Pollen Analysis from Achtercairn 2 & 3, Gairloch, Wester Ross, Highlands

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1. Introduction

Key-hole excavation of a hut circle at Achtercairn 2, Gairloch, Wester Ross (NG 8077 7693) was undertaken through the Wedig Project in 2012 (Wildgoose and Welti, 2012). Trench 1 and two testpits (Trenches 2 and 3) were undertaken at the site of roundhouse Achtercairn 2. Trench 1 was placed north to south across the hut, while Trenches 2 and 3 were located 10m to the north east and 10m to the west of the roundhouse. A small number of finds were retrieved from Trench 1, which included a broken sandstone rubber, a pebble hammer and a quartz flake (Wildgoose and Welti, 2012). A radiocarbon date taken from birch charcoal recovered from the lower hearth has provided a Late Bronze Age date for the roundhouse of 896-799 cal BC (GU-30616; 2679±29 BP). A further circular stone setting, Achtercairn 3, was recorded approximately 40m downslope of the roundhouse and a further small trench (trench 4) was put in to investigate this feature (Wildgoose and Welti, 2012). This trench was extended to Trenches 5 and 6. (See illus 15 in main report text). Trench 7 was later dug in line with Trench 5, separated by a 50cm baulk. Radiocarbon dating of alder charcoal retrieved from a cobbled area, within Achtercairn 3 has shown this stone circle feature to be earlier than the Achtercairn 2 roundhouse, dating to 3633-3376 cal BC (GU-30617; 4719±30 BP) placing activity in the Late Neolithic period. A further radiocarbon date of alder charcoal has recently been obtained from beneath the 'wall' of the stone circle and provided a Middle Bronze Age date of 1736-1528 cal BC (GU-34311; 3341±35 BP) suggesting its construction took place in this period.

As part of the excavation a kubiena tin (8 x 5cm) sample (ACHT2) was taken through organic deposits within Trench 3 of Achtercairn 2 at the contact point between Contexts 3.3 and 3.4. A further sequence of kubiena tins (ACHT3.0-3.4) was taken through loam deposits 7.1 to 7.3 within Trench 7 of Achtercairn 3. The kubiena tin sample from Achtercairn 2 and two of the kubiena tin samples from (ACHT3.1 and 3.2) have been sub-sampled to provide material for pollen analysis. It is hoped this analysis will provide information on the environment of the hut circle during its lifetime and any evidence of how people interacted with this environment. All samples have been analysed for pollen, non-pollen palynomorphs (NPPs; includes fungal spores, animal hair and wood detritus) and microscopic charcoal.

2. Aims and Objectives of the work

The main objective of the analysis was to investigate the landscape around the two hut circles and to investigate any evidence of human-environmental interaction.

The key aims to achieve this objective are:

- To establish the presence and state of preservation of any pollen grains, NPPs and microscopic charcoal within the spot-samples.
- To reconstruct the local environment during the use of the hut circles.
- To investigate for any evidence of human-environmental interaction, such as farming, woodland clearance, burning events etc.

3. Methods

3.1 Pollen Analysis

A total of 15 samples of c. 2g wet weight were sub-sampled from the kubiena tins and prepared for pollen, non-pollen palynomorphs (NPPs) and microscopic charcoal analyses using the procedure described by Barber (1976). In order to remove mineral matter, the organic component of each sample was separated using a density flotation method, which also aids in concentrating the pollen from each level (Nakagawa et al, 1998). At least 500 total land pollen (TLP) grains were counted for each sub-sample; being grains of trees, shrubs, dwarf shrubs and herbs, excluding aquatics. Where pollen was found to be especially degraded and sparse a count of 300 TLP was employed; namely for levels 25cm and 27cm from ACHT3.1. Pollen was identified using key reference texts such as Moore et al (1991) and when needed through comparison with modern reference material from a collection housed in Orkney College UHI. Cereal-type pollen identification was made using the identification keys from Fægri et al. (1989), Moore et al. (1991) and was differentiated from wild grass pollen based on grain size, pore and annulus diameter and surface sculpturing (Andersen, 1979). Pollen preservation was recorded following Cushing (1967) and each pollen grain was classified as broken, corroded, crumpled or degraded. Pollen grains that had no remaining distinguishing features were categorised as unidentified. NPPs were recorded during routine pollen counting and they were identified using the descriptions and photomicrographs of van Geel (1976), van Geel et al (1989; 2003) and van Geel and Aptroot (2006). Microscopic charcoal was routinely counted during pollen analysis and has been divided into three size categories (<21µm; 21-50µm and >50µm) in order to distinguish between fire events taking place close to and some distance from the site; the larger microscopic charcoal fragments being closest to the site. Microscopic charcoal fragments where enough structure survived have been identified as either wood or grass charcoal and these counts added to the pollen diagrams.

The pollen and non-pollen palynomorph diagrams are shown in Illustrations 1 and 2. Plant nomenclature follows Stace (2010). Summary curves for trees, shrubs (constituting arboreal pollen, AP), dwarf shrubs and herbs (non-arboreal pollen, NAP) are shown. NPP terminology follows the type system devised by van Geel (1976) and uses the laboratory code as prefix (HdV), followed by the type number. NPP types not listed by van Geel have been given an OC prefix. The pollen data is expressed as percentages of total land pollen (TLP). Rare pollen types are denoted by a +, where + is one grain, ++ is two grains and +++ is three grains. NPPs are expressed as percentages of total land pollen plus NPPs. The pollen diagrams have been constructed using Tilia and Tilia.graph version 1.7.16 (Grimm, 2011). The pollen diagrams have been zoned using the sediment context for the purpose of this report.

3.2 Radiocarbon Dating

A 2g radiocarbon dating sample of peat was taken at 3cm from the sedimentary sequence in the kubiena tin sample recovered from Achtercairn 2. The sample was taken from this level following analysis of the pollen in order to date the appearance of cereal pollen in the assemblage.

