Insect remains from the midden at Möðruvellir

Status of the analysis and preliminary results

Véronique Forbes, Université Laval, Québec City, Canada
November 2013

Sediment samples for archaeoentomological analyses were collected during the summer of 2008 from archaeological deposits excavated in the midden at the site of Möðruvellir in Eyjafjörður, northern Iceland (fig. 1). This work was done as part of the US National Science Foundation-funded 'Gásir Hinterlands Project' (GHP), a research effort involving archaeologists and environmental specialists from Forneifastofnun Íslands (FSÍ, Institute of Archaeology of Iceland), City University New York (CUNY) and other North American and British Universities. The project uses documentary sources, site-focused archaeology and palaeoenvironmental data to investigate the dynamics between local farm economies and subsistence strategies and their interactions with the medieval seasonal trading center of Gásir (see Harrison 2008; 2010 for more details). This report focuses on the archaeoentomological analyses – the analysis of preserved insect remains – which were undertaken on samples from Möðruvellir as part of the GHP project. Methods employed for the collections of archaeoentomological data in the field and in the laboratory are presented along with some preliminary results.

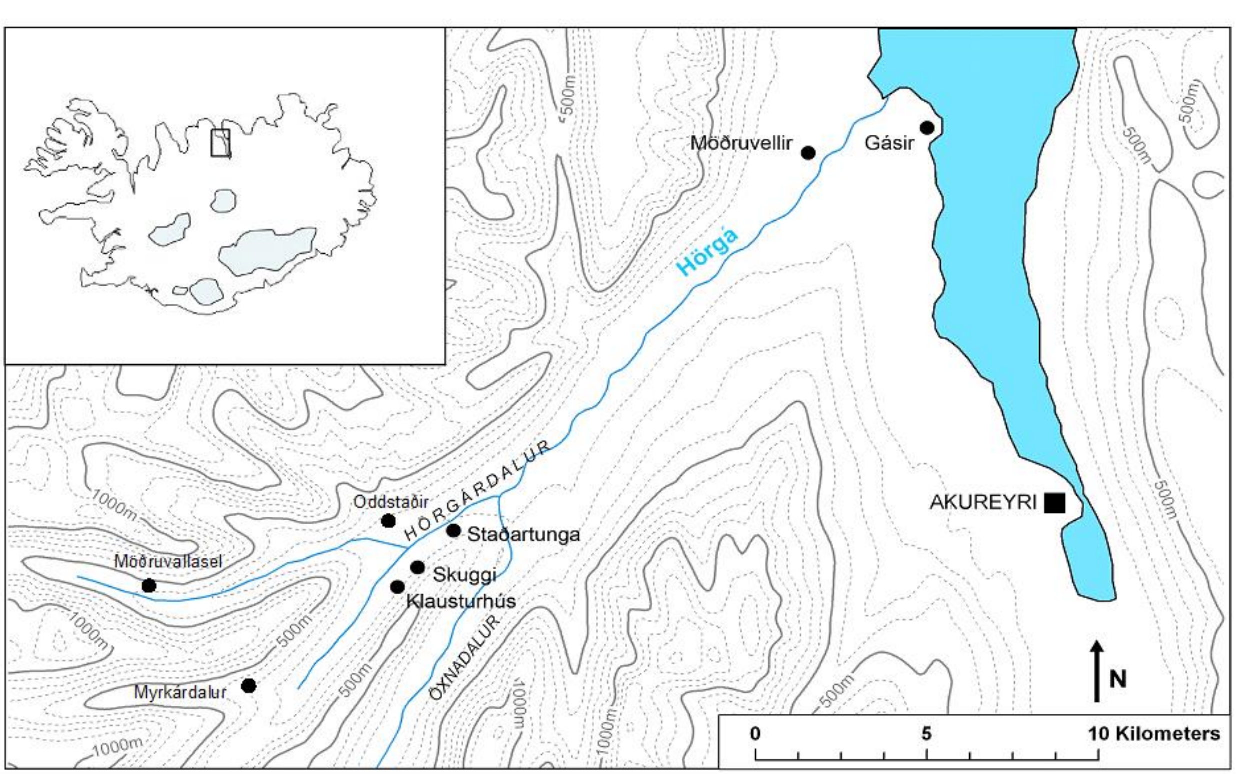

Figure 1. Map of Eyjafjörður showing the location of Möðruvellir and other sites investigated as part of the GHP Project (Map by R. Streeter, Dept. of Geography and Sustainable Development, U. St Andrews, edited by R. Harrison, CUNY, New York).

1. Archaeoentomological methods

1.1 Field methods

The collection of sediment samples for archaeoentomolgy was undertaken in June 2008 at Möðruvellir, during the third field season at the site. Excavations were directed by Howell M. Roberts (FSÍ) and Ramona Harrison (CUNY) and targeted the midden or Öskuhóll (the ash mound, see fig. 2), located next to the historic farm mound or Bæjarhóll formed by the buried remains of ancient buildings. Archaeological excavations at the site largely focused on trench 1, where excavations had started in 2006. During the 2008 season, the trench was extended both horizontally and vertically. Previous excavations allowed the collection of large zooarchaeological assemblages dating to the post-medieval period, and thus one of the main goals of the 2008 season was to reach medieval deposits and collect zooarchaeological and other archaeoenvironmental datasets. Although the crew was successful in reaching layers dating from the earlier occupation of the site, the preservation of zooarchaeological remains in the lower deposits proved to be very poor, due to a sudden change in soil acidity caused by the accumulation of peat ash. At the end of the field season, the 2 by 8m trench had reached a depth of c. 3m, and the natural soil had not been reached (Harrison 2008).

