A multi-proxy palaeoenvironmental investigation of the findspot of an Iron Age bog body from Oldcroghan, Co. Offaly, Ireland


Published in:
Journal of Archaeological Science

Document Version:
Publisher's PDF, also known as Version of record

Queen's University Belfast - Research Portal:
Link to publication record in Queen's University Belfast Research Portal

General rights
Copyright for the publications made accessible via the Queen's University Belfast Research Portal is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy
The Research Portal is Queen's institutional repository that provides access to Queen's research output. Every effort has been made to ensure that content in the Research Portal does not infringe any person's rights, or applicable UK laws. If you discover content in the Research Portal that you believe breaches copyright or violates any law, please contact openaccess@qub.ac.uk.
A multi-proxy palaeoenvironmental investigation of the findspot of an Iron Age bog body from Oldcroghan, Co. Offaly, Ireland

Gill Plunkett, Nicki J. Whitehouse, Valerie A. Hall, Dan J. Charman, Maarten Blaauw, Eamonn Kelly, Isabella Mulhall

Abstract

In 2003, the remains of an Early Iron Age bog body, known as ‘Oldcroghan Man’, were recovered during the cutting of a drainage ditch in a bog in the Irish Midlands. Only some fingernails and a wirthe fragment remained undisturbed in situ in the drain face, providing the sole evidence for the original position of the body. A detailed reconstruction of the depositional context of the body has been undertaken through multi-proxy analyses of a peat monolith collected at the findspot. The palynological record shows that the surrounding area was the focus of intensive human activity during the Later Bronze Age, but was largely abandoned during the Bronze Age–Iron transition in the mid-first millennium BC. In the mid-4th century BC, a bog pool developed at the site, evidenced in the stratigraphic, plant macrofossil, testate amoebae and coleopteran records. Plant macrofossil and pollen analysis of peat samples associated with the fingernails suggests that the body was deposited in this pool most likely during the 3rd century BC. Deposition occurred shortly before or around the time that the surrounding area again became the focus of woodland clearance, as seen in the extended pollen record from the peat monolith. This period corresponds to the Early Iron Age in Ireland, during which renewed cultural connections with Britain and continental Europe can be seen in the archaeological record and widespread forest clearance is recorded in pollen records from across Ireland. The palaeoenvironmental results indicate, therefore, that the demise of Oldcroghan Man took place at a pivotal time of socio-economic and perhaps political change.

1. Introduction

In 2003, human remains, consisting of the upper torso and arms of an adult male, were discovered by an operative of Tipperary Peats Ltd in the bucket of a mechanical excavator during the recutting of a drainage ditch in the southern part of Clonearl Bog, in Oldcroghan townland, Co. Offaly, Ireland. Subsequent examination of the remains revealed that the individual, dubbed ‘Oldcroghan Man’, had been decapitated and severed at the mid-torso in antiquity, and 14C determinations on samples of internal tissue (OxA-14281, 2170 ± 30 BP; 361–115 cal BC) and an associated piece of wirthe (OxA-14280, 2189 ± 29 BP; 362–175 cal BC) returned dates firmly within the Irish Early Iron Age (Mulhall, in press; Mulhall and Briggs, 2007).

The body is one of two Early Iron Age bog bodies discovered recently in the Irish Midlands (Kelly, 2006), the second of which (‘Clonycavan Man’) also displayed evidence of physical mutilation. At least three other bog bodies of this age are known from Ireland (Brindley and Lanting, 1995), while in Britain and on continental Europe, the phenomenon is also well attested from this time (Brothwell, 1986; Glob, 1969; van der Sanden, 1995, 1996). With rare exceptions (e.g. Birmingham and Delaney, 2006; Branch and Scaife, 1995; Stead et al., 1986), however, reconstructions of the contexts in which bog bodies were deposited have been few, limiting the understanding of the wider circumstances of the burials. Discrepancies between dates from Lindow II and III bog bodies from Cheshire, England, and their surrounding deposits have raised interesting debates about the burial methods employed and the taphonomic processes affecting the bodies in the bog (Barber, 1995; Buckland, 1995).

This paper describes the results of a multi-proxy palaeoenvironmental study conducted on a peat monolith collected from a section adjacent to the findspot of Oldcroghan Man. Using pollen, plant macrofossil, testate amoebae and coleopteran analyses, we reconstruct the landscape history of the surrounding area in the
centuries bracketing the burial, as well as detailed local environmental conditions at the time the body was deposited in the bog.

2. Site description

Clonearl Bog, Co. Offaly (53°19’7”18’’), is a small raised bog (maximum dimensions ca. 5 km long, ca. 2 km wide) that forms part of the extensive Derrygreenagh system of bogs in the Irish Midlands (Fig. 1). It lies immediately to the southwest of Croghan Hill, a volcanic plug that constitutes the highest (234 m) point in the surrounding landscape. The bog is currently being developed privately for peat extraction by Tipperary Peats Ltd. Drainage ditches were initially inserted some 20 yr ago, with drains in the southern part of the bog deepened in the mid-1990s. Field drains have been placed at 10 m intervals in a northwest–southeast direction, but surface vegetation, dominated now by Calluna vulgaris, remains across much of the southern part of the bog. The bog body was buried approximately 250 m from the southern dryland margin.

2.1. Geology, soils and climate

The geology of area is characterised by Carboniferous limestone bedrock overlain by limestone-dominated glacial till and lowland raised bog peats with an outcrop of Carboniferous basalt and dark green volcanic ash defining Croghan Hill. Dryland areas are dominated by well-drained Grey Brown Podzolics that support good grassland and have high arable potential while on the low lying ground immediately surrounding Clonearl Bog, Gleys prone to waterlogging yield moderate pasture (Hammond and Brennan, 2003). Extensive raised peatlands surround Croghan Hill, most of which have been taken into production for milled peat extraction. Cut-away bogs to the north and west of the hill now support conifer plantations. Mean annual precipitation is between 800 and 1000 mm, and mean air temperatures range from 4.5 °C (January) to 15.5 °C (July).