4. Results

4.1 Stratigraphy

The stratigraphy of the sedimentary sequence within the Kubiena tin samples was recorded during sub-sampling (Tables 1 and 2).

4.1.1 Achtercairn 2

The contact point between the two stratigraphic units 3.3 and 3.4 was visible at 6cm showing there to be a sharp transition between the two sediment types. The basal context (3.4) was a minerogenic horizon of brown slightly peaty silt. Inclusions of brown-grey silt and coarse sand, suggest erosion episodes possibly associated with slope wash (colluvium), leading to observable accumulation of silt within the deposit. This unit was overlain by a dark brown, slightly silty, peat with visible monocotyledon plant fragments (e.g. grasses and sedges). The presence of silt and coarse sand within this layer again indicate periods of probable slope wash accumulating within the peat. The high minerogenic and organic nature of the two deposits has been shown from the Loss on Ignition analysis undertaken on these two sediment layers (see Local Soil testing Results, Prof B Ing, Appendix 3).

Context Number	Stratigraphic Description	Corresponding Pollen Levels
3.3	Dark brown, slightly silty, monocotyledon peat with occasional coarse sand inclusions.	1-6cm
3.4	Brown slightly peaty silt with light brown-grey silt inclusions and occasional coarse sand inclusions.	6-8cm

Table 1 – Stratigraphic sequence from Kubiena Sample taken from Trench 3

4.1.2 Achtercairn 3

The sedimentary sequence from Trench 7 was a sequence of minerogenic layers. The sampled part of the sequence from the two kubiena tins (ACHT3.1 and 3.2) showed a brown clayey loam that was observed to have an increase in clay fraction moving vertically upwards through the sediment column (Table 2). The upper unit of the sequence (7.1) contained occasional root fragments from the overlying vegetation cover.

Context Number	Stratigraphic Description	Corresponding Pollen Levels
7.1	Brown clayey loam, with occasional penetrating root fragments.	1-18cm
7.2	Brown slightly clayey loam.	18-30cm

Table 2 – Stratigraphic sequence from Kubiena Samples taken from Trench 7

4.2 Pollen and NPP results

The results of the pollen analysis are presented in Illustration 1 and are discussed below by Sequence and Context (Zone).

4.2.1 Achtercairn 2

4.2.1.1 Zone 1; Context 3.4

Zone 1 (Context 3.4) corresponds to levels 6-8cm in the pollen sequence (Table 1 and Illus. 1). The pollen assemblage from this zone consists largely of arboreal and shrub pollen, which together account for approximately 90% TLP. In particular this sum is contributed to mainly by birch (*Betula* sp.) and hazel (*Corylus avellana*) pollen, which make up around 60% and 30% TLP, respectively. Small values of oak (*Quercus* sp.) and alder (*Alnus glutinosa*) pollen are present indicating the presence of these trees in the landscape. There is some suggestion for the existence of heathland through the recording of heather (*Calluna vulgaris*) pollen, which contributes to around 2% TLP. The majority of herbaceous pollen present is represented by grass (Poaceae) pollen at around 5% TLP, with a range of other taxa present as rare types, including marsh marigold (*Caltha palustris*-type), butter cups (Ranunculaceae), devils-bit scabious (*Succisa pratensis*), nettles (*Urtica*-type) and marsh violet (*Viola palustris*-type). The spore assemblage consists mainly of ferns (*Pteropsida* (monolete) indet.) with polypoidy (*Polypodium*), sphagnum (*Sphagnum*) and bracken (*Pteridium*) present as rare types. The NPP assemblage also contains rare-types with no type being present in any significant number and includes HdV-16C, HdV-52 (animal hairs), HdV-55A/B (Sordaria type) and HdV-118 (globose microfossils). Microscopic charcoal for this zone is present across all fractions but highest at the 1-21µm fraction, suggesting burning is taking place but within the wider area of the roundhouse. A decrease in burning is also seen from the base to the top of this zone. The small number of Lycopodium spores counted from these levels demonstrates the high abundance of pollen observed for these levels, while the small values of corroded, crumpled, broken, concealed and unknown (pollen too degraded to positively identify) indicates pollen grains were also well preserved. The number of degraded grains is around 10% TLP and suggests that biological degradation (e.g. bacterial attack) is the main factor hindering preservation.