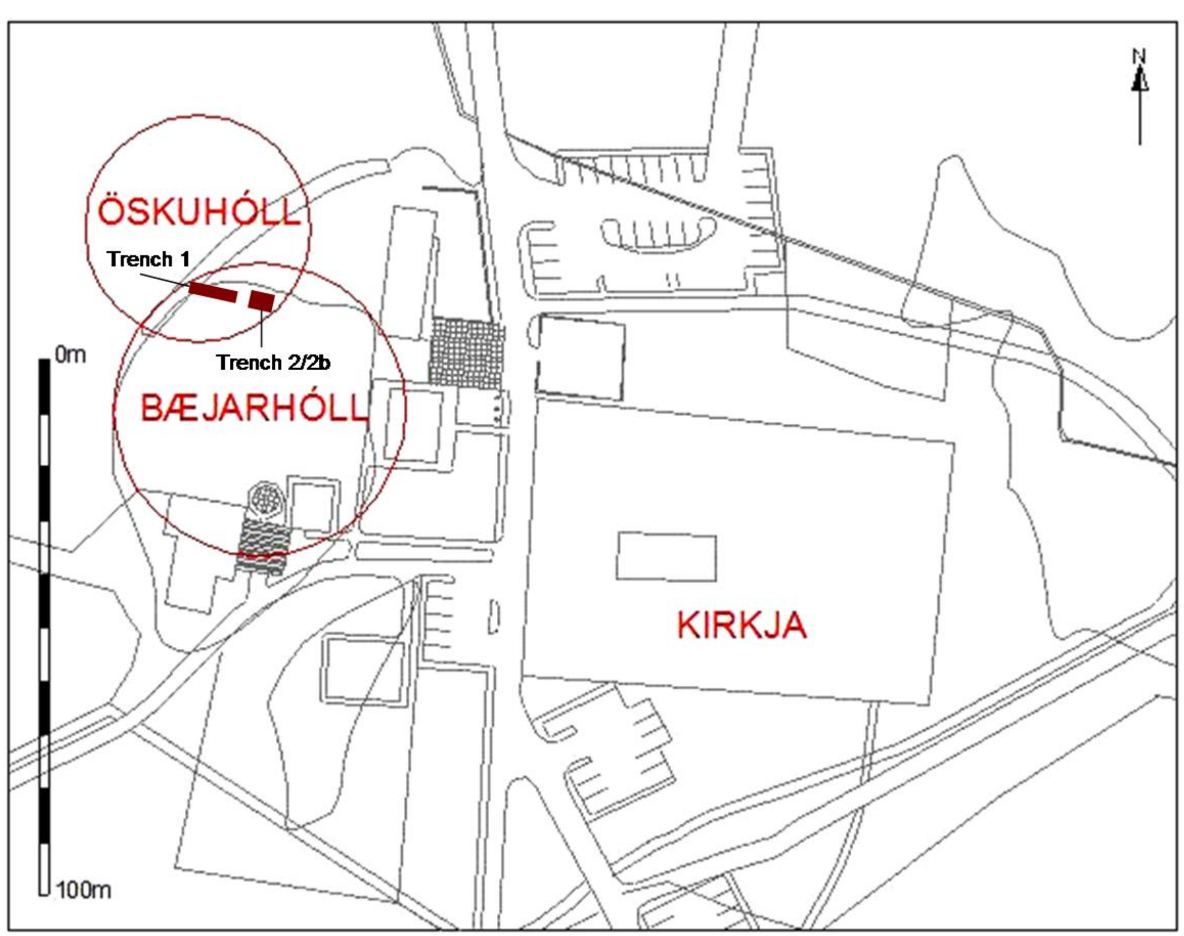

Figure 2. Map of Möðruvellir showing the location of buildings and excavation trenches (Map by H.M. Roberts, FSÍ, 2004, trenches added by R. Harrison, CUNY).

Samples for archaeoentomological analyses were collected by the author and R. Harrison in 10-cm sampling units from two columns placed in the north-facing section of trench 1. The first column (A) was placed 3m from the eastern end of the section, while the second column (B) was placed at the very eastern end of it (fig. 3). Because samples were taken by 10-cm arbitrary units, some of them incorporate more than one stratigraphical unit. Although this sampling method inevitably leads to a certain loss in chronological/context resolution, it has the advantage of being efficient in terms of field and recording logistics while also generally reducing the volume of sediment/number of samples to be processed.

