Reynistaðir Pollen Analysis: Sample KLI-2014-21-014

Monasticism in Iceland

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1. INTRODUCTION

The key aim of the Monasticism in Iceland project is to discern the development of a European institutional framework within Iceland and its impact on Icelandic society during the medieval period. As part of the investigative process, a pollen sample was acquired from a soil sample (KLI-2014-21-014) derived from an archaeological context at Reynistadir, the former site of a medieval monastic complex. Pollen analysis is able to provide an indication of plant species or taxa present during the period of the monastery's occupation and thereby allows for the archaeological context to be set within an ecological context (Whittington & Edwards 1994). This in turn can inform on former land management practiced within the immediate locale of the archaeology as well as allowing for the identification of species that may have been utilised for specific purposes e.g. edible or medicinal plants (Kristjánsdóttir *et al*. 2014).

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2. SAMPLE SITE

Reynistaðir is in Skagafjörður in northern Iceland (Fig. 1). The soil sample KLI-2014-21-014 was acquired from an archaeological context (Trench 2) at ISNET 93: E 474.065, N 573.248 (Fig. 2). The excavation trench lies within an area believed to be a structure associated with a former monastery (AD 1295-1551). The archaeological context is described as comprised of peat ash and turves that incorporated fragments of iron and animal bone. Turves also contained traces of the Hekla AD 1300 tephra which suggests that the structure was built after the deposition of the ash (Kristjánsdóttir pers. comm.).

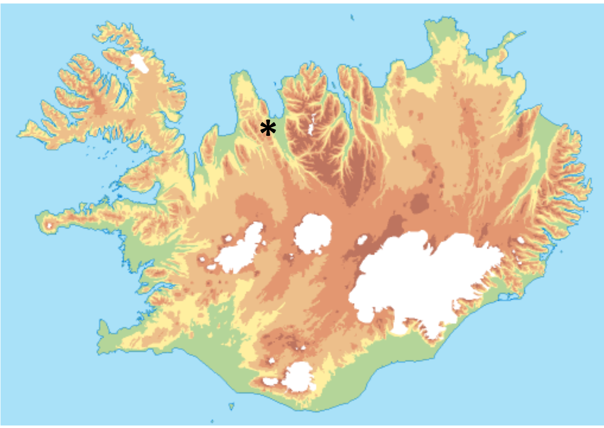

Fig. 1: Map denoting the general location of Viðey in Iceland (asterisk).

Fig 2: Trench 2 from where Sample KLI-2014-21-014 was acquired (circle).

3. METHODOLOGY

A 2 cm^3 sub-sample was taken from the bulk sample acquired from the archaeological context. Volume of pollen samples was determined by displacement in 10% hydrochloric acid (HCl) (Bonny 1972).The samples were subjected to further treatments in 10% sodium hydroxide (NaOH) sieved (150 µm) and subjected to acetolysis mixture. After washing in NaOH the samples were subjected to dense media separation using LST Fastfloat liquid with a density of 1.92 g/cm^3 to separate organic and inorganic components. One *Lycopodium clavatum* tablet (Batch No. 1031) was added to each sample (Stockmarr 1971). Each tablet contains c. 20848 spores and provides a control for the calculation of palynomorph concentrations. Pollen grains were slide mounted with silicone oil (Moore *et al.* 1991, 48-49).

Pollen counts were conducted using a microscope at 400x magnification (at 600x and 1000x magnification for specific detail). A minimum of 300 pollen grains were counted. In this instance, grass (Poaceae) pollen was found to be overly dominant and it was necessary to count beyond 300 grains in order to ensure sufficient pollen representation of other species (Moore *et al*. 1991). All Poaceae pollen were evaluated as potential *Hordeum*-type i.e. grain size >37 µm, annulus diameter >8 µm (Andersen 1978). Coprophilous fungi were counted as it has been shown that there is a relationship between spore concentration and grazing intensity (Cugny *et al*. 2010). Pteropsida and bryophyte spores (*Sphagnum*) were also counted. In order to maximise the opportunity to identify a range of plant species, especially those associated with cultivation, medicinal purposes or other utility, a rapid scanning method was applied following the standard count (Tweddle *et al*. 2005). This entailed examining an estimated minimum of 1500 pollen grains at 200x magnification.