4.2.1.2 Zone 2; Context 3.3

Zone 2 (Context 3.3) corresponds to levels 1-6cm in the pollen sequence (Table 1 and Illus. 1). This zone is again dominated by birch and hazel pollen which make up to 70% and 30% TLP, respectively at their highest peaks in this zone (at 5cm for birch and 3cm for hazel). These values are seen to gradually fall to the end of the zone where birch accounts for 42% TLP and hazel accounts for 16% TLP. Other tree and shrub taxa are present at smaller percentages and rare types such as oak, alder, willow (*Salix* sp.) and ivy (Hedera helix). The top of the zone also sees the first appearance of pine (*Pinus* sp.) and elm (*Ulmus* sp.) pollen. Heather pollen values increase significantly in this zone from around 2% TLP at the base of the zone to 20% TLP at the top of the zone. Accompanying the rise in heather is the increased appearance of crowberry (*Empetrum*) and heaths (*Erica*-type) pollen. There is a slight increase also in grass pollen within this zone, which increases from around 5% TLP at the base of the zone to 9% at the top of the zone. There are also significant increases in the pollen of sedges (Cyperaceae), meadowsweet (*Filipendula*), cinquefoils (*Potentilla*) and star saxifrage (*Saxifraga stellaris*), which all form continuous curves for parts of this zone. A range of other herbaceous pollen also appears as rare types within this zone including pinks (*Dianthus*-type), Michaelmas daisies (*Aster*-type), ribwort plantain (Plantago lanceolata), chicory (*Cichorum intybus*-type) and hogweed (*Heracleum sphondylium*-type). Cereal pollen in the form of barley (*Hordeum*-type) pollen appears for the first time at 3cm and then continues to be present in the above levels. The spore assemblage is again dominated by ferns but there is also an increase in bracken values recorded in the upper part of the zone. Other spore types in the form of sphagnum, polypoidy and buckler-ferns (*Dryopteris*) are also present. Accompanying the rise in heather pollen is a rise in the curve of HdV-10 (*Conidia*), suggesting a local presence of heather around the hut circle. There are peaks also in the values of HdV-52 and HdV-16C, while from 4cm upwards there is a continuous curve in the values of HdV-181. In the upper part of the zone are the first appearances of HdV-1 (*Gelasinospora* spp.) and HdV-3B (*Pleospora* spp.), which are both indicative of local burning. This is also indicated by a large rise in the values of microscopic charcoal particularly at the 1-21µm and 21-50µm cross fractions, suggesting a significant increase in burning activity from 3cm upwards. Charcoal retaining enough structure to be identifiable as wood microscopic charcoal was present at 4 and 5cm, with that at 5cm identifiable as hazel wood. The percentages of degraded, broken and corroded pollen grains present, together with Lycopodium spores are all low indicating there was good pollen preservation and abundance. There is a slight increase in the numbers of crumpled grains indicating some mechanical damage of pollen grains, which may be a reflection of sediment mixing through erosional episodes of hill wash material moving downslope into the peat as suggested by the stratigraphic record.

4.2.2 Achtercairn 3

4.2.2.1 Zone 1; Context 7.2

Zone 1 (Context 7.2) corresponds to levels 18-27cm in the pollen sequence (Table 2 and Illus. 2). The pollen assemblage within this zone changes fairly abruptly between 23 and 25cm, from a landscape with some scrub woodland cover, to open heath environment. At 25-27cm the pollen assemblage comprises of arboreal and shrub pollen contributing 55-60% TLP; the main taxa being birch, alder and hazel, with oak and pine only represented as rare types. From 18-24cm the combined arboreal and shrub pollen has fallen to make up only 7-10% TLP. A rise is also recorded in dwarf shrub pollen at 24cm, dominated by an increase in heather pollen, contributing approximately 20-40% TLP for the remainder of this zone. A local presence of heather close to the sampling site is demonstrated by the large values of HdV-10 throughout the zone. Grass pollen remains consistent throughout the zone with values of around 25% TLP and is the largest contributor to the herbaceous pollen sum, which comprises between 35-52% TLP within this pollen zone (Illus. 2). Together with grass pollen there are also significant quantities of sedges, ribwort plantain, chicory, Michaelmas-daisies (*Aster*-type), bog myrtle (*Myrica gale*), cinquefoils and marsh valerian (*Valeriana dioica*). Other herbaceous pollen, present as rare types include vetches (*Vicia*-type), meadowsweet, cowbane (*Cicuta virosa*-type), mint (*Mentha*-type) and devil's bit scabious. Cereal pollen is present at 23-24cm and at 19cm with the appearance of barley-type pollen. The spore assemblage is largely made up of ferns and bracken, with polypoidy, marsh fern (*Thelypteris palustris*) and parsley fern (*Cryptogramma crispa*) present as rare types. There is a rich NPP assemblage for this zone containing significant amounts of a number of taxa including HdV-16A, HdV-52A, HdV-55A/B (*Sordaria* spp.), HdV-112 (*Cercophera* sp.), HdV-181 and HdV-350. There are high values of microscopic charcoal across all fraction sizes in this zone, with a steady decline from 27cm to 23cm, with values then increasing before decreasing again. The high microscopic charcoal values indicate burning activity taking place within the local and wider area of Achtercairn 3. The high values for *Lycopodium* spores in the bottom two levels (26-27cm) reflects the paucity of pollen grains on the slides, with only 300 TLP recorded for these basal layers. These two levels also have the highest numbers of degraded grains with smaller values of crumpled and broken grains, suggesting degradation of pollen has been caused by biological damage rather than mechanical. The number of degraded grains and the number of *Lycopodium* spores can be seen to decrease vertically up the sediment column, indicating grains are better preserved and more abundant in the levels closer to the surface. This increased level of preservation mirrors the increased clay content in the loam suggesting there is a greater level of waterlogging in these sediments aiding the preservation of the pollen grains.

4.2.2.2 Zone 2; Context 7.1

Zone 2 (Context 7.1) corresponds to levels 17-18cm in the pollen sequence (Illus. 2 and Table 2). The pollen assemblage within this zone reflects a similar landscape to the previous zone with no major changes in vegetation taking place. Arboreal pollen (tree and shrubs) makes up around 20% of TLP in this zone, while dwarf shrubs, largely consisting of heather and heaths (*Erica*-type) contributes approximately 40% TLP, with herbaceous pollen adding the final 40% TLP (Illus. 2). There is an absence of pine pollen within this zone, while there is an appearance of ash (*Fraxinus excelsior*) pollen. Alder pollen decreases slightly from the previous zone, with hazel pollen showing a slight rise; oak and birch pollen values remain the same. The herbaceous pollen assemblage is again dominated by grass pollen, with significant values of sedge, ribwort plantain, chicory, Michaelmas-daisies and star saxifrage. Other herbaceous pollen present as rare types within this zone include meadowsweet, vetches, alpine saxifrage (Saxifraga nivallis), nettles, chamomiles (Anthemis-type), devils-bit scabious and mugwort (*Artemisia*-type). Cereal pollen is again present in this zone with the recording of barley-type pollen in rare quantities at 17cm. The spore assemblage again consists mainly of ferns, bracken and sphagnum, with polypoidy occurring as a rare type. The NPP assemblage is dominated by HdV-10 spores indicating that there is a local presence of heather close to the sampling site. A number of other NPP's are also present in the assemblage with continuous curves from the previous zone for types such as HdV-16A, HdV-52C, HdV-55A/B, HdV-112, HdV-350 and HdV-422. A number of other types are also present as rare types including HdV-1, HdV-4 (*Anthrostomella fuegiana*), HdV-123 and HdV-205 (possible *Sordaria* spp.). Microscopic charcoal values remain high across all fraction sizes, rising slightly from the end of Zone 1, suggesting burning activity took place close to the sampling site. The lower value of *Lycopodium* spores in this zone continues from that previously and indicates a greater abundance of pollen in this level. There is a slight decrease in the number of degraded pollen grains in this level, with small rises in the numbers of crumpled and broken grains; corroded grains only occurring in rare values. These categories for pollen preservation indicate that pollen continues to be better preserved in the upper levels of the sediment column and that biological damage is the main form of degradation.