A chronology for the midden mound has been established on the basis of radiocarbon dating and was also aided with artifacts such as glass and ceramics in the case of the later periods (see Harrison 2011 for details). The deposits, which span the Medieval, Post-medieval and Early Modern Periods, can be divided into four phases: 1) from the mid-13th to the early 14th century AD, 2) from the early 14th to the early 15th century, 3) from the mid-16th to the early 20th century and 4) from the mid-19th to the early 20th century. Table 1 shows that samples for insect remains have been collected from deposits dating from the Medieval to the Early Modern Periods (phases 2, 3 and 4), but not from layers dating of the earliest occupation at the site, which were concentrated in the bottom of the western half of trench 1. It was decided to target the eastern half of the section because the nature of the sediments there, which included more organic 'turfy' silts than peat ash, seemed more suited for the preservations of insect remains.

Table 1. List of sediment samples for archaeoentomological analyses collected from the midden at Möðruvellir in 2008.

COLUMN A	
Sample	**Dating**
08-86	Phase 2: early 14th to early 15th century AD
08-87	
08-88	
08-89	
08-90	
08-91	
08-92	
08-93	
08-94	
08-95	
08-96	
08-97	
08-98	
08-99	
08-100	Between phases 2 and 3
08-101	Phase 3: mid-16th to early 19th century AD
08-102	
08-103	
08-104	
08-105	
08-106	
08-107	
08-132	
08-133	Between phases 3 and 4

COLUMN B	
Sample	**Dating**
08-108	Phase 3: mid-16th to early 20th century AD
08-109	
08-110	
08-111	
08-112	
08-113	
08-114	
08-115	Between phases 3 and 4
08-116	Phase 4: mid-19th to early 20th century AD
08-117	
08-118	
08-119	
08-120	
08-121	
08-122	
08-123	
08-124	
08-125	
08-126	

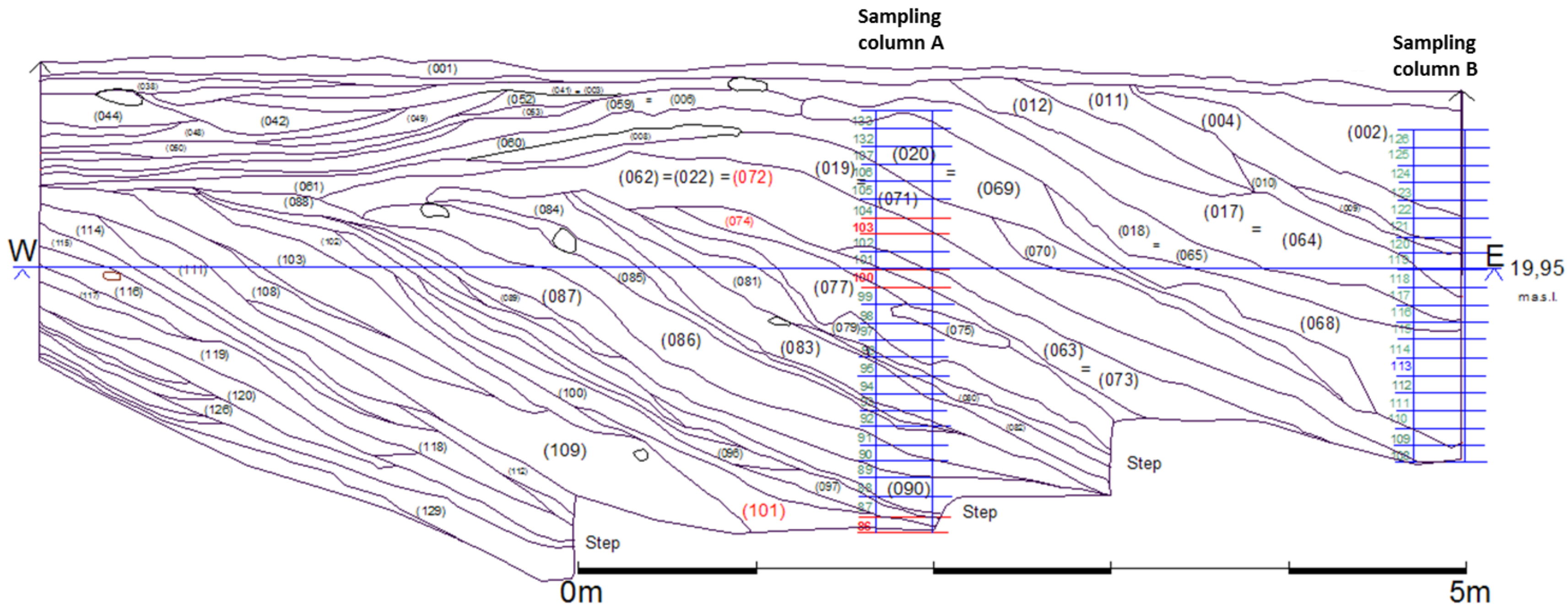

Figure 3. Localisation of the two sampling columns located in the north-facing section of trench 1 at Möðruvellir (image by R. Harrison, CUNY).

Samples collected from column A were stored in a garage owned by the FSÍ in Reykjavík a few weeks after the 2008 field season. They are still there at the present day awaiting analysis. The remaining samples, from column B, were sent to the Environmental Archaeology Laboratory of Université Laval in Québec City, Canada (see appendix 1 for details on the status of the analysis).