2.2. Archaeology

A diverse range of archaeological sites, including tumuli, burial mounds, a ring barrow, a possible hillfort, a church site and graveyard, holy wells, cultivation ridges and a deserted village, on and around Croghan Hill demonstrate that it was the repeated focus of human activity since prehistoric times. Elsewhere around Clonearl Bog, dryland archaeological sites consist mainly of ring-forts, typically dating to the Early Medieval period. Later prehistoric activity in the region has been more clearly affirmed by the Irish Archaeological Wetland Unit (IAWU) surveys of the cut-over raised bogs around Croghan Hill, which have identified at least 26 wetland sites and finds of Late Bronze Age and Iron Age date (IAWU, unpublished reports 2002–2003; McDermott et al., 2002; Murray et al., 2002).

3. Methods

3.1. Material collection

In August 2004, archaeological investigations were undertaken by Eachtra Archaeological Projects Ltd., in collaboration with the National Museum of Ireland (NMI), to determine if any further remains of the bog body could be recovered in situ. Two trenches were opened up approximately 0.5 m to either side of, and parallel to, the drainage ditch in which the body was discovered (Fig. 1). The sections of the trenches and the drain were examined visually and revealed no apparent evidence for a cut or disturbance in the peat stratigraphy. A layer of Sphagnum cf. cuspidatum was visible in all but the northernmost baulk, varying in thickness from 7 to 17 cm. The pool seems to have had a width of ca. 1.5 m and a minimum length of 2 m.

Column samples for palaeoenvironmental analysis were extracted from each trench (OC1 – south trench; OC2 – north trench) using monolith tins measuring 100 × 18 × 13 cm. The monoliths were wrapped in polythene and removed for cold storage and analysis to the Palaeoecology Centre, Queen’s University Belfast. During the ensuing excavation of the baulks adjacent to the drainage ditch, the archaeologists succeeded in recovering three fingernails and a withe fragment which remained in situ within the pool peat (Kiely, 2005). The fingernails were located next to a cavity in the drain section, first noted during the initial recovery of the body and out of which one of the body’s hands was thought to have come. These finds provide the only definite evidence for the original level of the body. The archaeologists collected a bulk peat sample from the fingernails’ findspot, three subsamples of which (hereafter referred to as ‘fingernail samples’) were sent to the Palaeoecology Centre. These samples were further subsampled for pollen and plant macrofossil analysis to establish a correlation between the findspot and the monolith profiles.

The stratigraphy of each monolith was recorded. OC2 was selected for analysis as it was located closest (within 50 cm) to the drain face in which Oldcroghan Man’s fingernails were found (Kiely, 2005).

3.2. Loss-on-ignition and chronology

Five bulk peat samples were selected for AMS 14C dating on the basis of changes in the stratigraphy or pollen record. The samples were submitted for pre-treatment to the Radiocarbon Laboratory, Queen’s University Belfast, and were analysed at the Oxford...
Radiocarbon Accelerator Unit. Two additional samples (prefixed UBA-) were subsequently extracted, and were pre-treated and analysed at the AMS radiocarbon facility at Queen’s University Belfast. An age model was constructed with the IntCal04 calibration curve (Reimer et al., 2004) and the Bayesian software Bgate (Blaauw and Christen, 2005; Blaauw et al., 2007) using the following prior assumptions: i) accumulation occurred approximately linearly within sections (section breakpoints set at 13.7, 37.5 and 48.5 cm based on stratigraphy), ii) accumulation rate likely varied between 10 and 20 yr cm\(^{-1}\) (AlphaMean 12, AlphaStd 5, Epsilon 5), iii) hiatuses between the sections were considered unlikely, and iv) prior outlier probabilities for the \(^{14}C\) dates were 5\% (0\% for the Microlite tephra). More than 250 million iterations were run to obtain the posterior age model and its uncertainty. Age estimates have been rounded to the nearest decade.

Contiguous 1 cm samples were extracted from OC2 for loss-on-ignition and tephra analysis, and were prepared following standard procedures (Dean, 1974; Pilcher and Hall, 1992).

3.3. Palynology

Pollen samples of 1 cm depth were extracted at 2 cm intervals from the length of the profile. *Lycopodium clavatum* spore tables were added to the samples to enable pollen concentration calculation (Stockmarr, 1971), and standard pollen preparation procedures, including dilute potassium hydroxide, sieving and acetolysis (Faegri and Iversen, 1989) were employed. Samples were washed with alcohol and mounted in silicon oil. A minimum pollen sum of 250 grains was counted for each level, and identifications were assisted by reference to Faegri and Iversen (1989), Moore et al. (1991), van Leeuwen et al. (1988) and the type collection in the Palaeoecology Centre, Queen’s University Belfast. Where possible, 100 leaves of *Avena*–*Triticum* (oat–wheat) group following the criteria of Andersen (1979). Pollen nomenclature follows *Flora Europaea* (Tutin et al., 1968, 1972, 1976, 1980, 1990, 1993). A percentage pollen diagram was drawn using Tilia and TView (Grimm, 1992, 2004), and divided into local pollen assemblage zones (LPAZ) using CONISS (Grimm, 1987). Percentages are based on total dryland pollen (trees, shrubs, dryland herbs and grasses), except for wetland taxa whose percentages are calculated using the total pollen sum. Small subsamples were taken from the fingernail samples, and were similarly processed. A minimum pollen sum of 250 grains was counted to quantify the main pollen taxa in each sample.