4.3 Radiocarbon dating results

All radiocarbon dates have been calibrated using the University of Oxford Radiocarbon Accelerator Unit calibration program OxCal 4.1.7 (Bronk Ramsey 2010) and are presented in the text using the 2σ calibrated age ranges. The radiocarbon date obtained from the Achtercairn 2 sequence provided a post medieval date for the cultivation activity of cal AD 1485-1649 (GU-35220; 313±30 BP). This date indicates that the pollen sequence represents vegetational changes within the late medieval to post medieval period rather than relating to activity corresponding with the archaeology.

5. Discussion

5.1 Achtercairn 3; possible Late Neolithic to Early Bronze Age date

There are no radiocarbon dates available for the pollen assemblage analysed for Achtercairn 3, therefore it is not known for certain what the chronology is for the vegetational information garnered from the pollen analysis. The kubiena tin sequence (KT1-4) from Trench 4, associated with the stone enclosure extends from c. 2cm to 30cm (with the pollen sequence presented here covering 17-27cm). The stone wall of Achtercairn 3 was encountered close to the surface within Phase 2 of T5 correlating to Context 7.1 of the sediment profile. This phase of activity has been radiocarbon dated from alder charcoal underlying the stone 'wall' to 1736-1528 cal BC, placing activity in the Middle Bronze Age. Underlying this is a previous phase of activity (Phases 1a and 1b) represented by a cobbled area within a stone setting, which corresponds with Context 7.1 of the sediment profile. Alder charcoal from the cobbled area has provided a Late Neolithic date for this activity of 3633-3376 cal BC. Therefore it is likely that the pollen sequence from Achtercairn 3 (Illus. 1), sampled mainly from the Phase 1 sediments, with one level from those of Phase 2 relates to the Late Neolithic to Early Bronze Age period.

The pollen sequence from Achtercairn 3 reflects a fairly open environment of initial scrub woodland cover followed by a more open heath environment; as such the pollen catchment is likely to provide information on both the local and more widespread vegetational changes. Although the pollen levels have been taken contiguously through the sediment sequence, it is not clear what the sediment accumulation rate is for the two sampled contexts as they are likely to have formed at various rates over the Phase 1 and Phase 2 periods; compared to the potentially steadier rate of accumulation of organic sediments such as peats. Therefore a general chronology has been used based on the radiocarbon dates information for the two phases in the interpretation of the sequence.

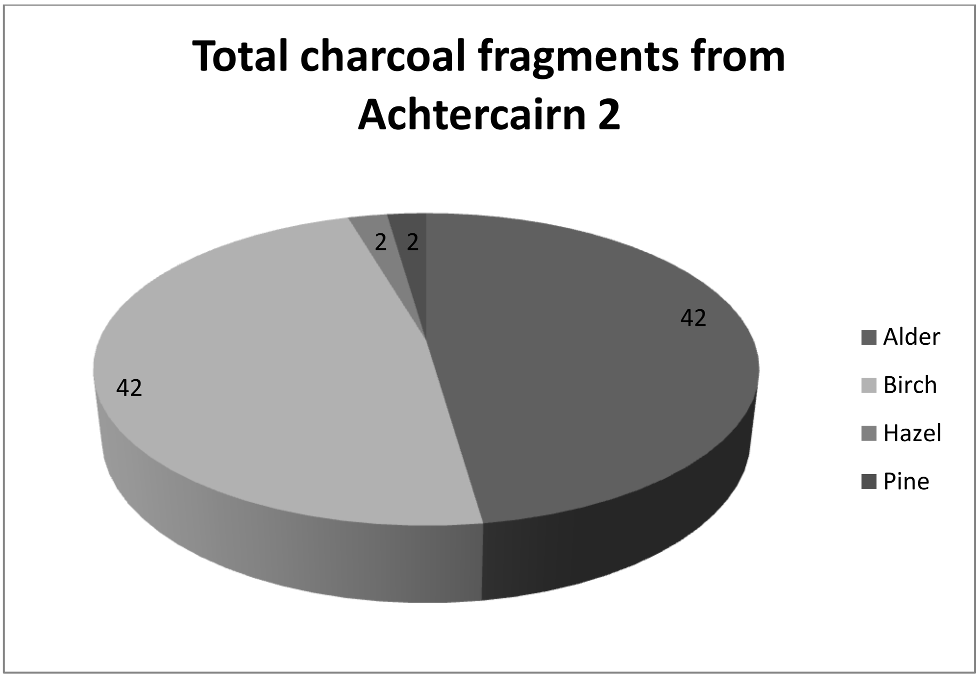
Arboreal and shrub pollen values are highest in the basal two levels (25 and 27cm) where probable scrub woodland of birch and hazel was growing on the slopes of the hillside and/or on areas of mire within the landscape. Alder is also shown to have had a significance presence in the landscape in these levels and is likely to have been growing in the wetter locations of this landscape, such as fringing burns or may have been growing on wetter parts of the mire similar to birch and hazel (Rodwell, 1991). There is some evidence for the presence of oak in the wider landscape with rare pollen values of this taxon recorded (Illus. 1). A local tree presence is also signalled in the NPP record from the presence of dead wood indicators such as *Bactrodesmium obovatum*, which is related to decaying wood of deciduous trees (van Geel *et al*, 1981) present on the woodland floor. The pollen assemblage indicates a largely open environment during this phase with high values of grass pollen (c. 20-25% TLP), together with appearances of other grassland taxa such as devil's-bit scabious, campions (*Silene*-type) and Michaelmas-daisies. Damp ground indicators are also present including, sedges, cowbane and hog's fennel suggesting these taxa were growing within wet woodland areas or in wetter areas of marsh/mire (Clapham *et al*, 1962; Stace, 2010). The basal pollen assemblage from Achtercairn 3 reveals a more open landscape of scrub and wet woodland, together with heath and grassland then is suggested by other Late Neolithic pollen sequences from across the region. For example at Badentarbet, Highlands, higher values of birch, alder and hazel pollen are present with tree and shrub pollen making up 75-85% TLP during the Neolithic to Middle Bronze Age period (Bunting and Tipping, 1997).

