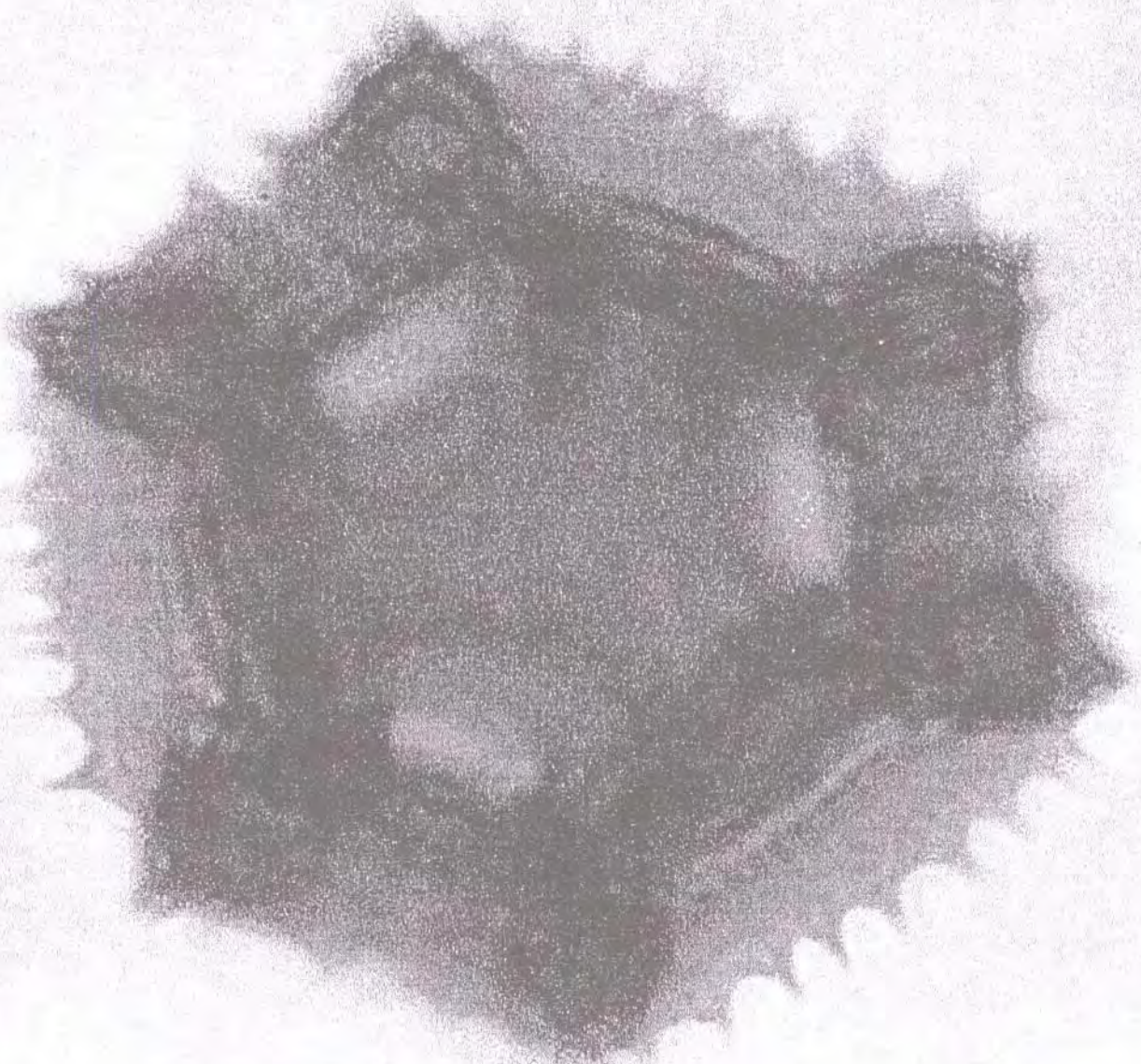
A POLLEN ANALYTIC ASSESSMENT OF SUB-SAMPLES FROM THREE CORES FROM TWMBARLWM, RISCA, SOUTH WALES



F.R.GRANT

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Contained within this report:

1. Introduction

This report describes a preliminary palaeoecological assessment of sub-samples from three cores extracted from the area of Twmbarlwm hill, north-east of Risca, South Wales. It outlines the field and laboratory procedures, and discusses the results of the analysis.

In 2019 the author was commissioned by the Clwyd-Powys Archaeological Trust (CPAT) on behalf of Cymdeithas Twmbarlwm Society, to extract cores for palaeoenvironmental assessment of peat deposits on and around the scheduled monument MM044 Twm-Barlwm Mound and Bailey Castle. The programme of palaeoenvironmental work was undertaken in order to enhance the understanding of the broader environment of the monument, and to identify any significant changes the area has undergone prior to and through the existence of the monument. Severe fires in 2018 caused significant damage to the vegetation and soil cover within the scheduled area, and this has further prompted the need for archaeological and palaeoenvironmental mitigation projects.