3.4. Plant macrofossil analysis

Samples of 5 cm\(^3\) were extracted for plant macrofossil analysis at 2 cm intervals between 36 and 96 cm, and at 4 cm intervals between 0 and 32 cm. The peat was disaggregated in dilute potassium hydroxide and washed on a 120 \(\mu\)m sieve. In addition, 5 cm\(^3\) of peat were selected from each of the three fingernail samples to compare with the OC2 sequence. For all samples, the relative proportions of the main peat components were estimated using a quadrat method (Barber, 1981) under a binocular microscope at \(\times 10\) magnification. Identifiable components (stems, leaves, flowers, seeds) of the Ericaceae and monocotyledons were counted, with identification aided by Grosse-Brauckmann (1972, 1974, 1992). Lévesque et al. (1988) and the plant macrofossil reference collection in the Palaeoecology Centre, Queen’s University Belfast. Where possible, 100 leaves of *Sphagnum* were extracted from each sample and identified under high power magnification (\(\times 100\)) with the aid of Smith (1980). Minor peat components were quantified on a three-point frequency scale (present, occasional, frequent). The plant macrofossil diagram was zoned into plant macrofossil assemblage zones (LPMAZ) using CONISS.

3.5. Testate amoebae analysis

Nine samples were selected at 1–2 cm intervals between 36 and 51 cm, corresponding to below, across and immediately above the pool peat horizon. Samples were prepared using standard techniques of disaggregating in distilled water, and sieving to extract the fraction between 15 and 300 \(\mu\)m (Hendon and Charman, 1997). At least 150 tests per sample were counted using the nomenclature in Charman et al. (2000). In ombrotrophic peatlands, testate amoebae communities are primarily controlled by hydrological conditions and they can therefore be used as indicators of changes in parameters such as depth to water table (Charman, 2001). Inferred water table depth for OC2 was calculated using a transfer function based on European ombrotrophic bogs (Charman et al., 2007). The specific model applied is a weighted-average tolerance downweighted (WA-Tol) model. Changes in water table are described in terms of the reconstructed water table (RWT). A fall in RWT indicates drier conditions (deep water tables) and a rise indicates wetter conditions (shallower water table depths).

3.6. Coleopteran analysis

Three contiguous bulk samples of ca. 2.0–2.5 l were extracted for fossil beetle analysis at 35–39, 39–48 and 48–58 cm. The samples followed the peat stratigraphy within the monolith; the uppermost and lowermost samples consisted of poorly humified *Sphagnum* peat and the intermediate horizon comprised S. *cf. cuspidatum* peat. The paraffin flotation method (Coope and Osborne, 1968) was used to concentrate the insect remains, with each sample disaggregated over a 300 \(\mu\)m sieve. The flows were sorted by hand in ethanol for insect chitin under a binocular microscope at \(\times 10–40\) magnification. Fossil Coleoptera extracted from the fingernail samples were also examined. Insect nomenclature follows Lucht (1987) and plant nomenclature follows Stace (1991).

Identification of insect remains was undertaken using the Coleoptera Gorham and Girling reference collections at the Institute of Antiquity and Archaeology, University of Birmingham. Habitat information was obtained from the coleopteran database BUGS (Buckland et al., 1997; www.bugs2000.org) and the faunas are simply described, along with habitat preferences of species. Where necessary, reference is made to the current threatened status of some of the beetles as defined by the Nature Conservancy Council’s British Red Data Books: 2, Insects (Shirt, 1987). There is no equivalent Red Data Book for Irish species so the British version is applied, whilst acknowledging that their status in Ireland may be different. As the numbers of fossils recovered varied, species richness was estimated using an index of diversity, Fisher (1944) alpha (\(\alpha\)). This technique is independent of sample size (Fisher et al., 1943) and has the potential to distinguish between autochthonous and allochthonous components of a fossil assemblage (cf. Kenward, 1978).

4. Results and interpretation

4.1. Chronology

Tephra sherd abundance is very low throughout OC2, although minor peaks (>5) of brown sherd occur at 72 and 83 cm, and of colourless sherds at 80–81 cm. The number of sherds in each instance, however, was too low to warrant electron microprobe analyses to identify the tephras. Nevertheless, in view of other chronological evidence from the profile, the position of these three layers suggests that they correspond to a suite of tephras of Late Bronze Age date found elsewhere in Irish bogs (Plunkett et al., 2004). The recognition of microlite crystals in sherds of the colourless layer at 80–81 cm strongly supports its identification as the Microlite tephra of Icelandic origin that has been \(^{14}C\) wiggle-match
dated to 755–680 cal BC (Plunkett et al., 2004), providing a good chronostratigraphic marker for the lower part of the monolith. The brown tephras are believed to be the GB4-150 (800–758 cal BC) and BMR-190 (705–585 cal BC) tephras, also of Icelandic origin, but in the absence of any supporting evidence, the ages of these layers are not included in the age model.

The results of the 14C determinations from OC2 are presented in Table 1 and the age model is shown in Fig. 2. Average age model uncertainties are 74 yr at 2 standard deviations (sd), the highest uncertainties being obtained at the top of the core between 12 and 38 cm (2 sd range ca. 100–170 yr), while the most secure section is between 45 and 65 cm (2 sd range ca. 34–44 yr). The age model suggests an average peat accumulation rate of ca. 12 yr cm−1 in the lower half of the monolith, prior to pool formation. Such a rate is typical of Irish raised bogs (Plunkett et al., 2004). Pool formation begins ca. 370 cal BC, and peat accumulation slows to ca. 18 yr cm−1. This slower rate is likely due to the higher decay rate and potentially greater compression of the small-leaved S. cuspidatum peat that comprises the pool peat (Johnson and Damman, 1991). The age model suggests that the pool persisted until ca. 170 cal BC, after which the peat accumulation rate increases substantially to ca. 5 yr cm−1. This change coincides with the development of a poorly humified and loosely compacted Sphagnum imbricatum peat (see below). The rate slows slightly after ca. 45 cal BC when a more humified, ericaceous peat begins to form.