The pockets of scrub and wet woodland signalled inn the pollen record at Achtercairn 3 are depleted even more between 24 to 23cm when there is a marked decrease in the values of birch, hazel and alder pollen (Illus. 1). A slight rise is seen in the pollen values of oak, which increases from a rare type to begin a continuous pollen curve. It is likely that this rise in oak pollen reflects an increase in pollen into the catchment due to the decline in other arboreal pollen rather than an actual increase in the number of oak trees in the landscape. Similarly following this decline in overall arboreal pollen there are also appearances of elm, pine and willow pollen. This decline in tree pollen is accompanied by a rise in heather pollen, which increases from 5% to 35% TLP from 25 to 23cm (Illus. 1). The high values of HdV-10 spores, which relates to fungi that grows on the roots of heather (van Geel, 1976; van Geel and Middeldorp, 1988) in the pollen assemblage indicates that heather was present locally at the pollen sampling location prior to this increase in heather pollen, indicating the pollen reflects a more widespread rise in heather across the landscape. There are also increases in the representation of other heath vegetation accompanying the rise in heather such as heaths, bog myrtle and crowberry. The NPP assemblage also indicates the occurrence of other potential vegetation, within the heath communities. HdV-16A, HdV-16B and HdV-16C are present as both rare values and as continuous curves and indicate the presence of purple moor grass (*Molinea caerulea*), while the occurrence of HdV-18 suggests the presence of cottongrass (*Eriophorum vaginatum*) communities (van Geel, 1976; van Geel and Middeldorp, 1988). Increased values of HdV-120 are also recorded during the period of heathland cover and it is likely this spore also relates to the *Conidia* family (Pals *et al*, 1980) and thus related to a local presence of heather. This rise in heather and establishment of heathland vegetation appears to take place earlier than in other pollen studies across the region, which have been recorded across varying time periods, for example at Loch Maree, Wester Ross this rise in heather (to c. 20% TLP) took place at around 1900 BP, whilst at Badentarbet, Highlands a similar rise was dated as occurring at approximately 940-730 BP (Birks, 1972; Bunting and Tipping, 1997). However, it does occur at a similar period as that recorded at Loch Clair, where a heather rise took place sometime between 3410 to 2750 BP (Pennington *et al*, 1972).

At the same time as the decline in trees and rise in heather takes place there is a rise in disturbance indicators such as ribwort plantain, which can be seen to have a sharp increase from 25 to 23cm and then maintains a steady presence in the pollen assemblage of c. 8-15% TLP. Other disturbance indicators seen to rise during this phase include chicory, plantain sp. (*Plantago* sp.) and Michaelmas-daisies (Behre, 1981). All of these taxa are also associated with arable land and it is during this phase that the first cereal pollen is recorded in the assemblage with the appearance of barley-type pollen at 24cm and 23cm. Cereal pollen is absent in the previous studies from Wester Ross, which may be due to these studies having taken place at a distance too far from settlements and agricultural activity to have picked up such signals in the pollen record. The presence of cereal pollen and other arable taxa occurring at the same level as the decline in tree pollen implies that the woodland in this location may have been deliberately felled by people to create areas for arable farming. The large microscopic charcoal values across all size fractions indicates burning activity was taking place near to Achtercairn 3 as well as in the wider landscape and is thought to be representative of anthropogenic activity rather than natural causes. Local burning activity is also signalled by the presence of burning indicators HdV-1 and HdV-3B in the NPP record van Geel 1976; Innes and Blackford, 2003), the latter particularly prominent between 27-23cm (Illus. 1).

That wood was being burnt is evident from microscopic charcoal with enough structure preserved to be able to identify as wood charcoal (e.g. surviving scalariform plates) recorded in the pollen record at 25-24cm (Illus. 1). The microscopic wood charcoal was able to be identified as birch/alder and hazel therefore suggesting that some of the woodland was either felled by burning or that felled wood was used as wood fuel. The identification of alder charcoal in both the charcoal spread associated with the Late Neolithic cobbled surface and charcoal recovered from under the 'wall' of the stone circle at Achtercairn 3 would imply that the felled wood was used for wood fuel and that these reduced areas of woodland were returned to as a source for fuel in the Middle Bronze Age. This continuation of burning activity is also implied by the microscopic charcoal record, with values remaining high across all fraction sizes throughout the pollen sequence of Zone 1 (Context 7.2) and into Zone 2 (Context 7.1) (Illus. 1).