1.2 Laboratory methods

To this date, all of the 19 samples from column B except 1 (sample 08-111) have been through the first processing stage in the laboratory (the 'washing' stage), which consists in disaggregating the samples in warm water and passing them through a 300μ-mesh sieve. For each sample processed, the floating material (the organic fraction) was collected and stored in jars with ethanol in a refrigerator, while the heavy residue was left to dry. These heavy residues were scanned under a lamp with a magnifying glass to aid the description of the samples' contents.

For three of the samples (08-108, 08-113 and 08-116), full archaeoentomological analysis has been completed. The organic fractions of these samples were submitted to paraffin floatation, following the standard procedure used in archaeoentomology, originally devised by Coope and Osborne (1968) and described in detail in Kenward *et al.* (1980). Paraffin floatation was undertaken once for each sample. The resulting 'flots' were stored in ethanol and examined under a low power (10X) binocular microscope in order to retrieve insect remains.

Identifications of beetles (Coleoptera) and ectoparasites (Phthiraptera and Diptera: Hippoboscidae) were achieved through anatomical comparisons with modern specimens from the author's reference collection of Icelandic beetles and aided by consultation of entomological publications (Bousquet, 1990; Price and Graham 1997; Séguy, 1944). The minimum number of individuals was calculated from the most abundant insect part. Remains of flies (Diptera) were collected but not identified.

2. Preliminary results

The preservation conditions of insects in the three samples analyzed varied from medium (08-108) to good (08-113 and 08-116). A total 108 individual insects were recovered from the three samples analyzed, all of which are beetles (order Coleoptera) except for two ectoparasites, i.e. parasites that live on the body of their hosts (Table 2). The recovered insects are distributed among 24 insect taxa, each of which has been placed into an ecological group (Table 3). The classification used in this report separates the taxa between outdoor fauna, i.e. beetles able to complete their whole developmental cycle outdoors in Iceland, and synanthropes, which includes beetles that are either completely dependent on cultural habitats or clearly favored by human activity. The category 'other' includes ectoparasites and taxa considered 'unclassifiable' because they are eurytopic (occuring in a wide range of natural and synanthropic habitats) and/or could not be identified to a precise taxonomic level. The following paragraphs present each of the insect taxa identified from Möðruvellir and describes their preferred habitats in Iceland.

Table 2. List of identified insects from the three analyzed samples collected from the midden at Möðruvellir. The taxonomy employed is based on Ólafsson's checklist of Icelandic insects (1991) and the nomenclature used for the Coleoptera follows Böhme (2005).

	08-108	**08-113**	**08-116**
PHTHIRAPTERA			
BOVICOLIIDAE			
Bovicola ovis (L.)			1
COLEOPTERA			
CARABIDAE			
Patrobus septentrionis (Dejean)		1	
Calathus melanocephalus (Linnaeus)		1	1
DYSTICIDAE			
Hydroporus nigrita (F.)		1	1
STAPHYLINIDAE			
Omalium excavatum Stephens		5	
Omalium spp.			3
Xylodromus concinnus (Marsham)		5	1
Aleochara sparsa Heer		1	1
Oxypoda spp.	1	3	16
Aleocharinae indet.	1	4	18
Stenus spp.	2	7	2
Staphylinidae indet.			1
SCARABAEIDAE			
Aphodius lapponum Gyllenhal		1	
BYRRHIDAE			
Byrrhus fasciatus (Forst.)			1
PTINIDAE			
Tipnus unicolor (Piller & Mitterpacher)		4	1
CRYPTOPHAGIDAE			
Cryptophagus pilosus Gyllenhal			1
Cryptophagus spp.	1	1	4
Atomaria spp.	1	1	2
LATRIDIIDAE			
Latridius minutus grp. (Linnaeus)	1	5	1
Corticaria elongata (Gyllenhal)		1	1
CURCULIONIDAE			
Otiorhynchus rugifrons (Gyllhenhal)			1
Tropiphorus obtusus (Bonsdorff)		1	
Coleoptera indet.	1		
DIPTERA			
HIPPOBOSCIDAE			
Melophagus ovinus (Linnaeus)			1
TOTAL	8	42	58

Table 3. Ecological groupings of identified insect taxa from samples 08-108, 08-113 and 08-116 from the midden at Möðruvellir. The classification is based on the Icelandic entomological literature (e.g. Buckland et al. 1991; Gudleifsson 2005; Larsson 1959; Larsson & Gígja 1959; Sadler & Dugmore 1995), habitat information provided in the BugsCEP database (Buckland & Buckland 2006) and results of a survey of modern Coleoptera from farm buildings in northern Iceland (Forbes 2013b).

