC-400 AD (c. 2,500-1,600 cal. BP)

Linked with the palaeoenviromental evidence from the late Bronze Age, arboreal pollen amounts declined to their lowest level (50%) in the pollen cores recorded from the early Iron Age (Figure 12). Early Iron Age furnaces and associated metal working activities were present in the study area. However, pollen evidence indicated the presence of a more aggressive settlement culture and more widespread woodland clearance phases in the early Iron Age periods than that recorded from the archaeological excavations. Is it possible that the consumption of firewood and charcoal in relation to the smithing hearths and associated activities were expressed in the pollen record so virulently? Indeed, the beginnings of a more widespread and dominant metalworking culture may have only begun to occur in the study area during the early Iron Age. The suspicious death and deposition of the bog body known as the Old Croghan Man in the early Iron Age, during a period of woodland clearance associated with social and economic changes, may only be the beginning of an intriguing and unexplored culture (Plunkett et al. 2009). More evidence in relation to the role this culture played in the depletion

of the surrounding woodlands is only just emerging. Certainly the extraction of bog iron ore, which is plentiful in the surrounding peat bogs, may have played a role in this emerging Iron Age culture.

A wider array of wood taxa identified from the charcoal dataset during the early Iron Age periods may demonstrate a greater reliance on a more scrub-like environment where the species forming the main woodland canopies had been depleted during the earlier Bronze Age population expansion. Pomoideae types (*Cratageus*, *Malus*, *Pyrus* and *Sorbus acuparia*) are intolerant of shade, and their increased presence in the charcoal record suggests that the woodland became more open in structure (Cunningham 2005). Similarly *Betula* spp., being light pioneering trees, are recorded in their highest numbers within the charcoal data during the Iron Age periods. The Iron Age sites were generally dated to before 0 AD and therefore pre-date the Iron Age lull (AD 1 – 500) where widespread regeneration of woody vegetation took place (Newman et al. 2007). Pollen data from Cornaher Lough in Co. Westmeath, close by to the eastern side of the study area, also shows this change in woodland structure whereby arboreal taxa decrease significantly.

Consistency between the pollen and charcoal results also occurred in the early Iron Age periods where the pollen profile showed a decline in arboreal taxa and increasing indicators of farming during the period 300 BC-20 AD (Heery 1998, Newman et al. 2007). By comparison, there was an increase in *Quercus* spp., *F. excelsior*, *Ulmus* and *C. avellana* cover, in association with a decline in pastoral activities and in the conversion of land to arable farming during 20-500 AD. This period was during the Iron Age Lull or a period in Ireland's history associated with little anthropogenic activity, consistent with the recorded decline in pollen quantities throughout Ireland and the low number of archaeological sites representing this period.

Medieval periods 400 AD – 1,650 AD (c. 1,600 BP – 300 cal. BP)

The Medieval landscapes of the M6 route comprised of a series of important well organised secular settlements interspersed with ecclesiastical centres, all of which were linked by established routeways (Egan 2007). Ringforts were particularly dominant on the northern portion of the study area, located on slightly better soil types. By comparison, castle sites were located at the southern side of the study area close to the poorer peat bog soils.

Reconstructing Ireland's woodland history throughout the Medieval periods in Ireland is more difficult from archaeological charcoal due the increase in industrialisation and the preferential exploitation of certain wood taxa over another. This is clear from Figure 10a, which shows that *Quercus* spp. were identified more frequently from the charcoal taken from archaeological excavations, but its occurrence in the pollen records is low. Various pollen studies throughout Ireland have

recorded much lower levels of tree pollen relative to herbaceous pollen, indicating that large-scale destruction of the major woodlands had taken place during the earlier pre-historic periods to provide land for arable and pastoral farming (Mitchell and Ryan 1997). This was also the case in the midlands. Identifications of charcoal by this author indicated that there were nearly equal quantities of *Quercus* spp. from the early to the late Medieval periods, with only minor fluctuations in the quantities of *C. avellana* and *A. glutinosa* charcoal.