Charcoal identifications from the Late Bronze Age roundhouse Achtercairn 2 would suggest that these areas of scrub and wet woodland survived into this period. The charcoal fragments showed an assemblage comprised mainly of alder and birch, together with smaller numbers of hazel and pine (Illus. 3) (Robertson, 2013). A fragments of alder charcoal from this assemblage produced a radiocarbon date of 896-799 cal BC (GU-30616) for this phase of burning activity. The charcoal assemblage reveals a data set slightly at odds with that of the pollen data from Achtercairn 3. Both assemblages indicate a presence of birch and alder in the landscape; however the charcoal assemblage shows hazel was hardly used as a fuel source suggesting that there may have been a further decline in hazel in the landscape or else birch and alder were deliberately preferred to hazel as fuel sources. Pine is only present in small amounts in both assemblages suggesting it was probably scarce within the immediate landscape.



Illus. 3 – Charcoal identifications after data produced by Robertson (2013)

There is evidence for the presence of grazing animals throughout the pollen sequence suggesting the keeping of livestock in the area around Achtercairn 3. From 26cm upwards through the profile there is evidence of animal dung from the consistent presence of dung related fungal spores HdV-55A/B and HdV-112, together with appearances of HdV-52A and HdV-52C (animal hairs) (van Geel, 1976; van Geel *et al*, 2003). HdV-55A/B has also been linked to the presence of decaying wood (van Geel, 1976); however given the decline in arboreal pollen and the low representation of other dead wood indicators in the assemblage it is more likely this instance to be related to animal dung. A small number of grazing indicators are also present in the pollen assemblage, such as cinquefoils which form a continuous curve from 24cm (Illus. 1). Bracken has also been linked to grazing (Innes and

Blackford, 2003) but is consistently present throughout the pollen sequence with no peaks occurring at the same time as increases in the NPP dung indicator assemblage, suggesting it is more likely to be a constituent of the heath vegetation; although this does not rule out the grazing of livestock on these areas.

Evidence for arable activity recommences in the upper part of the pollen sequence, with the reappearance of barley-type pollen at 19cm and at 17cm across the top of Context 7.2 and base of Context 7.1 (Illus. 1). Despite the absence of cereal pollen between 23-19cm, this only corresponds to one level of pollen (21cm) and it may be that this lacuna in cultivation activity is a reflection of the pollen levels counted rather than an absence altogether of arable activity during this period. The identification of barley-type pollen across Late Neolithic and Early Bronze Age contexts, suggests it is likely to represent the cultivation of naked barley (*Hordeum vulgare var nudum*), charred grains of which have been recovered from sites of these periods across Scotland (e.g. Bishop *et al*, 2009; Timpany, 2014). The continued high values of ribwort plantain, together with chicory, Michaelmas-daisies and plantain sp. suggest the presence of arable land throughout this period. Other arable pollen indicators are also present including buttercups, carrot family (*Apiaceae* sp.) and chamomiles (Clapham *et al*, 1962; Stace, 2010). It appears likely that arable activity, together with the keeping of livestock took place from around 25-24cm to 17cm in the Achtercairn 3 sequence.

5.2 Achtercairn 2; c. cal AD 1485-1649

The pollen assemblage from Achtercairn 2 has been dated to the post-medieval period from a radiocarbon date of the peat at 3cm providing a date of cal AD 1485-1649. Therefore the pollen assemblage does not relate to the archaeology of the roundhouse. Despite this the pollen is nonetheless interesting as it provides landscape information for a period of which there is little existing pollen information.

The overall pollen catchment for this sequence is likely to be quite small, given the sediments are accumulating near a scrub woodland environment for the majority of the sequence. It has been suggested that the catchment area for such sequences is that of tens of metres rather than hundreds (Mitchell, 1988). The woodland canopy will also act as a filter for pollen and thus during periods of high arboreal (trees and shrubs) pollen counts the pollen signal from the catchment will again be quite local (Tauber, 1965; Odgaard, 1999). Therefore the pollen signal is dominated by local scrub woodland taxa and in particular those of birch and hazel, which may be over-represented as they are known abundant pollen producers (Birks and Birks, 1980; Bennett and Birks, 1990).

The overall pollen assemblage from Achtercairn 2 shows that birch-hazel scrub woodland was already well-established in the landscape prior to the commencement of this pollen sequence and therefore must have recovered significantly since the Middle Bronze Age assemblage of Achtercairn 3. As noted above, both of these tree types are abundant pollen producers and therefore the high pollen values of these taxa may to some extent mask vegetation changes that are taking place in the wider environment. However, as we are mainly interested in the local environment around the Achtercairn 2 hut circle then this information should still be relevant for this study. A local presence for these two tree types is also signalled by the presence of HdV-114 (scalariform plates) recorded in both zones (Illus. 2), which were identifiable as birch/alder (more likely birch based on the pollen evidence) and hazel. HdV-114 indicates that wood debris, such as dead wood from these tree types was present on the sampling site, decaying into the sediment (Pals *et al*, 1980; Schweingruber, 1990).

The tree and shrub pollen data also indicates that oak and alder both had a significant presence in the landscape (allowing for over-representation) and may have been present locally. Alder would again have been present in the wetter areas, such as fringing the burn, to the north west of the hut circle that runs down to the bay. Willow is also likely to have been present within this wetter area and may also be under-represented in the pollen assemblage due to it being insect-pollinated (Moore *et al*, 1991). It is within this location around the burn that other vegetation signalled in the pollen diagram were also growing such as stream-side plants like starry saxifrage, golden saxifrage (*Chrysosplenium*-type), hog's fennel (*Peucedanum palustre*-type) and alpine saxifrage (Clapham et al, 1962; Stace, 2010).