OUTDOOR FAUNA	SYNANTHROPES	OTHERS
Dry grasslands / sparse vegetation fauna	**Eurytopic synanthropes**	**Ectoparasites**
Calathus melanocephalus (Linnaeus)	*Omalium excavatum* Stephens	*Bovicola ovis* (L.)
Byrrhus fasciatus (Forst.)	*Aleochara sparsa* Heer	*Melophagus ovinus* (Linnaeus)
Otiorhynchus rugifrons (Gyllhenhal)		
	Rotting foul matter fauna	**Unclassifiable**
Meadows / wetlands fauna	*Aphodius lapponum* Gyllenhal	*Omalium* spp.
Patrobus septentrionis (Dejean)		*Oxypoda* spp.
	Dry mouldy matter fauna	Aleocharinae indet.
Aquatic / waterside fauna	*Xylodromus concinnus* (Marsham)	*Stenus* spp.
Hydroporus nigrita (F.)	*Cryptophagus pilosus* Gyllenhal	Staphylinidae indet.
	Cryptophagus spp.	Coleoptera indet.
Outdoor eurytopic fauna	*Atomaria* spp.	
Tropiphorus obtusus (Bonsdorff)	*Latridius minutus* grp. (Linnaeus)	
	Corticaria elongata (Gyllenhal)	
	General indoor pests	
	Tipnus unicolor (Piller & Mitterpacher)	

a) Dry grasslands / sparse vegetation fauna

The ground beetle (fam. Carabidae) *Calathus melanocephalus* is known to prefer dry biotopes with sparse vegetation in Iceland and is very common in pastures and grasslands all around the island (Larsson & Gígja 1959, 31-32). The pill beetle (fam. Byrrhidae) *Byrrhus fasciatus* is a moss-feeder, which is also common in Iceland on dry grounds (Larsson & Gígja 1959, 158) and the weevil taxon (fam. Curculionidae) *Otiorhynchus rugifrons* is wingless and also occurs on grasslands, most often in association with wild thyme (*Thymus serpyllum*) (Larsson & Gígja 1959; Lindroth *et al.* 1973).

b) Meadows / wetlands fauna

Ground beetles of the genus *Patrobus* occur in open environments on moist ground (Lindroth 1969, 178). In Iceland, *P. septentrionis* is most commonly found in meadows and is widely distributed around the country (Larsson & Gígja 1959, 29).

c) Aquatic / waterside fauna

Most water beetles (Coleoptera: Dysticidae) are free-swimming in water or live in submerged sediment. The species *Hydroporus nigrita* is not very particular in terms of its habitat requirements and is found in Iceland in various types of stagnant or slowly running waters (Larsson & Gígja 1959, 49; Lindroth *et al.* 1973).

d) Outdoor eurytopic fauna

As an adult, the weevil *Tropiphorus obtusus* is known to gnaw on the variety of plants, while the larvae are root eaters. The species is known from dry to moist biotopes in Iceland, where it has been encountered in various situations that include cultivated lands, hayfields, pastures and heaths (Gudleifsson 2005; Larsson & Gígja 1959, 199).

e) Eurytopic synanthropes

Two rove beetle (fam. Staphylinidae) taxa have been placed in this group because they are able to exploit a rather wide range of materials in synanthropic situations. Indeed, *Omalium excavatum* and *Aleochara sparsa* have both been recorded mainly from decaying plant matter in Iceland, but also from animal manure (Larsson & Gígja 1959, 64, 121; Forbes 2013b, 100-101).

f) Foul rotting matter fauna

The dung beetle (fam. Scarabaeidae) *Aphodius lapponum* breeds in the dung of large herbivores such as sheep, cattle and horse (Larsson & Gígja 1959, 128), all of which were introduced to Iceland by the Norse people from the late 9th century AD (Buckland 2000, 146). Even though the species is strongly synanthropic, it is normally encountered in the open. However, the species is able to fly and may therefore enter buildings adventitiously.

g) Dry mouldy matter fauna

The group dry mouldy matter fauna is mainly composed of beetle taxa of the families Cryptophagidae (*Cryptophagus pilosus*, *Cryptophagus* spp., *Atomaria* spp.) and Lathridiidae (*Latridius minutus* grp., *Corticaria elongata*), which feed on moulds growing on decaying vegetation. Only one of the species placed in this group, the rove beetle *Xylodromus concinnus*, is a predator, preying on the microfauna living in this biotope. In Iceland, all these species are strong synanthropes known to occur nowadays in decaying hay in barns and byres (Larsson 1959, 68-69). Some of these beetles have so far only been encountered indoors in Iceland, but others, such as *Xylodromus concinnus* and *Latridius minutus* (grp.), are known to be able to fly to hayfields and haystacks outside farm buildings (Larsson & Gígja 1959, 65, 144).

h) Ectoparasites

Two ectoparasites, both parasitic on domestic sheep, have been identified from these samples: the sheep biting louse *Bovicola ovis* and the sheep ked *Melophagus ovinus.* Both insects spend their whole lifecycle in the wool of the animal (Lloyd 2002, 353; Price & Graham 1997, 89). The first is known to feed on skin debris (Price & Graham 1997, 93), while the second is a wingless fly that feeds on blood (Lloyd 2002, 352).

i) Unclassifiable

Some of the remaining insect taxa are considered unclassifiable because they could only be identified to the taxonomic level of the order, family or subfamily. This is the case of Staphylinidae indet., Aleocharinae indet and Coleoptera indet. Other taxa were successfully identified to the level of genus, but the ecological habitats spanned by the species in those genera are too diverse to allow them to be placed in an ecological group. This is the case of the rove beetle taxa *Omalium* spp., *Oxypoda* spp. and *Stenus* spp.

j) Inter-samples comparisons

The three samples analyzed have been compared both in terms of the concentration of insect recovered per litre of sediment processed (table 4) and of the ecological habitats represented by these faunas (fig. 4). Implications for these results are discussed in the following section.