Quercus spp. wood was of increasing importance for use in charcoal production pits during the last millennia and may have been managed to support the charcoal industry, with the aim of producing a steady supply of even-sized oak rods. Over 14 areas along the M6 route produced evidence of charcoal production pits. Some were dated to the early Medieval period and others to the Medieval or late Medieval periods. Therefore, their use spans over 1,000 years. *Quercus* spp. charcoal dominated at the majority of the charcoal production pits. *Salix* charcoal was identified in one pit while some pits near Kilbeggan showed a wider variety of other genera in addition to *F. excelsior*, *C. avellena* and Pomoideae, suggesting that this pattern was not consistent across all pits.

A large portion of the identified *Quercus* spp. ranged in age from 5 to 35 years and occurred mainly as brushwood. According to Gale (2003), the best charcoal for iron smelting came from 25-year-old coppiced *Quercus* spp. In England coppicing was practiced by ironworkers to ensure a continuous supply of wood (Armstrong 1978) and it is likely, based on the tree rings counted and the wood species identified from the charcoal pits, that oak wood was being coppiced in Ireland for charcoal requirements in the early Medieval periods.

Similar studies by this author along the N5, Charlestown by-pass in Mayo, have shown that these charcoal pits are most likely related to large scale settlement sites, such as at Lowpark in Mayo (Gillespie and Kerrigan 2010). The high-status crannog site, known as Ballinderry 2 where much precious metalwork was found, is located close to many of the charcoal production pits along the M6 and is likely to have made use of much of the charcoal burnt to support the metalworking activities at the crannog site (Hencken 1936 and 1942).

The Anglo Norman invasion in 1169 heralded the beginnings of a new era in Ireland, coinciding with the initial stages of the Medieval period (1200-1400 AD). The invasion resulted in the foundation of many walled borough towns, castles and churches and an increase in agricultural and commercial activities. Charcoal production pits were still in use, albeit not as frequently and kilns associated with cereal and pulse drying were uncovered and became more frequent along the M6. The use of kilns along the M6 shows that a move towards arable agriculture occurred at this time. *Quercus* spp. and *C. avellana* were the main wood genera associated with

these kiln activities, suggesting these woodland types were still in existence and use during this Medieval period.

Indeed, cartographic sources, such as Honer's map of Co. Offaly, show that woodlands were still a prominent feature in the landscape in the 15th and 16th centuries (Honer 2007). These woodlands were most likely in the form of scrub or coppiced *Quercus* spp. and *C. avellana* woodlands. Platforms and wooden structures were being constructed within the bogs from *A. glutinosa*, *C. avellana*, *Betula* spp. and *Salix* spp. These platforms and structures were constructed during the 12th – 16th centuries in the bog areas as part of a tradition of exploitation of the natural flora and fauna (OCarroll 2009). These structures may have been constructed in response to the drop in temperature during the "Little Ice Age" experienced in the 14th – 16th centuries. The increased accessibility afforded by the trackways allowed greater exploitation of wildfowl as a food source and rushes for domestic and constructional uses. Tower houses were also being constructed during the late medieval periods, of which there are many recorded from the study area.

Pollen records show the clearance of woodlands in the early Medieval period (400 – 1200 AD) which continued steadily through the Medieval and late Medieval periods (Figure 12). This period of woodland depletion included substantial loss of hazel scrub due to population expansion and ever increasing demands on the wooded landscape, both commercially and domestically. There was a rise in *C. avellana* cover, as shown by the pollen core data during the late medieval periods, followed by a sharp drop during the post-Medieval period (to present). The rise in *C. avellana* scrub was likely related to a decrease in human activity due to the Black Death, which arrived in Ireland in 1348 and dramatically reduced Ireland's population, particularly in the towns (Kelly 2001). *Quercus spp, Ulmus* and *F. excelsior* never fully recover after the earlier woodland clearances in the late Bronze Age and Iron Age. *Alnus* and *Betula* are present in the landscape in varying amounts during this Medieval period and were shown to be used as construction material for the platform sites uncovered in the peat bogs (Whitaker and OCarroll 2009). Grass pollen increases in response to woodland clearance phases as indicated through the pollen diagram from Cornaher Lough (Figure 12).