Despite the large arboreal and shrub pollen values the scrub-woodland was probably quite open and this is signalled by the range of herbaceous pollen types present (Illus. 2). The field layer for this woodland is seen to have been quite wet, particularly during Zone 1 as it grew on the peaty silt layer and this is indicated by the presence of herbaceous taxa, which grow in marsh and wet woodland environments such as cowbane, ragged robin (*Lychnis*-type) and marsh marigold (Clapham et al, 1962; Stace, 2010), which are confined to this layer. The continued presence of damp ground and wet wood indicators within Zone 2 suggests that although ground conditions were probably drier than in Zone 1 they would still have been wet during the transition and formation of the monocotyledon peat. These taxa include St John's wort (*Hypericum* sp.), cinquefoils, marsh violet, devils-bit scabious and meadowsweet, together with ferns (Clapham et al, 1962; Stace, 2010). This form of open, wet scrub woodland is a common feature from other pollen studies that have been undertaken in the region, such as at Loch Maree and Loch Claire, Wester Ross (Birks, 1972; Pennington *et al*, 1972) and Badentarbet, Highlands (Bunting and Tipping, 1997).

A distinctive feature of the pollen assemblage in Zone 2 is the rise of heather pollen from 6cm onwards (Illus. 1) indicating the spread and development of heathland in the area. An increased presence of crowberry, heaths and bog myrtle are also indicative of the development of this vegetation community (Clapham *et al*, 1962; Stace, 2010). The rise in heather pollen is accompanied by a rise in the number of HdV-10 spores, which again relates local growth of heather at the sampling site (van Geel, 1976; van Geel and Middeldorp, 1988). The appearance of HdV-20 within Zone 2 is also suggestive of a local presence of heather (van Geel, 1976; Kuhry, 1985). An increase in the presence of Types HdV-16A, HdV-16B and HdV-16C may also indicate an increased presence in purple moor grass, whilst the presence of cottongrass is inferred from the occurrence of HdV-18 both are associated with heathland communities (van Geel, 1976; van Geel and Middeldorp, 1988).

Towards the top of Zone 2 at 3cm there is a decline in tree pollen notably that of birch, together with alder, while there is a slight rise in the pollen of hazel, together with an overall increase in the pollen of herbaceous taxa (Illus. 2). This suggests that there has been a reduction in the amount of scrubland in the area and increase in more open ground together with that of heathland. It is at this point in the pollen diagram that evidence for human-environmental interaction within the landscape appears. The decline in arboreal pollen is accompanied by a cross-fraction rise in microscopic charcoal, particularly within the 1-21µm fraction. This increase in burning activity around the site is reflected by the appearance of NPP types HdV-1 and HdV-3B, which have been linked to localised dry conditions caused by burning (van Geel 1976; Innes and Blackford, 2003). The appearance of cow-wheats (*Melampyrum*-type), a herb that is also associated with dry conditions provides another indicator for local conflagration events (Simmons, 1996). An anthropogenic cause for this burning activity appears to be extremely likely given that it is during this phase of activity that disturbance indicators such as mugwort, chamomiles and ribwort plantain (Behre, 1981). It is from this level that cereal pollen is also present with the occurrence of barley-type pollen, accompanied by a slight rise in the pollen of grasses (Illus. 2). The barley-type pollen within this phase of activity it likely to represent hulled barley (*Hordeum vulgare*) of either the 2-row or 6-row variety (the latter including Bere barley), which has been evidenced as being cultivated in post-medieval assemblages from Scotland (e.g. Timpany and Haston, 2011). There is evidence of cereal cultivation more regionally within the post-medieval period from the study at Badentarbet, Highlands with agricultural activity taking place in a largely open landscape of grassland (including arable land) and heath, although still fringed by scrub woodland of birch, alder and hazel (Bunting and Tipping, 1997). A field system present on the first edition of the OS 6-inch map for this area from 1881 to the north of the roundhouse (RCAHMS, 1996) indicates agricultural farming was practiced during the later post-medieval period in this landscape and highlights the possibility of similar field systems being in use previous to this. Additional Shieling huts and farm boundaries have also been mapped in this area during the course of the field investigations.

There is some indication for the presence of grazing animals around the area of Achtercairn 2 throughout the period covered by the pollen assemblage from the presence of animal hairs (Hdv-52) observed within the pollen levels (van Geel, 1976), which are seen to peak at 3cm; during the period of increased anthropogenic activity. Unfortunately no fungal spores associated with dung were recorded from these levels, but herbaceous taxa that have been linked to grazing activity such as cinquefoils and bracken both increase during this period, while others such as devils-bit scabious are an ever-present in the assemblage (Innes and Blackford, 2003). There is a slight increase in the presence of nitrophilous taxa such as nettles towards the top of the zone, which may also signal a presence in dung (Stace, 2010). An increase in eutrophic conditions locally is signalled by the recorded rise in HdV-181 within the NPP assemblage (van Geel *et al*, 1983), which may again be associated with an increased animal presence; this type may also indicate the presence of shallow pools of stagnant water, although there is an absence of aquatic pollen evidence for such pools. Therefore there is some tentative evidence for the presence of livestock around Achtercairn 2, during the period of increased burning and cultivation activity.

6. Conclusions

- Pollen analysis of the kubiena tin sub-samples has shown that pollen is present in all levels, with pollen preservation being generally good and abundant within the Achtercairn 2 sequence but within the Achtercairn 3 sequence becomes more degraded and sparse in the lower levels of the sequence, which are less waterlogged than those above.
- The pollen assemblage from Achtercairn 3 corresponds with two phases of archaeological activity. Phase 1 of Early Neolithic date associated with a cobbled surface and burning activity and Phase 2 of Middle Bronze Age date associated with the circular stone 'wall'.
- The pollen assemblage from Achtercairn 3 shows an initial landscape of scrub woodland and grassland with some heath is replaced abruptly by heath and grassland communities following the decline of the woodland.
- The appearance of cereal pollen and high values of microscopic charcoal corresponding with the decline in woodland at Achtercairn 3 suggests deliberate removal of woodland by people for arable activities. Macroscopic charcoal suggests wood from the felled trees was used for fuel.
- The NPP assemblage for Achtercairn 3 indicates that livestock was also present from the occurrence of dun-related fungi and animal hairs.
- The Achtercairn 2 sequence was dated to the post-medieval period, much later than was expected.
- The pollen assemblage at Achtercairn 2 is dominated by that of birch and hazel, which may be over-represented leading to the masking of more subtle vegetation changes in the landscape and indicates the recovery of woodland in this area following the demise recorded in the Achtercairn 3 sequence.
- Anthropogenic activity is observed in the pollen record from 3cm onwards within the Achtercairn 2 sequence, signalled through an increase in burning activity, some loss of woodland and the appearance of cereal pollen, which indicates the cultivation of hulled barley.