### 4.2. Stratigraphy and loss-on-ignition

Both monoliths are dominated by poorly to moderately humified Sphagnum peat with occasional Ericophorum or ericaceous remains. In OC2 (Fig. 3), between ca. 37 and 49 cm, there is a distinct change to moderately humified S. cf. cuspidatum peat with occasional leaves of Andromeda polifolia. Humification increases slightly above 25 cm, and the upper 15 cm incorporate a change to a darker, moderately humified Sphagnum peat containing abundant Ericophorum and ericaceous remains.

Loss-on-ignition results from OC2 indicate a very minor mineral component, with inorganic content ranging from 0.7 to 5.2% (Fig. 3).

### 4.3. Palynology

The pollen diagram (Fig. 3) has been divided into four principal local pollen assemblage zones.

#### 4.3.1. OC2-1 (ca. 920–840 cal BC)

This zone corresponds to a phase of open landscape, with arboreal pollen at ca. 50%. Corylus and Quercus appear to have been the main constituents of the surrounding woodland, while Alnus may have been present in the wetter areas along the bog edge. High Gramineae and Plantago lanceolata values indicate open conditions and imply a substantial level of human activity in the area. Arable agriculture is represented by Cerealia-type, including Hordeum and Avena–Triticum groups, with as many as five instances of these grains recorded at 94 cm. Few definite arable weeds are represented, however, and it is likely that pastoral farming dominated the subsistence economy of the surrounding area.

#### 4.3.2. OC2-2 (ca. 840–580 cal BC)

Anthropogenic activity is reduced in this zone, evidenced by a drop in Gramineae and P. lanceolata representation. Quite rapid woodland regeneration appears to have taken place, and most notable is the expansion of Ulmus, previously insignificant in the pollen record. Secondary woodland regeneration is suggested by increases in Corylus-type and Fraxinus pollen. Nonetheless, some level of farming is maintained in the surrounding landscape, illustrated by the continued importance of P. lanceolata, as well as Cerealia-type at four levels. The beginning of the zone also sees an increase in total pollen concentration, registered at first in the arboreal taxa, and subsequently in the herbs and grasses (individual concentration curves not shown). At ca. 810 cal BC (86–87 cm), total pollen concentration peaks just before a change in peat stratigraphy, and may signify a reduction in peat accumulation, possibly due to drier bog surface conditions. Towards the top of the zone, P. lanceolata values are further suppressed as Corylus-type rises to over 50%.

#### 4.3.3. OC2-3 (ca. 580–270 cal BC)

A greater decline in human activity is witnessed in this zone, as the proportions and concentrations of Gramineae and P. lanceolata are reduced. Values of anthropogenic indicators in general are lowered considerably, although occasional instances of Cerealia-type pollen could signify that the area was not entirely abandoned. Ulmus and Fraxinus are the principal taxa to colonise the abandoned
Fig. 3. a. Percentage pollen diagram from OC2, showing lithostratigraphy, inorganic content and tephra sherd abundance. b. Percentage pollen diagram from Oldcroghan fingernail samples. þ¼Less than 1%.
areas, and Corylus-type expands slightly later. The development of the bog pool begins towards the top of the zone. This change is not reflected in the pollen diagram, although an initial increase in pollen concentration may be the result of a reduced peat accumulation rate within the pool environment.

4.3.4. OC2-4 (ca. 270–120 cal BC)

The substantial decline of Ulmus, and to a lesser extent of Quercus and Fraxinus, at the beginning of this zone, accompanied by rising values of P. lanceolata and Gramineae, signals a renewed phase of anthropogenic activity. The reduction in Ulmus is drastic and suggests its almost complete removal from the surrounding vegetation. Corylus-type expands briefly at first but this does not seem to represent a real expansion of Corylus in the landscape as its pollen concentration declines at this time.

Human activity becomes more pronounced in OC2-4b (from ca. 170 cal BC), where a greater range of anthropogenic indicators is represented, including Avena–Triticum group and microscopic charcoal. The level of openness is not as pronounced as in OC2-1. A fall in pollen concentration corresponds to a stratigraphic shift to poorly humified peat, representing the infilling of the bog pool and rapid peat accumulation. Increasing Calluna values suggest that the surrounding bog surface was becoming drier. The subzone features the highest microscopic charcoal values in the profile, including a pronounced peak at ca. 150 cal BC (34–35 cm). This event almost certainly represents burning in the surrounding area as there are no indications in any of the proxies that the bog itself was burnt at this time.

4.3.5. OC2-5 (ca. 120 cal BC–cal AD 30)

At the beginning of this zone, a similar level of human activity appears to be maintained in the region, with relatively stable curves in Gramineae, P. lanceolata and Cerealia-type pollen, albeit with a reduced range of herb taxa. Ulmus remains suppressed, Quercus values are at their lowest in the profile and Fraxinus also declines. There is, on the other hand, a substantial expansion in Corylus and to a lesser extent in Alnus, both in their percentages and concentrations. Calluna also expands, indicating increasingly dry conditions on the bog. The upper part of the zone sees an expansion of Cyperaceae, coeval with a change in peat stratigraphy.

4.3.6. Fingernail samples

Despite some small variations, the main pollen taxa of all three fingernail samples are quite comparable to each other (Fig. 3b). Arboreal pollen is consistently greater than 85%, dominated by Corylus-type at 54–57%. Ulmus values range from 3.7 to 7.1%, and these relatively high values, in particular, indicate that the samples pre-date the major decline of Ulmus in OC2 at 42 cm. On the whole, an assessment of the main pollen taxa suggest that the three fingernail samples correspond approximately to OC2 levels of 44–45 or 48–53 cm.

4.4. Plant macrofossil analysis

The plant macrofossil profile is presented in Fig. 4.

4.4.1. OC2-P1 (ca. 920–800 cal BC)

The peat is composed predominantly of S. imbricatum, with an increase in Eriophorum vaginatum and Unidentifiable Organic Matter (UOM) perhaps suggesting a shift to drier conditions towards the top of the zone.