Post Medieval c. 1650 to present AD (c. 300 – 60 cal. BP)

Pollen evidence from the post Medieval periods show a dramatic decline in the amount of arboreal cover, most notably by *C. avellana,* coupled with a rise in modern agricultural activities and the export of timbers of such species to Europe and beyond (McCracken 1971). The use of *C. avellana* at the archaeological sites increased. Other charcoal woods present in the archaeological samples were *Quercus* spp. as well as smaller quantities of *F. excelsior*, *A. glutinosa*, *Salix* spp. and *Prunus* types

(Figure 10a). The widespread clearance of woodlands may have occurred during the Plantation period. This decrease in woodland pollen is noted in other cores from the midlands such as at Monaincha, Co. Tipperary (Hall 2003). From the 16th century on, tree clearances accelerated probably because the ruling English Government required timber for building and industrial uses. Consequently, by the 1900s only 1.46% of the land area of Ireland was covered by woodland (OCarroll 1984). *Pinus* and *Fagus* curves, albeit small, occur indicating the introduction of these taxa types into the midland areas during the post Medieval periods.

Conclusions

Charcoal, wood and pollen records from archaeological sites provided essential information, thus allowing the change in the composition of past woodlands over time to be described. Woodland history however, is not the same throughout Ireland.

There was little evidence of occupation along the M6 during the Mesolithic and Neolithic periods. Although few charcoal samples were dated to the Neolithic period, the data indicated woodland cover comprising *Quercus* spp. and *C. avellana* woodland types. *C. avellana,* as well as *Betula* spp. and *A. glutinosa* were mainly used in the construction of the Neolithic trackways. Pollen, wood, charcoal and insect evidence indicated the presence of a dense primary woodland forest during this period. There was no evidence in the pollen proxy records of *Landnam* or woodland clearance phases during the Neolithic periods, although it is recognised that there was a dramatic reduction of arboreal cover during a similar period along the western seaboards of Ireland (O'Connell and Molloy 2001). Bronze Age woodland clearance was also much less visible in the study area when compared with other parts of Ireland (Molloy and O'Connell 2011). However, clearance of primary woodland during the Bronze Age and early Iron Age periods resulted in the growth of secondary woodlands in which *F. excelsior,* Pomoideae and *C. avellana* were common. *C. avellana,* followed by *F. excelsior, Quercus* spp. and *A. glutinosa,* were identified more frequently from the *fulachta fiadh* archeological sites, indicating that these were more abundant in the vicinity of these sites. Due to previous woodland clearance episodes during the Iron Age, charcoal identifications and pollen evidence suggest a more open, varied, wet and scrubbier-type of landscape.

Quercus spp. dominated records from the Medieval periods onwards, which is in part an indicator of arboreal cover, but this may also be related to an increase in the complexity and economic reliance on the wood from certain species, i.e. *Quercus* spp. predominated in charcoal pits and as construction material. The regular even-aged *Quercus* spp. identified from charcoal remains indicated that *Quercus* spp. woods were managed at this time to supply material for use in the charcoal pits. These pits, which were numerous between the 8th and 14th centuries, would have been used to

supply and support an emerging metal working industry at the ecclesiastical centers and crannog sites in the midlands areas.

The extensive clearance of woodlands that occurred in the late Bronze Age and early Iron Age along the M6 continued into the Early Medieval periods until by the 1650s there was little forest cover present in the Irish Midlands.

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