General Site Description

The monument lies within the community of Risca, in Caerphilly. It is believed to comprise the remains of a medieval motte and bailey castle, but this may have been constructed on the site of an earlier, prehistoric hillfort. It consists of a large, conical, flat-topped mound situated at the eastern end of an oval enclosure. Other features, including possible cultivation ridges, have been recorded in the interior.

2. Laboratory and Fieldwork Procedures

Fieldwork

Sampling took place on 21st October 2019. Two areas in particular had originally been suggested for palaeoenvironmental sampling; namely a "pond" in the northern part of the interior, and the lower ground on the ridge to the east and north-east of the motte. Unfortunately the pond was dry, and appears to have been regularly cleared with virtually no organic material suitable for sampling being present. Similarly, the area to the east and north-east was much disturbed, and contained no deposits deeper than 0.2m.

Using local knowledge, map evidence, and identifying areas of wetland vegetation, several potentially suitable sampling sites were located, within 1km of the monument. Although none contained significantly deep deposits (of 1m or more), sampling took place at three of these sites, identified as A, B & C. Depending upon the nature and depth of the material, cores were extracted using an Eijkelkamp auger and a Russian corer. The samples were immediately wrapped in cling-film, labelled, and covered in black plastic before being transported to cold storage. A photographic record of the area and the process involved was maintained.

Laboratory Treatment

The three cores were cleaned and a visual stratigraphic description was compiled. Ten 1cm samples for pollen analysis were extracted at regular intervals throughout the core. The pollen samples were prepared using standard techniques (Moore et al., 1991), including HCl to remove carbonates, micro-sieving through a mesh aperture of 10µ, HF digestion to remove silicates, and acetolysis to digest organic matter. A known quantity of Lycopodium spores were added to each sample to enable the calculation of pollen concentrations within the samples (Stockmarr 1971). The residues were mounted in silicon oil. Counting and identification was carried out using an Zeiss Axiolab at x400 magnification, and with the aid of a reference collection of type slides, online pollen image databases, and the pollen and spore key in Moore et al. (1991). Within the text the most likely genera or species is identified

in brackets, where this may help the discussion. This identification is based on the pollen evidence and that of the modern distribution. The nomenclature used is principally that of Bennett (1984), with additional notes from Moore et al. (1991).

An assessment level count of 100 pollen grains (excluding aquatics) plus spores, was aimed for. If concentrations were extremely poor the count was continued until 100 Lycopodium spores were recorded.

Microscopic charcoal

Microscopic charcoal particles were counted as they were encountered during the general pollen count.

The results for each sampling site are described, either on a sub-sample by sub-sample basis, or where it aids the description, as a grouped set of sub-samples. This is a descriptive device only, and whilst some similarity in vegetation and land-use may be inferred within the groupings, the sampling interval within this assessment may conceal hitherto unidentified changes.

3. Results

Twmbarlwm A

The soils on the hilltop, within the enclosure, are generally shallow, and have been extensively damaged by the fire. However, a small, isolated area of blanket peat, undamaged by burning, was identified slightly upslope to the south of the pond (grid reference ST2421 9261). Probing revealed a depth of material of approximately 0.25m. This area of blanket peat extended approximately 24m north-west to south-east to the pond edge x 9m north-east to south-west, and appears to represent accumulation within a shallow basin. The vegetation community is typical M17 *Scirpus (Trichophorum) cespitosum – Eriophorum vaginatum* blanket mire (Elkington et al. 2001, 40; Rodwell 1991), consisting of *Trichophorum cespitosum* (common deergrass), and *Eriophorum angustifolium* and *E.vaginatum* (cottongrass), all members of the sedge family (Cyperaceae) and *Sphagnum* spp. (bog moss). The surrounding, drier, area is characterised by *Molinia coerulea* (purple moor-grass) with *Vaccinium myrtillus* (bilberry).

Sampling took place at ST24210 92618.

Depth	**Description**
0-0.04m.	Active layer - *Sphagnum* spp.
0.04-013m.	Well humified dark black-brown moss peat
0.13-0.15m.	Mid brown sandy-silt
0.15- 0.21m.	Light brown sand

Figure 1: Profile Stratigraphy Sample A

Sub-sampling took place to 0.15m. Close interval (every 1cm) sub-sampling between 0.08-0.15m allows a continuous curve to be attained for this part of the core. Pollen was well preserved in all of the samples, and assessment level counts of 100 total land pollen (TLP) grains were achieved. The results of the initial assessment are presented in Appendix 1.

0.08-0.15m:

Arboreal pollen (AP) generally demonstrates an increasing trend from the base of the core to peak at 0.08-0.09m at *c.*16% TLP. *Betula* (birch) and *Alnus glutinosa* (alder) are the dominant species, although *Quercus* (oak) appears at 0.10-0.11m. The trend for *Alnus glutinosa* is one of general decline though time, (albeit with some fluctuation). Shrub pollen is dominated by that of *Corylus* t. (including *Myrica gale;* bog myrtle, and *Corylus avellana*; hazel), although *Lonicera* (honeysuckle),) and *Hedera* (ivy), make occasional sporadic appearances. *Corylus* t. is generally consistent at between 20-30% TLP, aside from a decline at 0.10-0.11m to *c.*13%.