4.4.2. OC2-P2 (ca. 800–370 cal BC)

Monocotyledons and UOM decrease as Sphagnum again comprises the bulk of the peat. S. imbricatum is dominant, but also present in low numbers are S. papillosum, S. magellanicum, S. section Acutifolia and S. section Cuspidata. Ericaceae remains are few and, where identifiable, consist mainly of Erica tetralix, Rhynchospora alba and Drosera rotundifolia/anglica are also represented initially, pointing towards wetter conditions at the sampling site, but these conditions are neither marked nor sustained. Overall, it is likely that S. imbricatum comprised a lawn vegetation not characterised by any significant hummocks in the vicinity of the sampling point during this time period.

4.4.3. OC2-P3 (ca. 370–170 cal BC)

A significant shift towards Sphagnum section Cuspidata-dominated peat mirrors the stratigraphic change visible in the lithology, and verifies the emergence of a pool. This is accompanied by small rises in S. section Acutifolia and S. magellanicum, and the reappearance of R. alba. UOM also increases temporarily, and E. tetralix (mainly leaves and seeds) dominates the identifiable Ericaceae remains. The latter probably is derived from plants growing at the pool edge. Age modelling suggests that peat accumulation slowed to approximately 18 yr cm⁻¹ while the pool remained extant over a period of some two centuries (see above). A transition back to S. imbricatum-dominated peat begins at 38–39 cm, signifying the infilling of the pool.

4.4.4. OC2-P4 (ca. 170–50 cal BC)

The peat is again dominated by Sphagnum imbricatum, with some S. section Acutifolia. The age model and low pollen concentrations indicate extremely rapid peat accumulation (ca. 5 yr cm⁻¹) at this time. Monocotyledons and Ericaceae become increasingly important in the upper part of the zone. C. vulgaris, in particular, demonstrates a shift to drier conditions.

4.4.5. OC2-P5 (ca. 50 cal BC–cal AD 30)

The peat matrix changes significantly in this zone, as Sphagnum is almost entirely replaced by Ericaceae and monocotyledons. The dominance of C. vulgaris remains and Ericales rootlets suggests the build-up of a hummock vegetation, with both Eriophorum vaginatum and E. angustifolia also present. At the top of the zone, E. vaginatum dominates the assemblage.

4.4.6. Fingernail samples

The components of these samples (Fig. 4b) confirm that the bog body was deposited in a pool peat. Sphagnum section Cuspidata dominates all samples and comprises 63–82% of the Sphagnum content. Compared to the OC2 plant macrofossil profile, the remains of monocotyledons are more frequent (comprising 4% of peat remains) and E. vaginatum is better represented in two of the samples. The remains of mites and other insects are also more in number, and the leaves of A. polifolia and Vaccinium spp. are recorded. Although the three samples differ slightly from the OC2 sequence, they reflect a pool peat environment similar to that seen in the monolith with some localised differences, as might be expected given that the samples were collected approximately 50 cm away from OC2. On the basis of the consistently high S. section Cuspidata content in the fingernail samples, it is possible, nonetheless, to suggest that the fingernails lay at a level corresponding to between 40 and 47 cm in OC2, after a pool had developed fully and before it began to infill with S. imbricatum.

4.5. Testate amoebae analysis

The testate amoebae assemblages are divided into three zones (Fig. 5). The zones are primarily defined by changes in the two dominant taxa, Amphitrema flavum and A.wrightianum, which together comprise approximately 90% of the tests. More minor taxa also show some differences but numbers are generally low, so these differences should be regarded with some caution, especially
Fig. 4. a. Plant macrofossil diagram from OG2; b. Plant macrofossil diagram from Oldcroghan fingernail samples. + = Present; ++ = occasional; +++ = frequent. The lithological key is presented in Fig 3.
where they are based on only 1–2 specimens representing <1.5% of the assemblage.

4.5.1. OC2-T1 (ca. 380–330 cal BC)
A. flavum is the dominant taxon at the start of the zone, but declines to be co-dominant with A. wrightianum by the end of the zone. There is also a diverse assemblage of eight associated taxa, with Assulina muscorum being the most abundant. As a whole the assemblage suggests a very wet mire surface with a water table just below the surface. Reconstructed water table (RWT) depth declines slightly through the zone with water table rising from 2 cm depth to 0.7 cm depth.

4.5.2. OC2-T2 (ca. 330–200 cal BC)
The transition to OC2-T2 is marked by a switch to dominance by A. wrightianum, with values at 50–60%. A. flavum declines to values of 30–40%. Some of the minor taxa continue to occur (A. muscorum, Centropyxis aculeata type) but others disappear (Arcella discoideus type, Heleopera sphagni). In addition, Arcella articulata type occurs more consistently. Overall there is a decline in diversity. The change in balance of the dominant taxa suggests a change to a shallow pool, with water tables just above the surface. The magnitude of the changes in RWT depth is not large but the indicators are robust. Without exception, A. wrightianum has been shown to be an indicator of shallow pool or very wet lawn conditions and A. flavum is indicative of wet to moist conditions on ombrotrophic peatlands throughout Europe and North America (Booth, 2002; Charman and Warner, 1997; Mitchell et al., 1999; Tolonen et al., 1994; Woodland et al., 1998). Interestingly, A. wrightianum is also a more oceanic taxon and is absent from more continental data in both North America (Charman and Warner, 1992; Warner and Charman, 1994) and Russia (Bobrov et al., 1999), whereas A. flavum is more widely distributed. Conditions during this wet phase are very similar throughout the zone, following the main shift at the start.