Table 4. Concentration of insect remains in each of the 3 samples analyzed from Möðruvellir.

	08-108	**08-113**	**08-116**
number of insects (n)	8	42	58
volume of sediment processed (l)	2	2	4
concentration (n/l)	**4**	**21**	**14.5**

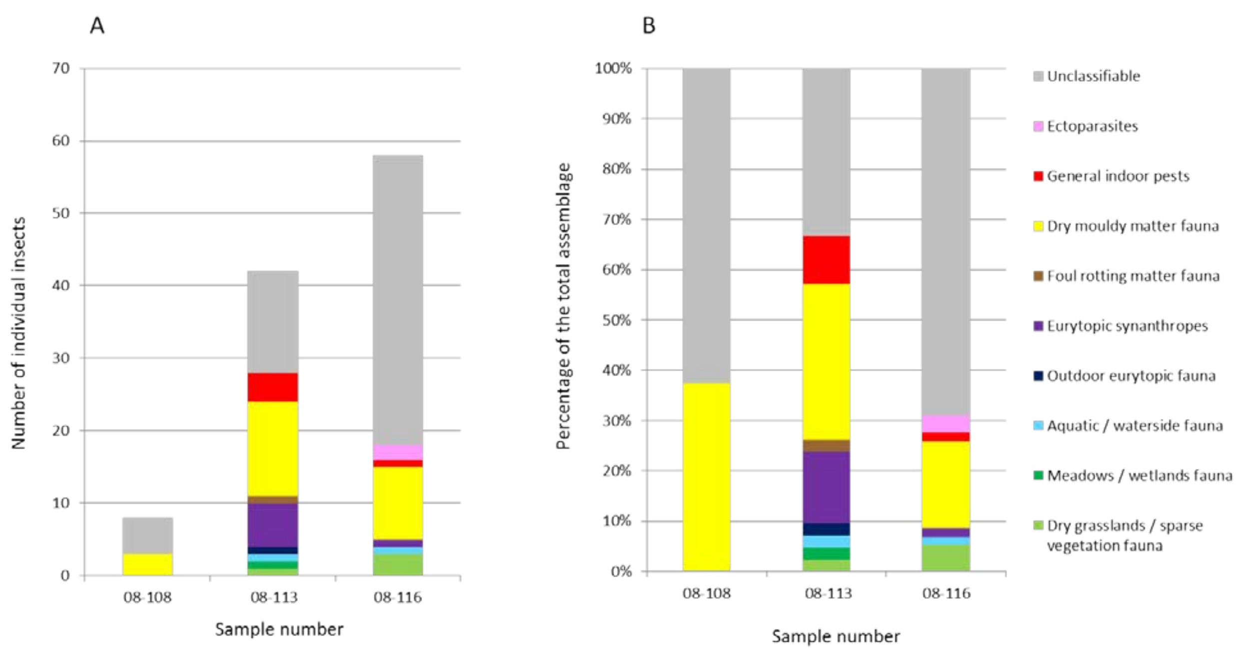

Figure 4. Comparison between the contributions of each ecological group to the insect faunas obtained from the three samples analyzed from Möðruvellir: A) based on the number of individual insects from each group; B) based on the percentage of the total assemblage that is represented by each group.

3. Discussion

Table 4 shows that for one of the samples analyzed, 08-108, the concentration of insect remains was very low. This sample is also the one where preservation conditions of insect remains were the poorest. Although concentrations obtained from the two remaining samples are also low, they resemble those of other midden samples from Icelandic sites where insect remains were rather well-preserved (e.g. Amorosi *et al.* 1994; Forbes *et al.* 2010). As middens are formed of occupation layers which are re-deposited and may remain exposed to the air during a certain time after and between episodes of deposition, they rarely produce insect assemblages that show excellent preservation conditions (this is also discussed in King & Forbes 2010; Forbes 2013a). The fact that two of the samples examined from Möðruvellir produced insect remains that were generally well-preserved should therefore be seen as a positive result.

The number of samples analyzed as part of this report is too small to allow for an explanation of the variations visible in figure 4, but a consideration of the ecological requirements of the insects identified highlights how the analysis of archaeoentomological assemblages from middens excavated as part of the GHP project could contribute to enhance our understanding of local site activities and human-environment interactions in the Eyjafjörður region.

3.1 Origin of midden materials and local resource exploitation

At least 10% of the three assemblages are composed of synanthropic beetles belonging to the group 'dry mouldy matter fauna'. These insects are associated with decaying vegetal matter where mould was able to grow, and today, these taxa are mostly found in old hay in barns and byres. In the past, however, they would have been common not only in farm buildings but also in dwellings made of turf, as this building material would have provided suitable conditions for them to thrive. Mould-feeders would no doubt also have been able to breed in decaying peat, which is known to have been used as fuel (Annandale 1905, 202; Ólafsson & Pálsson 1805), and which use at Möðruvellir from Medieval through Post-Medieval times is attested through thick deposits of peat ash in the midden (see Harrison 2008). The presence of these mould-feeders is also an indication that some of the materials dumped in there originated from indoors. This is supported by the presence of five specimens of the spider beetle *Tipnus unicolor*, a member of the group 'general indoor pests' which has so far only been recorded inside buildings in Iceland (Larsson & Gígja 1959, 166-167). This insect is a strong synanthrope with very poor dispersal capacities as it is unable to fly. There is little doubt that the vegetal materials used for flooring, as well as fuel and building materials would also have provided suitable conditions for other synanthropic beetles, and it is therefore possible that some of the 'eurytopic synanthropes' identified from the analyzed samples originated from such materials.