Heath pollen is dominated by *Calluna* (heather). At the base of the profile, heaths form *c.*41-46% TLP. They then decline dramatically to around 10% TLP before exhibiting a moderate increase at 0.08-0.09m.

Open area species are demonstrated by the presence of Poaceae pollen (grass), Cyperaceae (sedge) and other herb species. Values for Poaceae generally increase from the base of the profile, forming a peak at 0.11-0.12m at almost 50% TLP, before declining again. Cyperaceae values reflect a generally similar pattern. Other herb pollen identify species typical of a upland grassland, and from low levels of less than 5% through the majority of the lower part of the profile, begin to increase to above 10% by 0.08-0.09m. *Plantago lanceolata* (ribwort plantain) is the most prevalent herb, although Rubiceae (bedstraws) and Lactuceae (e.g. dandelion, sow thistle), *Potentilla*-type (tormentil) and *Cirsium* (thistle) are also recorded in more than single grains. A single large grass grain was recorded in the lowest sub-sample at 0.14-0.15m. *Pteridium aquilinum* (bracken) spores appear only sporadically and in very low values.

Microscopic charcoal values fluctuate at relatively low levels until a consistent rise is depicted from 0.10-11 to peak at 0.08-0.09m.

0.06-0.07m:

AP maintains its highest levels in this sub-sample, at *c.*16% TLP, with *Quercus* pollen peaking at the expense of *Alnus glutinosa.* *Corylus* represents *c.*20%, and values for heaths are low, forming only 6%.

Herbs form *c.*52% TLP, and whilst Poaceae dominates this spectrum, other herbaceous species are important, forming almost 20%. *P.lanceolata* is particularly important, but *Potentilla,* Lactuceae, Rubiaceae and *Urtica dioica* (nettle) amongst others, are all represented. Cyperaceae values are relatively low. Two large grass, possible cereal, pollen grains were identified in this sub-sample. Microscopic charcoal values are moderate. *P.aquilinum* spores comprise *c.*2%.

0.04-0.05m:

AP values have fallen slightly in this sub-sample to *c.*13% TLP, but *Betula* remains dominant, with *Quercus.* Values for *Alnus glutinosa* are low. Single grains each of *Tilia* (lime) and *Prunus* (possibly *P.spinosa* blackthorn) were also recorded. *Corylus* is represented only at low levels in this sub-sample, forming only 5% TLP. A single grain of *Salix* (willow) was also recorded.

Heaths dominate, forming over 60% TLP, whilst herbaceous species form less than 20%. In addition to Poaceae, and of lesser importance Cyperaceae, *P.lanceolata* and Rubiaceae predominate the herbs. Microscopic charcoal values are low. *P.aquilinum* spores comprise *c.*2%.

0.02-0.03:

In this uppermost sub-sample, AP values are very low, amounting to less than 5% TLP. *Pinus* (pine) appears, represented by a single grain. Shrub values are similarly very low. Heaths dominate again, forming *c.*65% TLP, whilst herbaceous species remain just under 20%. Microscopic charcoal values are moderately high. *P.aquilinum* spores comprise *c.*2%.

Twmbarlwm B

A confined area of blanket mire was identified at ST2491 9284, on sloping ground *c.*0.5km to the north-east of the monument. This was sited immediately adjacent to a fence-line dividing the open area to the north and west, from a coniferous forestry plantation to the south and east. Mire vegetation consisted of *T. cespitosum*, *E. angustifolium*, Sphagnum spp. within an area of *P.aquilinum* (bracken), with occasional *Ulex europaeus* (gorse). A mature *Fagus sylvatica* (beech) tree was located on the fence-line to the north-east.

The area of waterlogged organic deposition extended for approximately 38m south-west to north-east, and *c.*7m north-west to south-east. Probing identified deposits of up to 0.25m deep. A single core was extracted using the Russian corer from the deepest part at 324917 192849

Depth	**Description**
0-0.10m.	Well humified *Sphagnum* sp. (moss) peat
0.10-013m.	Dark brownish-black, rooty
0.13-0.15m.	Dark blackish-brown, organic-rich soil
0.15- 0.18m.	Homogenous brownish-black organic-rich soil
0.18-0.25m.	Yellowish-brown mineral soil

Figure 2: Profile Stratigraphy Sample B

Sub-sampling took place to 0.20m. Pollen was well preserved in all of the samples, and assessment level counts of 100 total land pollen (TLP) grains were achieved. The results of the initial assessment are presented in Appendix 2.

0.19-0.20m:

AP forms *c.*17% TLP in this basal sub-sample, and of this *Betula* and *Quercus* are the dominant species. *Pinus, Ulmus, Fraxinus,* and *Alnus glutinosa* are also represented in very low quantities. *Corylus* forms *c.* 14%, whilst values for heaths are negligible, represented by a single grain of *Calluna vulgaris* pollen. Herbs forms almost 60% TLP,

comprising predominantly Poaceae (*c.*29%) and Cyperaceae (*c*16%), but also recording *P. lanceolata, Rumex acetosella* (sheep's sorrel)*, Ranunculus*-type (buttercups), Lactuceae, *Achillea*-type (includes yarrow) and *U.dioica.*
P.aquilinum is recorded at *c.*30% TLP. Values for microscopic charcoal are low.