4.5.3. OC2-T3 (ca. 200–160 cal BC)
The upper two samples in the sequence show a reversion to similar hydrological conditions to those found in OC2-T1, with a return to very similar values of A. flavum and A. wrightianum. More minor taxa are again present and some of these did not occur in earlier zones (Hyalosphenia ovalis, Nebela militaris) and the overall diversity is lower. Reconstructed water table values show a return to terrestrial conditions with water table 1–2 cm below the surface. As with the earlier transition, the change from OC2-T2 to OC2-T3 is very clear, despite the relatively minor changes in assemblage.

4.6. Coleopteran analysis
Levels of fossil beetle preservation are excellent, usually with chitin still showing original colours and setae, and flimsy specimens intact. Species diversity is rather low, although this not unusual in the context of raised bog peats, which tend to attract highly specialised mire taxa that can tolerate acid conditions (cf. Whitehouse, 2004). The amount of material recovered is comparatively low, but there are sufficient species to provide useful insights into the nature of the contemporary bog environment of Oldcroghan Man. Table 2 presents results in taxonomic order, with minimum number of individuals (MINI) for each taxon and sample, and number of species and Fisher’s α for each sample indicated. Results are described from the oldest sample (OC2-B3: 48–58 cm) to the most recent sample (OC2-B1: 35–39 cm).

OC2-B3 is dominated by species characteristic of ombrotrophic conditions, including the reed beetle Plateumaris discolor, associated with Sphagnum and Eriophorum (Stainforth, 1944) and typical of acid raised bogs (Koch, 1992). Enochrus affinis is similarly characteristic of Sphagnum pools, where it is found in the surrounding wet moss, a habitat also suitable for the Notable B species Helichares punctatus. There is a diverse range of small water beetles, including Hydroopus obscurus which is characteristic of acid, Sphagnum-dominated water bodies (Friday, 1988), although curiously H. palustris is usually not peat inhabiting (cf. Balfour-Browne, 1940). Also present is the distinctive small RDB 2 dytiscid Hydroorus scalesianus, considered typical of floating Sphagnum carpets in continental Europe (Nilsson and Holmen, 1995), although Foster (2000) suggests that in Ireland and Great Britain it is more often characteristic of base-enriched waters in undisturbed fens and

---

**Fig. 5.** Testate amoebae diagram. Rare taxa with all values <1% shown as circles. See text for details of reconstructed water table depth.
carrs. Its recovery in fossil records both here and elsewhere (e.g. Dinnin and Skidmore, 1995; Whitehouse, 2004) associated with other ombrotrophic indicators would tend to confirm that it is an acidophilous taxon. Despite its RDB2 status in Britain, this species seems to be reasonably widespread in Ireland, and is probably not as rare as in Britain where there has been a large decline in its status (Foster, 2000). The absence of large water beetles in the sample would suggest that any areas of open water in this sampling locality were limited in extent and slightly drier, hummocky areas nearby are indicated by the presence of the heather beetle, Micrelus ericae. In terms of species diversity, this sample scored 1 Fisher's $a$, which is extremely low for any fossil assemblage and is likely to indicate the very nutrient-poor nature of the peats at this site.

OC2-B2, which corresponds to the pool peat, shows not only a sharp increase in the diversity and number of beetles, but also some unusual characteristics, which are explored below. The fauna includes species which are present in the previous sample, including many of the small water beetles, such as Hydrochares tristis, a typical bog-loving species, as well as a range of hydrophilids, including Enochrus spp., which may include the RDB3 species, *E. nigritus*. Enochrus species are usually associated with

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Species list of Coleoptera from Old croghan Monolith 2, with MNI and Fisher’s diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample number</td>
<td>OC2-B1</td>
</tr>
<tr>
<td>Depth (cm)</td>
<td>35–39</td>
</tr>
<tr>
<td>Sample volume (l)</td>
<td>2</td>
</tr>
<tr>
<td>Carabidae</td>
<td></td>
</tr>
<tr>
<td>Pterostichus diligens (Strm.)</td>
<td>1</td>
</tr>
<tr>
<td>Pterostichus minor (Gyll.)</td>
<td>1</td>
</tr>
<tr>
<td>Dytiscidae</td>
<td></td>
</tr>
<tr>
<td>Hydrochares spp.</td>
<td></td>
</tr>
<tr>
<td>Hydrochares scalesianus Steph.</td>
<td>2</td>
</tr>
<tr>
<td>Hydrochares ? tristis (Payk.)</td>
<td>1</td>
</tr>
<tr>
<td>Hydrochares ? palustris (L.)</td>
<td>1</td>
</tr>
<tr>
<td>Hydrochares Strm.</td>
<td>15</td>
</tr>
<tr>
<td>Hydrochares spp.</td>
<td>3</td>
</tr>
<tr>
<td>Agabus bipustulatus (L.)</td>
<td>1</td>
</tr>
<tr>
<td>Hydrochares Immerius type (F.)</td>
<td>1</td>
</tr>
<tr>
<td>Limneerus truncatellus (Thun.)</td>
<td>2</td>
</tr>
<tr>
<td>Helophorus sp.</td>
<td>1</td>
</tr>
<tr>
<td>Hydrophilidae</td>
<td></td>
</tr>
<tr>
<td>Helochares punctatus Sharp</td>
<td>2</td>
</tr>
<tr>
<td>Helochares sp.</td>
<td>1</td>
</tr>
<tr>
<td>Enochrus spp.</td>
<td></td>
</tr>
<tr>
<td>Enochrus affinis (Thun.)</td>
<td>1</td>
</tr>
<tr>
<td>Enochrus ? nigritus Sharp</td>
<td>4</td>
</tr>
<tr>
<td>Enochrus spp. (? dominated by nigritus)</td>
<td>4</td>
</tr>
<tr>
<td>Hydrophilidae gen. et sp. indet.</td>
<td>1</td>
</tr>
<tr>
<td>Liodidae</td>
<td></td>
</tr>
<tr>
<td>Agathidium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Staphylinidae</td>
<td></td>
</tr>
<tr>
<td>Aleocharinae gen. indet.</td>
<td>2</td>
</tr>
<tr>
<td>Scirtidae</td>
<td></td>
</tr>
<tr>
<td>Cyphon spp.</td>
<td>1</td>
</tr>
<tr>
<td>Elateridae indet</td>
<td></td>
</tr>
<tr>
<td>Scarabaeidae</td>
<td></td>
</tr>
<tr>
<td>Phyllopertha horticola (L.)</td>
<td>2</td>
</tr>
<tr>
<td>Chrysomelidae</td>
<td></td>
</tr>
<tr>
<td>Donacia impressa Payk.</td>
<td>2</td>
</tr>
<tr>
<td>Plateumaris discolor (Panz.)</td>
<td>2</td>
</tr>
<tr>
<td>Plateumaris sp.</td>
<td>2</td>
</tr>
<tr>
<td>Curculionidae</td>
<td></td>
</tr>
<tr>
<td>Sitona sp.</td>
<td>1</td>
</tr>
<tr>
<td>Micrelus ericae (Gyll.)</td>
<td>1</td>
</tr>
<tr>
<td>Ceutorhynchus sp.</td>
<td>1</td>
</tr>
<tr>
<td>Total species</td>
<td>6</td>
</tr>
<tr>
<td>Total MNI</td>
<td>13</td>
</tr>
<tr>
<td>Fisher’s $a$</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