Some of the outdoor insects recovered from these samples may have arrived in the midden either by accident or in search of prey, or they may have been transported with resources collected from the local environment. Previous archaeoentomological research in Iceland has suggested that the collection and use of peat and turf may cause the introduction of aquatic and waterside insects, as well as ground beetles, rove beetles and weevils living in open hayfields and pastures, in archaeological house floors (Amorosi *et al.* 1992; 1994; Buckland *et al.* 1992; Forbes & Milek 2013). It is possible that the water beetle *Hydroporus nigrita* and the ground beetles *Patrobus septentrionis* and

Calathus melanocephalus arrived in the midden on unusable turf, in burnt peat or with shovelled out flooring materials. However, as these beetles are able to move rather long distance, they are more likely to have ended up in the midden as a result of their own locomotive means rather than as a consequence of having been transported with collected resources. Wingless outdoor beetles such as the weevils *Otiorhynchus rugifrons* and *Tropiphorus obtusus* are perhaps more likely to have arrived in the midden this way.

There is little archaeoentomological evidence for the presence of foul matter, such as animal manure, in these archaeological contexts. A single dung beetle *Aphodius lapponum* has been identified from these samples, and as this insect lives in the open and is able to fly, it may have flown from pastures to the midden or have been transported there along with turf collected from grazed fields. The presence of *A. lapponum* is therefore more indicative of the proximity of pastures than of the dumping of manure or dung in the midden. However, with only one specimen and considering the fact that this beetle can fly rather long distances, it is possible that these pastures were located some kilometres away from Möðruvellir.

3.2 Sheep ectoparasites and wool processing

The sheep ked *Melophagus ovinus* and the sheep louse *Bovicola ovis* are rather common finds in samples collected from Icelandic sites (Amorosi *et al.* 1992; Buckland *et al.* 1992; Forbes *et al.* 2010; Vickers & Buckland 2012). These insects are normally strongly attached to the fleece, and it has been suggested that their presence in an archaeological layer may be more indicative of wool processing activities than of the presence of sheep on site (Buckland & Perry 1989). It is possible that the specimens recovered from the midden at Möðruvellir came from the floor of rooms where people were cleaning, carding or stretching wool, or that they came from wool processing residues dumped in there.

4. Recommendations

Results obtained from the analysis of three samples from the midden at Möðruvellir suggest that the site has a good potential for archaeoentomology, as insects appear to be rather well-preserved, at least in some of the stratigraphical layers post-dating 1500 AD. It is therefore recommended that further samples be analyzed. A more detailed analysis of insect remains form Möðruvellir would help to identify the types of materials disposed of in the midden, the types of resources that were exploited from the local environment, and reveal some of the domestic and economic activities that took place on the site.

The remaining samples from column B are presently being analyzed at the Environmental Archaeology Laboratory in Quebec. As these only cover two of the chronological phases encountered at the site (phases 3 and 4), it would desirable to analyze some of the lower samples collected from column A for insect remains, as these pre-date the 1500s (phase 2). Preservation may be poorer in these lower layers because of their rather high peat ash content, and it would therefore be preferable to target samples taken from levels with a higher organic silt content, if at all possible.

5. Acknowledgements

This study received financial support provided by the Arts Faculty at Université Laval. I would like to thank Ramona Harrison, Howell Roberts and Allison Bain for the opportunity to work on this material. Thanks are also due to Maryse Cloutier-Gélinas for her help with the processing of samples and the sorting of insect remains.

6. References

Amorosi, T., Buckland, P.C., Magnússon, K., McGovern, T.H. & Sadler, J.P. (1994) 'An Archaeozoological Examination of the Midden at Nesstofa, Reykjavík, Iceland'. In R. Luff & P. Rowley-Conwy (eds), *Whither Environmental Archaeology*, pp. 69-80. Oxbow Monograph, Oxford.

Amorosi, T., Buckland, P.C., Ólafsson, G., Sadler, J.P. & Skidmore, P. (1992) 'Site Status and the Palaeoecological Record: A Discussion of the Results from Bessasstaðir, Iceland'. In C.D. Morris & D.J. Rackham (eds), *Norse and Later Settlement and Subsistence in the North Atlantic*, pp. 169-191. University of Glasgow, Glasgow.

Annandale, N. (1905) *The Faroes and Iceland: Studies in Island Life*. Clarendon Press, Oxford.

Böhme, J. (2005). *Die Käfer Mitteleuropas. K. Katalog (Faunistiche Übersicht)* (2nd ed.). Spektrum Academic, Munich.