7. References

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Achtercairn, Gairloch 2, Pollen Diagram

Analyst: S. Timpany

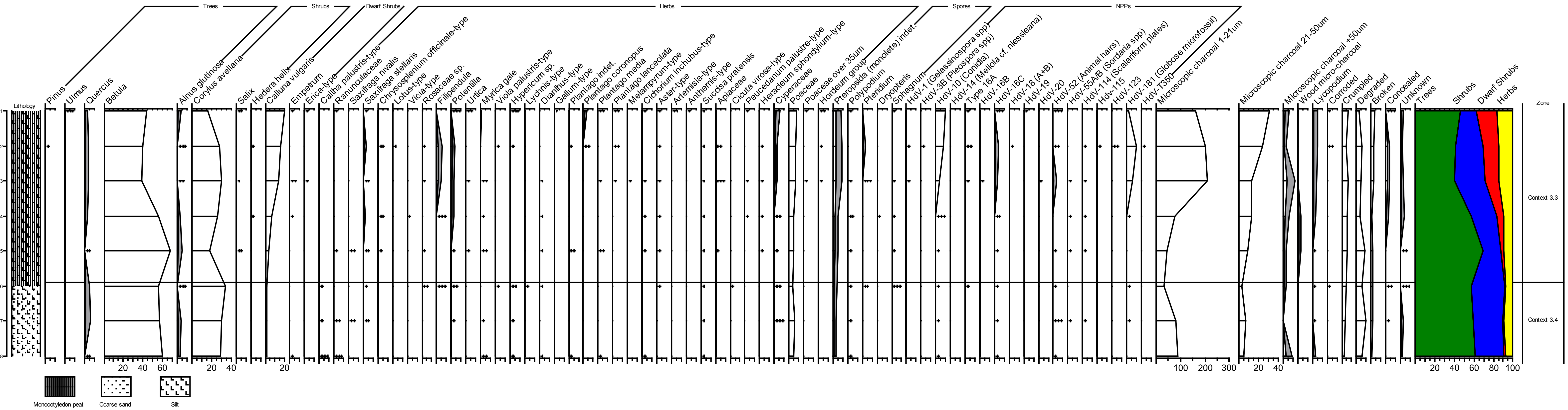

Illustration 2 - Achtercairn 3, Gairloch, Pollen Diagram
Analyst - Dr Scott Timpany

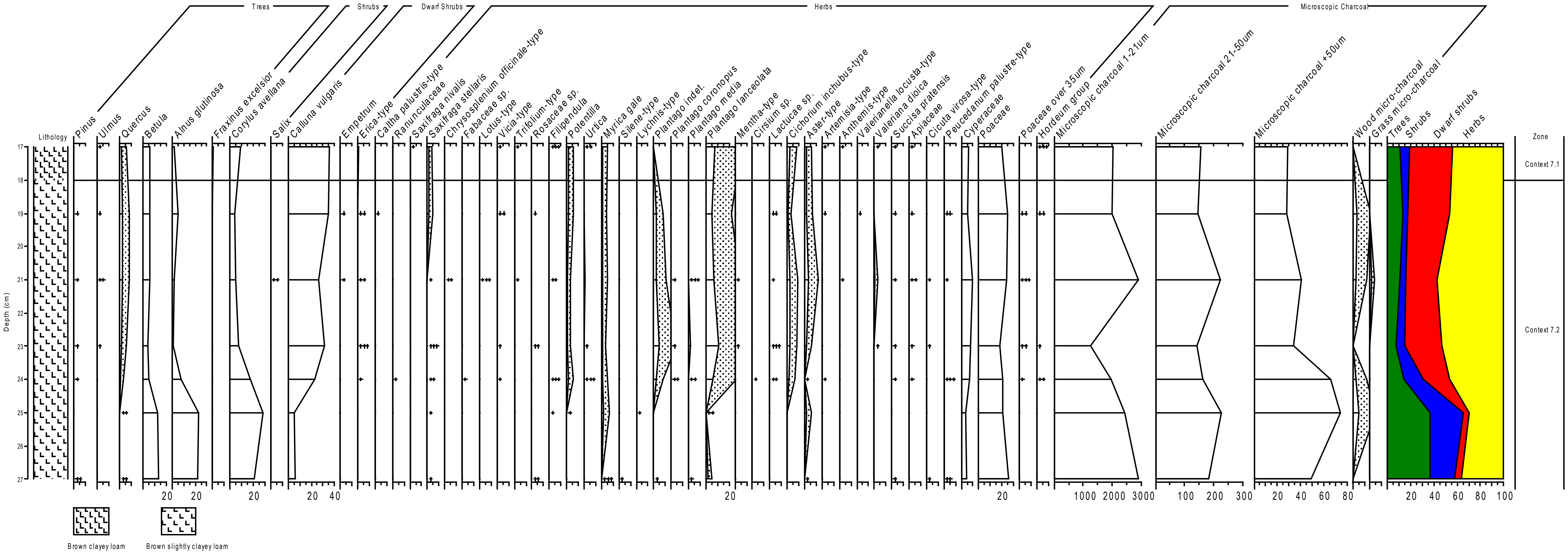

Illustration 2 - Achtercairn 3, Gairloch, Pollen Diagram

Analyst - Dr Scott Timpany