0.17-0.07m:
Herbs continue to dominate the pollen profile, achieving values of between 60-75% TLP. Cyperaceae becomes less important mid-profile, whilst values for Poaceae climb to peak at 0.15-0.16m at *c.*60% TLP.

Through much of this part of the profile AP fluctuates between 20-30% TLP, although there is a decline at 0.16-0.17m and a modest increase to *c.*35% at 0.11-0.12m. An expansion in *Quercus* and *Betula* appears to be responsible for the increase in AP at this point. *Larix*-type (includes *Pseudotsuga* (Douglas Fir)) and *Pinus* were recorded throughout, with *Fagus* appearing at 0.15-0.16m and being generally present thereafter. *Corylus* and heath species appear relatively unimportant in the pollen spectrum, with *Corylus* below 10% throughout, and heaths essentially absent.

P.aquilinum is present in fluctuating, and often relatively high, quantities aside from at 0.13-0.14m when it drops to a very low level. From 0.07m microscopic charcoal deposition appears to follow a generally increasing trend, aside from a slight reduction at 0.14-0.15m.

0.03-0.04m:
AP increases to *c.*40% TLP in this uppermost sub-sample, with *Larix*-type, *Fagus, Betula, Quercus* and *Pinus* all represented relatively equally. *Corylus* remains low. Herbs have fallen to just over 50% TLP. Poaceae remains the dominant herbaceous species, but Cyperaceae has increased in importance, with other herbs such as Rubiaceae, *P.lanceolata, R.acetosella, Ranunculus*-type, Lactuceae, *Achillea*-type also represented. Values for *P.aquilinum* have declined in this uppermost sub-sample, as has microscopic charcoal deposition.

Twmbarlwm C

A small, spring-fed mire was identified on a shelf downslope to the east of the monument at ST24597 192669 (centred). Probing revealed a depth of material of up to 0.35m, extending for approximately 70m north-west to south-east, and *c.*25m south-west to north-east, although the area of deeper, *Sphagnum*-rich mire, was somewhat more confined. A single core was extracted using the Russian corer from the deepest part at ST24598 192661. The vegetation consisted of patches of willow scrub (*Salix* cinerea) on a *Sphagnum*-rich mire, containing *S. papilosum* (Papillose), *S. subnitens* (Lustrous), *S.capillifolium* (Acute-leaved), and *S.fallax* (Flat-topped). The sloping ground below the enclosure is dominated by a *P. aquilinum* and *M. coerulea* community on acidic podzolic soils.

Depth	**Description**
0-0.03m.	Active layer – unhumified *Sphagnum* sp.
0.03-0.09m.	Dark brownish-black, moderately humified moss peat
0.09-0.13m.	Dark brownish-black, well-humified moss peat
0.13- 0.19m.	Dark blackish-brown well humified moss peat
0.19-0.23m.	Mid brown homogenous organic-rich silt
0.23-0.26m.	Dark brown well-humified peat
0.26-0.31m.	Greyish-brown mottled organic-rich soil
0.31-0.36m.	Dark brown organic-rich soil

Figure 2: Profile Stratigraphy Sample C

Sub-sampling took place to 0.33-0.34m. Pollen was well preserved in all of the samples, and assessment level counts of 100 total land pollen (TLP) grains were achieved. The results of the initial assessment are presented in Appendix 3.

0.33-34 – 0.23-0.24m

These sub-samples are dominated by arboreal and shrub pollen, together averaging between *c*70 and 90% TLP. Of the tree species *Betula* and *Alnus glutinosa* predominate, although *Quercus* and *Tilia* are represented, and in lesser quantities, *Ilex-*

type (holly), *Pinus, Prunus.* A single grain of *Fagus* (beech) was recorded at 0.23-024m. *Corylus* dominates the shrubs, although *Salix* and *Lonicera* were also present.
At 0.33-0.34m and at 0.23-0.24m herbs form just over 20% TLP. These increases are owing to increased Poaceae pollen. Elsewhere in these sub-samples Poaceae is generally less important, with herbs such as *R.acetosella, P.lanceolata, Filipendula ulmaria* (meadowsweet), Lactuceae and *Ranunculus*-type forming much of the herbaceous pollen spectrum. *U.dioica* becomes important in the upper samples, and *Rosa* (e.g: field rose), *Achillea*-type, *Artemisia* (mugworts), Rubiaceae, Apiaceae (parsleys) and *Calystegia* (bindweed) appearing as single grains. Cyperaceae never forms more than 5% TLP. Large grass grains were recorded at 0.25-0.26m and 0.23-0.24m; one of which was identified as *Avena*-type (oat).

Heaths and *P.aquilinum* appear insignificant in this part of the profile. Microscopic charcoal deposition is low, until a moderate peak at 0.23-0.24m.