Field identification guides were used to identify the habitat associations of the various plant species found within the pollen sample (Rose 1981; Kristinsson 1986; Fitter 1987). Plant nomenclature follows that of Kristinsson (1986). Pollen and spore nomenclature follows Bennett (2007) but is amended to better reflect the Icelandic flora (Erlendsson 2007). Indeterminate pollen is defined as material that was identifiably pollen but could not be assigned to a family, genus, species or –type groups of pollen. The identification of coprophilous fungi follows Van Geel *et al*. (2003). As the sample was acquired from a context that was partially comprised of peat ash, no attempt was made to quantify charcoal.

4. RESULTS

In total, an estimated minimum 9936 pollen grains were surveyed in total from sample KLI-2014-21-014 (Reynistaðir).

4.1 Standard Count

Given the dominance of grasses (Poaceae), the standard count proceeded beyond the specified 300 minimum in order to ensure the greatest potential for species diversity within the sample (Tables 1, 2 & 3). The condition of the pollen in the sample was often poor with grains clustered which can inhibit identification of taxa or species. Where pollen was identified as indeterminate it is suspected that most were derived from grass pollen, however, they were either too damaged or too difficult to manipulate in order to ascertain the presence or absence of a pore within the grain (a defining feature of grass pollen) (Moore *et al*. 1991).

Table 1: Vascular plant pollen identified in Sample KLI-2014-21-014 (Reynistaðir), standard count.

Latin	English	Icelandic	No. of Pollen
Betula	Birch	Birki	5
Poaceae	Grass family	Grasaætt	250
Cyperaceae	Sedge family	Staraætt	22
Lactuceae	Dandelions & hawkweeds etc.	Fíflar	8
Cerastium-type	Mouse-ear	Músareyra, fræhyrna	15
Montia fontana	Blinks	Lækjagrýta	24
Rumex acetosa	Common sorrel	Túnsúra	1
Potentilla-type	Cinquefoils & silverweed	Gullmura, engjarós & tágamura	2
Ranunculus acris-type	Buttercup	Sóleyjar	3
Thalictrum alpinum	Alpine meadow-rue	Brjóstagras	7
Drosera-type	Sundew	Sóldögg	1
Indeterminate pollen grains			76
Total no. of pollen grains			**414**

Table 2: Bryophyte and Pteridophyte (moss and fern) spores identified in Sample KLI-2014-21-014 (Reynistaðir), standard count.

Latin	English	Icelandic	No. of spores
Botrychium spp.	Moonwort	Mánajurt	1
Diphasium alpinum	Alpine clubmoss	Litunarjafni	2
Selaginella selaginoides	Lesser clubmoss	Mosajafni	2
Sphagnum	Sphagnum	Buramosar	1
Pteropsida (monolete) indeterminate	Fern	Byrkningar	1
Total no. of spores			**7**

Table 3: Coprophilous fungi identified in Sample KLI-2014-21-014 (Reynistaðir), standard count.

Coprophilous fungi	No. of spores
Sordaria-type (HdV 55a)	4
Sordaria-type (HdV 55b)	4
Total no. of fungal spores	**8**

4.2 Rapid Scanning

Following the standard count a further c. 9522 pollen grains were examined using the rapid scanning method. Taxa and species that were not identified during the standard count are detailed in Table 4.

Table 4: Additional vascular plant pollen and bryophyte spores identified in Sample KLI-2014-21-014 (Reynistaðir), rapid scanning.

Latin	English	Icelandic
c.f. Ambrosia-type	Ragweed	e.g. Ömbrugras
Brassicaceae	Brassica & crucifers	Krosblómaætt
Caryophyllaceae	Pink family	Körfublómaætt
Empetrum nigrum	Crowberry	Krækilyng
Galium-type	Bedstraw	Maðra
Hordeum-type	c.f. Barley	Bygg-gerð
Filipendula ulmaria	Meadowsweet	Mjaðjurt
c.f. Lychnis viscaria-type	Catchfly	Ljósberi
Rumex-type	Docks	Súrura
Sagina	Pearlworts	Kræklar
Lycopodium annotinum	Interrupted clubmoss	Lyngjafni

5. DISCUSSION

With reference to Tables 1-4:

5.1 Habitats

A pastoral context for the archaeology is inferred via the dominance of grass (Poaceae) pollen with coprophilous fungi indicative of grazing animals (although values for the latter are low it must be borne in mind that the sample originates from within a building). This is further borne out by the presence of taxa and species such as *Galium*-type, Lactuceae, *Potentilla*-type, *Rumex acetosa*, *Ranunculus acris*-type, *Thalictrum alpinum* and *Botrychium*; all species associated with grazed, acid grassland (Rose 1981; Kristinsson 1986; Fitter 1987; Edwards *et al.* 2011; Vickers *et al*. 2011). That conditions may be damp is intimated by the presence of *Thalictrum alpinum* and *Filipendula ulmaria* while *Botrychium* may imply a close cropped sward in some areas (Rose 1981; Kristinsson 1986; Fitter 1987). Particularly intensive grazing regimes or areas where livestock gather in concentrated numbers regularly may give rise to “poaching” i.e. damp grassland areas that have been trampled by livestock. *Montia fontana*, almost ubiquitous in both the standard and rapid scanning counts, is a species that favours such a habitat (Rose 1981; Kristinsson 1986; Fitter