?, Indicates that the identification is not absolutely certain.
Sphagnum- and detritus-dominated pools, although E. nigritus shows a preference for mesotrophic and base-rich fens (Foster, 2000). It is likely that the extent of aquatic habitats increased during this period, as some large water beetles (e.g. Agabus bipustulatus) are present. This is also attested by the sharp increase in the number of fossils of aquatic and hygrophilous taxa, especially of Enochrus spp. and H. obscurus and other members of the genus. The water may also have had some movement, as Limnethis truncatellus is usually associated with flowing water, although this is not indicated by any other taxa. Aquatic plants are indicated by the phytophagous reed beetles, P. discolor and Donacia impressa. The former is associated with Sphagnum and Eriophorum, and the latter with Scirpus lacustris (Stainforth, 1944). Eriaceae are indicated by the heather beetle, M. ericae, along with Sitona sp. and Cetourynchus sp.

The presence of Phyllopertha hortica, the garden chafer, is a slightly curious find. It is considered a pest, eating leaves on trees, rose flowers and its larvae eat roots in meadows and turf (Horion, 1957). It infests areas in swarms of numbers and can be found in a range of habitats including meadows, woodland margins, hedges and gardens, river floodplains, pine heaths, fields and weedy places (Koch, 1989), but not, notably, raised bogs. Within the palaeoenvironmental record, it is usually considered an anthropogenic indicator of cleared landscapes, especially where recovered in numbers. Its recovery from bog deposits is therefore curious, although it has been recovered singly in such deposits before (e.g. Thorne Moors – see Buckland, 1979; Roper, 1996; Whitehouse, 1997). The two individuals in this sample could be accidental inclusions – the species are strong fliers and may be part of the background fauna – or could be anthropogenic, i.e. associated with deposition of the bog body.

Fisher’s s for this sample rises to 4 and contrasts with diversity levels in the adjacent samples. Kenward (1978) has suggested that an increase in diversity may be due to anthropogenic activity on an archaeological site and it is tempting to interpret this increasing diversity as being associated with the deposition of the bog body.

OC2-B1 includes many of the species found previously (e.g. Enochrus spp., H. tristis, P. discolor) but sees a sharp decrease in MNI and numbers of species. It is clear that ombrotrophic conditions have continued as before, and that aquatic habitats remain important during this phase, although it seems the extent of this habitat had declined compared with previously. There are no large dytiscid beetles, suggesting a reduction in the surface area of aquacultural habitats.

The beetle assemblage from the fingernails samples is unremarkable and is dominated by species of the aquatic genus Enochrus, which, as discussed above, is an important element of OC2-B2, corroborating the suggestion that the fingernails were associated with the pool phase.

5. Discussion

The combined tephra and 14C dating evidence demonstrates that the OC2 profile spans the first millennium BC, incorporating much of the Irish Late Bronze Age, the Bronze Age–Iron Age transition and the Early Iron Age.

The pollen record shows a substantial level of Late Bronze Age activity. Woodland clearances of a comparable scale have been noted elsewhere in Ireland from the beginning of the Late Bronze Age, often within the vicinity of hillforts such as Haughey's Fort, Co. Armagh (Weir, 1993a,b), Mooghaun, Co. Clare (Molloy, 1997; O’Connell et al., 2001), and possibly Ballylin, Co. Limerick (Plunkett, 1999, 2006a). A major phase of activity between 1000 and 800 cal BC at Redbob, Co. Louth (Weir, 1995), is an exception, however, as it commences relatively late (ca. 1000 cal BC) and has not been linked to a hillfort. The level of activity represented in the OC2 pollen record raises interesting questions about the status of Croghan Hill, where the possible remains of a hillfort have been recorded.

This intensive phase of activity in the Oldcroghan pollen record diminishes during the latter centuries of the Late Bronze Age, but it is nevertheless sustained to some extent until the sixth century BC. Lower levels of farming between the ninth and seventh centuries BC have also been noted in other pollen records of this period (e.g. Weir, 1995; O’Connell et al., 2001; Plunkett, 1999), and may reflect decentralisation of population away from what were previously socio-political heartlands and the establishment of a more dispersed settlement pattern (Plunkett, 1999, 2006a). A brief wet phase at the sampling site is recorded by the plant macrofossils at ca. 760 cal BC, which may relate to a more pronounced wet shift recorded elsewhere in Irish bogs at this time (Plunkett, 2006b; Plunkett and Swindles, 2008; Swindles et al., 2007b).