0.19-0.20m:
Although AP and shrub pollen still dominate in this sub-sample, heaths have increased to *c.*10%TLP, at the expense of herbs. The herbaceous flora is represented essentially by Poaceae and Lactuceae. *P.aquilinum* remains insignificant, and microscopic charcoal deposition is low.

0.15-0.16m – 0.02-0.03m:
Values for AP are generally reduced in this part of the profile, falling initially to below 20% TLP. However, *Pinus* appears to demonstrate an increasing trend to the top of the core. Similarly *Corylus* and *Salix* reduce dramatically after 0.15-0.16m. Herbs however, increase dramatically to form around 50 % TLP, primarily owing to increases in Poaceae and Cyperaceae but also other herbs such as Lactuceae which increases to form *c.*10% TLP. Heaths reduce slightly, then fall to very low levels in the uppermost two sub-samples from the core. *P.aquilinum* becomes important initially, forming between 10-20% TLP. However, it too appears to suffer a decline, represented by a single spore only in the uppermost sub-sample.

Microscopic charcoal deposition increases dramatically, attaining a maximum at 0.10-0.11m before declining again. Spherical carbonaceous particles (SCP), associated with the burning of fossil fuels, were also identified within this sub-sample.

4. Interpretation of Results

Many factors may affect pollen and microscopic charcoal deposition and preservation, and any conclusion based on their analysis must take these factors into account. For example; the type and quantity of pollen produced varies from species to species, (partly dependent upon whether it is wind or insect pollinated). The geographic origin of deposited material varies depending upon the size of the mire (Jacobsen & Bradshaw, 1981). A spring-fed mire may have other inputs and suffer disturbance, in variation to a purely ombrotrophic, rain-fed mire. Accumulation rates for organic material accumulation can vary considerably.

The spatial extent of the mire deposits sampled from the Twmbarlwm area, and the site to site variation in the pollen recorded within them, suggests they may predominantly reflect local and ultra-local pollen rain. This therefore means they are most useful for describing vegetation change within the immediate locale of the sampling site, with a lower, more reduced regional input. Twmbarlwm C is slightly larger in extent and may thus contain a slightly greater proportion of input from a wider area.

Unfortunately none of the mires identified contained particularly deep deposits, and the temporal range for the record they contain is therefore likely to be limited to the later historical periods. A very slow accumulation rate may however extend this somewhat. No clear key vegetation markers were identified within any of the assessed samples, aside from the presence of SCPs in Twmbarlwm C. There are possible broad correlations inferred between some aspects of the pollen records, particularly for Twmbarlwm A and C. For example, both profiles appear to demonstrate a period of bracken expansion, occurring generally as deciduous

woodland declines. Further analysis would be required to investigate such possible correlations further.

Twmbarlwm A, from within the hillfort enclosure itself, was unfortunately particularly shallow. This shallowness did however allow relatively close interval sub-sampling to take place in this assessment, and the resultant record demonstrates consistency, implying the deposit has not been disturbed. Unsurprisingly, given the shallowness of the deposit, anthropogenic indicators are present throughout, demonstrating human activity in the area.

The lowest part of the profile, reflecting the oldest deposits sub-sampled, demonstrates a local landscape dominated by heathland, with moderate areas of grassy open areas, and hazel scrub. There then follows a period of grassland expansion, with a consequent reduction in heathland. Wooded areas also begin to expand, probably reflecting a more regional expansion in oak-birch woodland. Mid profile a period of higher levels of microscopic charcoal occurs, implying burning of the local vegetation. A reduction in alder and sedge pollen hint at increased dryness, with a possible short-lived expansion of drier heath. Bracken growth begins to increase after this burning episode. A peak in grass and herbs occurs at 0.06-0.07m, demonstrating increased areas of open grassland. Coupled with the appearance of large grass grains, this may suggest cereal cultivation locally, although the herb assemblage may equally imply increased pastoralism and grazing activity. The uppermost part of the profile demonstrates the landscape seen within and in the immediate environs of the monument today, dominated by upland heathland.

The profile from Twmbarlwm B depicts a local landscape of open grassland with fluctuating expanses of bracken, and low levels of heath, in the immediate area. Wooded areas are identified throughout, and generally display an increasing trend. Pollen indicating larch and/or Douglas Fir, and pine is present throughout the majority of the profile, identifying the coniferous plantation in the immediate vicinity of the sampling site. The beech pollen recorded probably reflects the presence of the beech tree currently growing close to the sampling site. Microscopic charcoal

deposition is relatively high throughout, albeit with some variation. The location of the sampling point to the east of the dry heathland upland may account for the high levels of microscopic charcoal deposition on account of the prevailing wind.

Twmbarlwm C, is the deepest core, and as such it is probable that the information it contains covers the longest time period. It does appear to contain a consistent record of change for the local vegetational history. The current counting levels of this assessment and the wider sampling regime employed for this profile may however mask significant vegetational changes. The presence of spherical carbonaceous particles (SCPs) in an upper sub-sample provides a proxy date for this part of the profile. Deposition of such particles begins in the mid nineteenth century AD, with a rapid increase in the mid twentieth century AD.