1987; Edwards *et al*. 2011). This habitat can also arise around buildings; also appropriate given the archaeological context (**Fig. 2**). Alternatively, *Montia fontana* could suggest the presence of a natural spring or slow flowing watercourse (Rose 1981; Kristinsson 1986; Fitter 1987). The former feature could be associated with a monastic garden i.e. a well, as observed in the cloister garden at Skriðuklaustur, while the latter could be indicative of either an artificial or natural drainage system in keeping with the plants Icelandic name "lækjagrýta" (lit: brook blinks) (Rose 1981; Kristinsson 1986; Fitter 1987; Kristjánsdóttir 2010). *Cerastium*-type also has a strong presence in the sample, second only to *Montia fontana*. This group of pollen occupies a range of habitats in Iceland and as with *Montia fontana* could be indicative of either a disturbed soil or a watercourse (Rose 1981; Kristinsson 1986; Fitter 1987). A further indicator of disturbed soil is *Sagina* (Rose 1981; Kristinsson 1986; Fitter 1987).

Birch (*Betula* spp.) pollen grains are predominantly very small, suggestive of dwarf birch (*Betula nana*). Given the poor condition of the larger *Betula* spp. pollen specimens i.e. worn, cracked, broken or fragmented, it may be that they were blown into the context from farther afield (Gathorne-Hardy *et al*. 2009). Alternatively, the larger grains may represent relict pollen found within peats that were burnt at the time that the structure was occupied. Either way, the evidence indicative of woodlands contemporary with the structure is negligible. Traces of heathland and/or bog/mire type habitats may be indicated through the presence of *Sphagnum*, *Lycopodium annotinum*, *Diphazium alpinum*, Cyperaceae (sedge), *Drosera*-type, *Empetrum nigrum* and *Betula nana* (Rose 1981; Kristinsson 1986; Fitter 1987). However, the signal is generally weak.

5.2 Cereal Pollen

The presence of *Hordeum*-type (barley) pollen within the pollen assemblage was considered a possibility given that macro-botanical material from the farm mound at Reynistaðir implied that cereals may have been grown in the area from the time of settlement until the early 11th century (prior to the establishment of the monastery there) (Trigg *et al*. 2009). In Sample KLI-2014-21-014, a total of 6 Poaceae pollen grains were found to conform to *Hordeum*-type based upon pollen grain and annulus size (Andersen 1978). Average annulus size was 8.5 µm (range: 8-10 µm) and average grain size was 39.5 µm (range: 37-45 µm). The identified material is sufficient to suggest that *Hordeum*-type (c.f. barley) cereals were either cultivated or stored at Reynistaðir; especially as *Hordeum*-type pollen does not travel far from the source (Tweddle *et al*. 2005). Plant species and taxa that can be associated with disturbed (i.e. ploughed) ground e.g. *Cerastium*-type, *Montia fontana* and *Sagina* along with the survival of grazing sensitive species within a grassland context e.g. *Filipendula ulmaria*, lend credence to the possibility that cereals were cultivated at Reynistaðir following AD 1300 (Erlendsson *et al*. 2009; Vickers *et al*. 2011). *Montia fontana* in particular has been associated with damp, arable fields elsewhere in the northwest Atlantic region (Dickson 1999). In hand with the macro-botanical data from the farm mound at Reynistaðir, continuity in the cultivation of cereals at Reynistaðir is implied (Trigg *et al*. 2009). If this analysis is correct, it immediately challenges the view that the cultivation of cereals in Iceland was restricted to the south west of Iceland from the 12th century onwards (Byock 1988; Karlsson 2000).

There is a possibility that *Hordeum*-type pollen grains could be derived from naturally occurring lyme grass (*Leymus arenarius*) (Einarsson 1962; Hallsdóttir 1987; Edwards *et al*. 2011). Nominally a coastal species, lyme grass will grow inland in Iceland given sandy, free draining, conditions (Rose 1981; Kristinsson 1986; Fitter 1987). However, as described above (Section 5.1), the pollen assemblage context envisaged for Reynistaðir is neither coastal in character nor indicative of sandy, free draining conditions. On the contrary, we are presented with damp grassland habitats incorporating plants such as *Filipendula ulmaria*, *Thalictrum alpinum* and notably, *Montia fontana* the most prolific of the forb pollen in the assemblage.