The general demise in anthropogenic indicators in the sixth century BC coincides with the Irish Bronze Age/Iron Age transition period that is still poorly recognised and understood in the archaeological record. Widespread woodland regeneration seems to have occurred at this time through much of Ireland, although infrequent anthropogenic indicators point to continued human impact on the landscape (e.g. Caseldine et al., 1996, 2005; Molloy and O’Connell, 1991; Plunkett, 1999; Weir, 1995). In the OC2 record, this closing up of the landscape includes a substantial rise in Ulmus pollen. Ulmus glabra (wych elm), the species of elm native to Ireland, thrives on rich, non-acid soils which can be found on the higher drylands surrounding Cloneaer Bog.

The plant macrofossil, testate amoebae and coleopteran data all tell a very clear story of a wet lawn surface changing to a pool environment at the bog body’s findspot in the early fourth century BC. In the testate amoebae record, the final transition appears sharp, with the main change taking place between contiguous samples either side of 47 cm, and thus lagging slightly the stratigraphic and plant macrofossil evidence for the emergence of the pool. However, no testate amoebae sample were analysed from below 50–51 cm, so the initial change towards wetter conditions may have been missed. Water table reconstructions suggest a rather shallow pool, with dominant A. wrightianum, a reliable indicator of such conditions. It is not clear if pool development at this time is related to internal bog dynamics or to external factors such as climate change but it is notable that Swindles et al. (2007a) also record a minor wet shift in bogs in the north of Ireland spanning the period between ca. 380 and 260 cal BC. In the OC2 profile, the pool appears to have persisted for approximately 200 yr.

Oldcroghan Man’s association with the pool is firmly demonstrated by plant macrofossil analysis of fingernail samples, and the dating evidence from the OC2 profile indicates that the body was contemporary with this feature. Stratigraphic evidence from the two excavation trenches suggests that the body was inserted close to the northern end of the pool, where the widest pool width was recorded in section. The precise level at which the body lay is not absolutely established in relation to the monolith profile but the combined evidence from the pollen and plant macrofossil content of the fingernail samples suggests that the fingers lay at a level corresponding approximately to ca. 44–45 cm (ca. 290 cal BC). It is conceivable, however, that the body sunk some centimetres into the soft, underlying pool peat (cf. Buckland, 1995), and this should therefore be considered the likely minimum level of the body. It would appear, therefore, that a pre-existing pool of water was selected as the burial site.

The absence of beetle species associated with the decomposition of flesh, such as carrion feeders, suggests that the body was rapidly submerged in wholly anaerobic conditions soon after death. This is consistent with the excellent preservation state of the body (Mulhall, in press; Mulhall and Briggs, 2007), and indicates that the pool was sufficiently deep to cover the remains entirely. There are,
It is therefore in the context of a changing landscape and a new socio-cultural milieu that Oldcroghan Man’s death took place. Numerous bog bodies of comparable date have been recovered from bogs across northwest Europe (see Housley et al., 1995; van der Sanden, 1996), revealing a widespread tradition of burials in these environments. The bodies in question frequently display evidence of excessive violence, and some, such as Lindow II and III (Branch and Scaife, 1995; Dinnin and Skidmore, 1993; Oldfield, et al., 1986; Stead et al., 1986), were deposited within existing bog pools. Oldcroghan Man, along with bog bodies from Gallagh, Co. Galway (Brindley and Lanting, 1995) and more recently, Clonycavan, Co. Meath, demonstrates that Ireland too shared this tradition, indicating that links with Britain or continental Europe were not solely confined to material culture. The reasons behind the prevalence of this practice in the Iron Age are not known, although van der Sanden (1995) speculates that increased social unrest might be a factor. Interestingly, the Lindow bodies, although later in date than Oldcroghan Man, appear to have been deposited at the start of a period of woodland clearance (Branch and Scaife, 1995; Oldfield, et al., 1986), similarly suggesting that their burials date to a period of change in the surrounding landscape.

6. Conclusions

This multi-proxy investigation provides important insights into fluctuating levels of human activity around Clonearl Bog in the centuries prior to, around the time of and after the deposition of Oldcroghan Man in the bog, as well as specific information about the local environmental conditions that existed around the time of burial. The pollen profile reveals a phase of substantial human activity that corresponds to the Irish Late Bronze Age. The landscape at this time was open and pastoral in structure, and some pastoral and arable farming is suggested. The intensity of the clearance phase hints that the area may have been an important centre of population. The most pronounced period of activity comes to an end ca. 842 cal BC, but less intense farming is maintained for a further three centuries. Woodland regeneration is observed, as elsewhere in Ireland, during the Bronze Age–Iron Age transition between 580 and 270 cal BC. It is towards the end of this period that pool formation begins at the findspot of Oldcroghan Man. An examination of plant macrofossil and beetle remains associated with Oldcroghan Man’s fingernails confirms that the body was placed in the pool, and ^14C dating evidence demonstrates that the body and the pool are broadly contemporary, with the body most likely buried during the third century BC. The position of his fingernails and the surrounding stratigraphy of the peat indicate that the remains were placed toward the northern end of the pool, where the pool was at its widest. The testate amoebae and coleopteran assemblages point to a shallow, Sphagnum-dominated pool and there is no indication that the body was exposed on the surface of the bog for even a comparably short period of time.

The pollen record suggests that Oldcroghan Man was buried at a time when human activity was starting to increase in the area surrounding Clonearl Bog. This circumstances relating to the demise of Oldcroghan Man can now be considered within a wider context of landscape clearance and cultural change that accompanied the start of the Early Iron Age in Ireland.

Acknowledgments

This project has been part-funded by the National Museum of Ireland. We are grateful to Dr Siobhán Geraghty, the staff of the National Museum of Ireland and Eachtra Archaeological Projects for their assistance in the field during the course of collecting the monoliths. Fossil insect sorting was undertaken by Dr. Emma Tetlow, now at the University of Edinburgh. Thanks to Dr David Smith,
Author's personal copy