The lower part of the profile appears to describe a predominantly wooded local landscape, of hazel, birch, alder, oak and lime, holly, with only limited open grassy areas. There are disturbance indicators in the herb flora, implying human activity in the locale. Large grass grains were recorded in very low numbers towards the end of this phase, including a single grain referable to *Avena*-type, which suggests cultivation (or cereal processing) was taking place close by. There appears to be little burning in the local area, as microscopic charcoal deposition is low.

A period of heath expansion follows, with increased burning evident and an expansion of bracken, suggesting a change in landscape use.

The appearance of SCPs coincides with the increase in *Pinus* pollen and the appearance of *Larix*-type, resulting from the later post-Medieval and industrial period conifer plantations. Grassland expansion is evident in the upper part of the profile.

5. Conclusions and Recommendations for Further Work

The material from Twmbarlwm A is valuable in that it is the only material to originate from within the monument itself. It is unfortunate therefore that it is so shallow. However, despite it shallowness, it is intriguing, as it appears to depict vegetation change more varied than may be expected from a deposit of the very latest historical origin. If peat accumulation has been particularly slow in this area it is possible that a greater temporal range is represented than may be expected in such a shallow profile. A spot sample submitted for radiocarbon dating would allow an assessment of the age of the material being analysed. Should additional information then be desired regarding the time period identified, further close interval sub-sampling may be carried out, to include sub-sampling of the very lowest material, up to 0.20m, and full counts of 4-500 grains.

No further work is suggested for Twmbarlwm B, as it appears to reflect the very latest period of history, following the introduction of coniferous plantations in the area.

There may also be some value in further investigating the material from Twmbarlwm C as it appears to reflect the greatest amount of change within the local vegetation, and probably the longest time period. As with Twmbarlwm A, a basal sub-sample submitted for radiocarbon dating would allow the profile to be more closely dated, (in addition to the proxy date suggested by the occurrence of SCPs.) Once the time period encompassed within the profile can be ascertained, a decision can be made as to whether additional pollen analysis is desirable. This would include closer interval sub-sampling, and a full pollen count of 4-500 grains.

6. Acknowledgements

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Appendix 1: Tabulated Data – Twmbarlwm A

Actual Pollen Count

Depth (m)	Betula	Alnus glutinosa	Quercus	Pinaceae	Tilia	Sorbus-type	Prunus
0.02-0.03	2	1	1	1	0	0	0
0.04-0.05	13	5	7	0	1	0	1
0.06-0.07	7	3	11	0	0	0	0
0.08-0.09	8	11	3	0	0	0	0
0.09-0.10	14	6	4	0	0	2	0
0.10-0.11	4	6	1	0	0	1	0
0.11-0.12	7	4	0	0	0	0	0
0.12-0.13	4	5	0	0	0	0	0
0.13-0.14	4	0	0	0	0	0	0
0.14-0.15	1	8	0	0	0	0	0

Depth (m)	Corylus avellana-type	Hedera	Lonicera	Salix	Erica-undiff	Calluna
0.02-0.03	5	0	0	0	2	72
0.04-0.05	11	0	0	1	5	126
0.06-0.07	20	0	0	0	0	8
0.08-0.09	32	1	2	0	0	31
0.09-0.10	49	0	0	0	0	15
0.10-0.11	25	0	0	0	0	13
0.11-0.12	13	0	0	0	0	13
0.12-0.13	33	0	1	0	1	11
0.13-0.14	28	0	0	0	5	37
0.14-0.15	22	0	0	0	0	51

Depth (m)	Cereal-type	Poaceae	Cyperaceae	Plantago lanceolata	Ranunculus-type	Rosaceae-undiff	Alchemilla-type
0.02-0.03	0	14	5	2	0	0	0
0.04-0.05	0	17	9	7	0	0	0
0.06-0.07	2	37	8	11	0	1	0
0.08-0.09	0	28	6	2	0	1	1
0.09-0.10	0	53	19	6	0	0	0
0.10-0.11	0	48	9	0	2	0	0
0.11-0.12	0	49	15	1	0	0	0
0.12-0.13	0	38	13	1	0	0	0
0.13-0.14	0	19	3	2	0	0	0
0.14-0.15	1	17	5	3	0	0	0

Depth (m)	Potentilla-type	Hypericum perforatum-type	Lactuceae undiff	Cirsium-type	Achillea-type	Rubiaceae-undiff
0.02-0.03	0	0	0	0	0	0
0.04-0.05	0	0	1	0	0	5
0.06-0.07	2	1	2	0	0	3
0.08-0.09	0	1	4	3	1	3
0.09-0.10	1	0	1	2	0	1
0.10-0.11	0	0	0	0	0	1
0.11-0.12	0	0	0	0	0	0
0.12-0.13	0	0	0	0	0	3
0.13-0.14	0	0	0	0	0	1
0.14-0.15	0	0	0	0	0	0

Depth (m)	Caryophyllaceae undiff.	Urtica dioca	Lycopodium	Charcoal
0.02-0.03	0	0	12	89
0.04-0.05	0	0	6	16
0.06-0.07	1	2	4	39
0.08-0.09	0	0	6	160
0.09-0.10	0	0	9	177
0.10-0.11	1	0	5	61
0.11-0.12	0	0	7	46
0.12-0.13	0	0	2	16
0.13-0.14	0	0	7	31
0.14-0.15	1	0	9	23