5.3 Medicinal or Edible Plant Species

A range of species contained within the assemblage may be deemed of value with regard to their utility as edible and medicinal plants e.g. *Sphagnum* moss, *Empetrum nigrum, Galium*-type and *Filipendula ulmaria* (Ayres 2013; Kristjánsdóttir *et al*. 2014). Unfortunately, as native plant species they are commonly represented in pollen assemblages for Iceland and it is impossible to connect their presence at Reynistaðir specifically to medicinal practices and/or monastic traditions (Kristinsson 1986; Þórhallsdóttir 1996; Edwards *et al*. 2011). With regard to taxa e.g. Brassicaceae, it is impossible to distinguish cultivated, edible plants from wild, non-edible members of this family palynologically (Moore *et al*. 1991).

5.4 *Ambrosia*-type Pollen

The *Ambrosia* genus (ragweeds) belongs to the Asteraceae family of plants. Globally, most members of this genus originate in North America although some species have become naturalised in Europe; particularly common ragweed *Ambrosia artemisiifolia* which is considered a pest species and is allergenic (Bullock *et al*. 2010). *Ambrosia artemisiifolia* first appeared in Europe, including Scandinavia, in the 19th century (Lid & Lid 1994; Kiss & Beres 2006). There is a single, casual, record of *Ambrosia artemisiifolia* growing in western Iceland in 1948, its presence attributed to accidental introduction (Wasowicz *et al*. 2013). The inability of this species to produce a flower or ripe seed in a cool climate such as that characteristic of Iceland perhaps explains why this plant has never become naturalised here (Kristinsson 1986; Þórhallsdóttir 1996; Bullock *et al*. 2010).

As far as the author is aware, this genus has never previously arisen within a pollen profile in Iceland although there are at least two instances of it being identified within

Viking Age pollen assemblages from the Eastern Greenland Settlement in the vicinity of Igaliku Fjord (Igaliko Kangerlua). For Vatnhverfi, no attempt is made to interpret its presence other than to allocate it as “exotic” (Ledger 2013). For Lake Igaliku, its presence is attributed to long-distance air transport (Bichet *et al*. 2013). *Ambrosia artemesiifolia* and *Ambrosia trifida* display a number of characteristics that indicate specialisation for wind pollination with studies of the former species showing that its airborne pollen is commonly dispersed far from any known source (Chauvel *et al*. 2006; Martin *et al*. 2009; Bullock *et al*. 2010). A tendency for pollen “clumping” by *Ambrosia artemesiifolia* may also explain why there were two pollen grains of this taxon in the sample, which may have otherwise been unusual for an exotic in such a small sample (Martin *et al*. 2009).

It is worth noting, with regard to monasteries and medicinal plants, that there is one species of this genus that is native to the southern fringes of Europe; *Ambrosia maritima*, a coastal plant of the Mediterranean and North Africa (Hammouda *et al*. 2005; Kristjánsdóttir *et al*. 2014). Within the modern context, this plant species has attracted considerable attention with regard to its medicinal properties e.g. anti-oxidant, anti-diuretic, anti-bacterial, anti-spasmodic etc. and is undergoing clinical trial as a treatment of Bilharziosis (Ahmed & Khater 2001; Hammouda *et al*. 2005; Abu-Rabia 2012; Badawy *et al*. 2014). However, this is not a modern phenomenon of western medicine as this species is utilised in folk remedies in North Africa; a tradition that developed from the writings of medieval Arabic scholars (Ahmed & Khater 2001; Abu-Rabia 2012).

6. CONCLUSION

The pollen assemblage derived from sample KLI-2014-21-014 at Reynistaðir implies an ecological context dominated by damp, acid grassland with further evidence to suggest that it was grazed by livestock. The presence of *Hordeum*-type pollen along with the occurrence of other plant species and taxa associated with disturbed ground might suggest that cereal cultivation was a feature of the land management regime at Reynistaðir in the past. There is no definitive evidence of other plant species that harbour utilitarian properties in the pollen assemblage. Some characteristics associated with moist conditions i.e. *Montia fontana* may arise from a natural spring and/or slow-flowing watercourse or alternatively, from a constructed well and/or drainage system. The presence of exotic pollen *Ambrosia*-type is explained via natural processes.

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