Depth (m)	Pteridium	Pteropsida monolete indet.	Polypodium	Pteropsida trilete indet.	Concealed /Crumpled	Degraded
0.02-0.03	2	1	0	0	5	3
0.04-0.05	5	5	0	3	2	1
0.06-0.07	2	0	2	1	4	5
0.08-0.09	1	4	2	0	1	1
0.09-0.10	2	3	4	1	1	2
0.10-0.11	0	4	0	0	1	1
0.11-0.12	1	0	2	0	1	1
0.12-0.13	0	2	9	0	1	1
0.13-0.14	1	2	6	0	1	2
0.14-0.15	0	4	4	0	1	1

Appendix 2: Tabulated Data – Twmbarlwm B

Actual Pollen Count

Depth (m)	Betula	Alnus glutinosa	Quercus	Pinaceae	Fraxinus	Ulmus	Larix -type	Populus	Fagus	Acer campestre
0.03-0.04	12	1	12	8	0	0	11	2	12	0
0.07-0.08	2	3	3	1	0	0	3	0	2	0
0.09-0.10	2	0	11	3	0	0	1	0	0	2
0.11-0.12	9	3	11	2	0	0	5	0	2	0
0.13-0.14	7	0	7	4	0	0	5	0	0	2
0.14-0.15	3	1	4	0	1	0	14	0	3	0
0.15-0.16	4	1	8	2	1	0	1	0	7	0
0.16-0.17	3	0	3	1	0	0	2	0	0	0
0.17-0.18	2	2	6	1	0	0	10	0	0	0
0.19-0.20	5	1	4	2	1	1	0	0	0	0

Depth (m)	Corylus avellana-type	Viburnum opulus	Lonicera	Salix	Erica-undiff	Calluna
0.03-0.04	3	0	0	1	1	0
0.07-0.08	4	0	0	0	0	0
0.09-0.10	3	0	0	0	0	1
0.11-0.12	2	0	0	0	0	0
0.13-0.14	4	0	0	2	0	0
0.14-0.15	4	1	0	0	0	0
0.15-0.16	5	0	0	0	0	0
0.16-0.17	2	1	0	0	0	0
0.17-0.18	1	0	0	1	0	0
0.19-0.20	12	0	0	2	0	1

Depth (m)	Poaceae	Cyperaceae	Cannabis-type	Rumex acetosella	Plantago lanceolata	Ranunculus-type	Rosaceae-undiff
0.03-0.04	56	13	0	2	1	2	0
0.07-0.08	31	7	0	0	0	1	0
0.09-0.10	44	1	0	1	2	3	1
0.11-0.12	48	4	0	0	2	1	0
0.13-0.14	42	1	0	1	2	2	0
0.14-0.15	42	9	0	0	2	1	0
0.15-0.16	60	4	0	0	3	2	0
0.16-0.17	46	7	0	1	5	1	0
0.17-0.18	34	17	0	2	2	2	0
0.19-0.20	24	13	0	1	5	1	0

Depth (m)	Hypericum perforatum-type	Hypericum elodes type	Lactuceae undiff	Artemisia-type	Cirsium-type	Achillea-type	Rubiaceae-undiff
0.03-0.04	0	0	0	0	0	1	1
0.07-0.08	0	0	0	0	0	0	0
0.09-0.10	0	0	0	0	0	0	0
0.11-0.12	0	0	0	0	0	0	0
0.13-0.14	1	0	1	0	0	0	0
0.14-0.15	0	0	0	0	0	0	0
0.15-0.16	0	0	0	0	0	0	0
0.16-0.17	0	0	2	0	1	1	0
0.17-0.18	0	0	3	1	0	4	1
0.19-0.20	0	0	2	0	0	2	0

Depth (m)	Caryophyllaceae undiff.	Urtica dioca	Narthecium ossifragum
0.03-0.04	0	0	0
0.07-0.08	0	0	0
0.09-0.10	1	0	0
0.11-0.12	0	0	0
0.13-0.14	0	0	0
0.14-0.15	0	0	3
0.15-0.16	0	0	0
0.16-0.17	0	1	0
0.17-0.18	0	0	0
0.19-0.20	0	1	0

Depth (m)	Pteridium	Pteropsida (monolete) indet.	Polypodium	Pteropsida (trilete) indet.	Sphagnum	Concealed /Crumpled	Degraded
0.03-0.04	7	1	0	3	1	3	2
0.07-0.08	32	6	0	0	0	2	1
0.09-0.10	62	3	0	0	0	4	1
0.11-0.12	41	6	0	0	0	2	1
0.13-0.14	7	3	0	0	0	1	1
0.14-0.15	54	5	0	0	0	5	2
0.15-0.16	17	8	0	0	0	1	1
0.16-0.17	43	3	1	3	0	5	3
0.17-0.18	76	4	0	0	0	1	2
0.19-0.20	25	2	7	3	0	4	1

Depth (m)	Lycopodium	Charcoal
0.03-0.04	133	52
0.07-0.08	60	206
0.09-0.10	34	201
0.11-0.12	67	199
0.13-0.14	105	100
0.14-0.15	65	67
0.15-0.16	64	158
0.16-0.17	62	92
0.17-0.18	28	85
0.19-0.20	33	29

Appendix 3: Tabulated Data – Twmbarlwm C

Actual Pollen Count

Depth (m)	Betula	Alnus glutinosa	Quercus	Pinaceae	Tilia	Larix-type	Fagus	Ilex	Acer campestre	Prunus
0.02-0.03	9	6	4	16	0	4	6	0	0	0
0.05-0.06	3	4	9	10	0	2	3	0	1	0
0.10-0.11	5	1	1	5	0	2	0	0	0	0
0.15-0.16	7	3	5	2	0	0	0	0	0	0
0.19-0.20	26	6	2	1	1	0	0	0	0	0
0.23-0.24	22	14	3	2	0	0	1	1	0	0
0.25-0.26	31	15	6	0	1	0	0	2	0	0
0.28-0.29	20	36	7	0	6	0	0	0	0	0
0.31-0.32	46	14	6	0	3	0	0	1	0	1
0.33-0.34	33	16	7	1	0	0	0	0	0	0

Depth (m)	Corylus avellana-type	Sambucus nigra	Lonicera	Salix	Erica-undiff	Calluna	Cereal-type	Avena-type
0.02-0.03	3	0	0	0	1	0	0	0
0.05-0.06	5	0	0	0	1	0	0	0
0.10-0.11	6	1	0	0	0	8	0	0
0.15-0.16	14	0	0	4	0	7	1	0
0.19-0.20	39	0	0	4	2	9	0	0
0.23-0.24	43	0	1	2	0	2	1	0
0.25-0.26	43	0	2	7	1	3	1	1
0.28-0.29	34	0	0	0	2	0	0	0
0.31-0.32	46	14	6	0	3	0	0	1
0.33-0.34	33	16	7	1	0	0	0	0

Depth (m)	Poaceae	Cyperaceae	Rumex acetosella	Plantago lanceolata	Ranunculus-type	Rosa	Filipendula	Potentilla-type
0.02-0.03	60	6	0	1	2	0	1	0
0.05-0.06	55	7	2	0	0	0	1	0
0.10-0.11	59	9	0	2	2	0	0	1
0.15-0.16	23	11	2	3	1	1	0	0
0.19-0.20	10	1	0	0	0	0	0	0
0.23-0.24	16	7	0	2	3	0	0	0
0.25-0.26	9	4	0	2	1	1	0	0
0.28-0.29	4	3	0	0	0	0	0	0
0.31-0.32	2	0	2	2	1	0	1	0
0.33-0.34	18	4	2	2	0	0	3	0

Depth (m)	Hypericum perforatum-type	Lactuceae undiff	Artemisia-type	Achillea-type	Centaurea nigra	Apiaceae-undiff	Rubiaceae-undiff
0.02-0.03	0	0	0	0	0	0	0
0.05-0.06	0	0	0	0	0	0	7
0.10-0.11	1	0	0	0	2	0	0
0.15-0.16	1	10	0	0	0	1	0
0.19-0.20	0	5	0	0	0	0	1
0.23-0.24	0	0	0	0	0	0	0
0.25-0.26	0	5	0	0	0	0	0
0.28-0.29	0	0	0	0	0	0	0
0.31-0.32	0	4	1	0	0	1	0
0.33-0.34	0	1	0	1	0	0	1

Depth (m)	Veronica-type	Urtica dioca	Calystegia
0.02-0.03	0	0	0
0.05-0.06	2	0	0
0.10-0.11	0	2	0
0.15-0.16	0	4	0
0.19-0.20	0	0	0
0.23-0.24	0	2	0
0.25-0.26	0	3	0
0.28-0.29	0	1	0
0.31-0.32	0	0	1
0.33-0.34	0	0	0

Depth (m)	Pteridium	Pteropsida (monolete) indet.	Polypodium	Pteropsida (trilete) indet.	Sphagnum	Concealed/ Crumpled	Degraded
0.02-0.03	1	3	0	0	0	2	1
0.05-0.06	10	4	0	0	0	1	1
0.10-0.11	19	3	1	0	7	5	2
0.15-0.16	10	0	0	0	2	2	1
0.19-0.20	1	8	3	0	2	4	2
0.23-0.24	0	5	5	0	0	5	2
0.25-0.26	2	11	13	0	0	3	1
0.28-0.29	1	36	22	0	0	3	2
0.31-0.32	4	9	9	0	2	9	2
0.33-0.34	1	8	15	1	3	8	1

Depth (m)	Lycopodium	Charcoal
0.02-0.03	30	24
0.05-0.06	15	77
0.10-0.11	7	115
0.15-0.16	15	10
0.19-0.20	6	3
0.23-0.24	3	30
0.25-0.26	7	3
0.28-0.29	3	4
0.31-0.32	3	8
0.33-0.34	6	3