Bousquet, Y. (1990) *Beetles Associated with Stored Products in Canada. An Identification Guide*. Ministry of Supply and Services, Ottawa.

Buckland, P.C. (2000) 'The North Atlantic Environment'. In W. Fitzhugh & E.I. Ward (eds), *Viking: The North Atlantic Saga,* pp. 146-153. Smithsonian Institution Press, Washington DC.

Buckland, P.C., Dugmore, A.J. & Sadler, J.P. (1991) 'Faunal Change or Taphonomic Problem? A Comparison of Modern and Fossil Insect Faunas from Southeast Iceland'. In J.K. Maizels & C. Caseldine (eds.), *Environmental Change in Iceland: Past and Present*, pp. 127-146. Kluwer Academic, Dordrecht.

Buckland, P.C. & Perry, D.W. (1989) 'Ectoparasites of Sheep from Stóraborg, Iceland and their Interpretation'. *Hikuin* 15: 37-46.

Buckland, P.C., Sadler, J.P. & Sveinbjarnadóttir, G. (1992) 'Palaeoecological Investigations at Reykholt, Western Iceland'. In C.D. Morris & D.J. Rackham (eds), *Norse and Later Settlement and Subsistence in the North Atlantic*, pp. 149-167. University of Glasgow, Glasgow.

Buckland, P.I. & Buckland, P.C. (2006). *Bugs Coleopteran Ecology Package* (Versions: BugsCEP v7.63; Bugsdata v72; BugsMCR v2.02; BugStats v1.22) [Downloaded: 16.01.12] www.bugscep.com.

Coope, G.R. & Osborne, P. J. (1968) 'Report on the Coleopterous Fauna of the Roman Well at Barnsley Park, Gloucestershire'. *Transactions of the Bristol and Gloucestershire Archaeological Society* 86: 84-87.

Forbes, V. (2013a) *Archaeoentomological Analysis of Midden and Off-Site Samples from Svalbarð and Hjálmarsvík, Þistilfjörður, Northeast-Iceland*. Université Laval, Québec City.

Forbes, V. (2013b) 'Chapter 4. Modern Analogues: A Study of Insects from Northern Icelandic Farms'. In V. Forbes *Evaluation of Archaeoentomology for Reconstructing Rural Life-Ways and the Process of Modernisation in 19th and Early 20th-Century Iceland*, pp. 68-126. PhD Dissertation, University of Aberdeen.

Forbes, V., Bain, A., Gisladóttir, G.A. & Milek, K.B. (2010) 'Reconstructing Aspects of the Daily Life in Late 19th and Early 20^{th-}century Iceland: Archaeoentomological Analysis of the Vatnsfjörður Farm, NW Iceland'. *Archaeologica Islandica* 8: 77-110.

Forbes, V. & Milek, K.B. (2013) Insects, Activity Areas and Turf Buildings' Interiors: An Ethno-archaeoentomological Case Study from 19th to Early 20th-century Þverá, Northeast-Iceland. *Quaternary International*. http://dx.doi.org/10.1016/j.quaint.2013.10.014.

Gudleifsson, B.E. (2005) 'Beetles Species (Coleoptera) in Hayfields and Pastures in Northern Iceland'. *Agriculture, Ecosystems and Environment* 109: 181-186.

Harrison, R. (2008) *Midden Excavation at Möðruvellir, and Prospection in Hörgárdalur*. Interim Field Report, Gásir Hinterlands Project 2008. Fornleifastofnun Íslands, Reykjavík.

Harrison, R. (2010) *Gásir Hinterlands Project 2009. Midden Prospection and Excavation*. Fornleifastfnun Íslands, Reykjavík.

Harrison, R. (2011) *Möðruvellir in Hörgárdalur, N. Iceland: General Overview of the Archaeofauna Analyzed from the 2006-08 Midden Mound Excavations*. HERC/NORSEC Zooarchaeology Laboratory REPORT No.59. Brooklyn College Zooarchaeology Laboratory, City University New York, New York.

Kenward, H.K., Hall, A.R. & Jones, A.K.G. (1980) 'A Tested Set of Techniques for the Extraction of Plant and Animal Macrofossils from Waterlogged Archaeological Deposits'. *Science and Archaeology* 22: 3-15.

King, G. & Forbes, V. (2010) *Archaeoentomological Investigations at Skútústaðir, Mývatnssveit, N-Iceland.* Unpublished report, Université Laval.

Larsson, S.G (1959) 'Coleoptera 2. General Remarks'. In Á. Friðriksson & S.L. Tuxen (eds), *The Zoology of Iceland.* Volume III, Part 46b. Ejnar Munksgaard, Copenhagen.

Larsson, S.G. & Gígja, G. (1959) 'Coleoptera 1. Synopsis'. In Á. Friðriksson & S.L. Tuxen (eds), *The Zoology of Iceland.* Volume III, Part 46a. Ejnar Munksgaard, Copenhagen.

Lindroth, C.H. (1969) 'The Ground Beetles (Carabidae, excl. Cicindellidae) of Canada and Alaska, Part 2'. *Oposcula Entomologica Supplementum XX:* 1-200. Entomologiska Sällskapet I Lund, Lund.

Lindroth, C.H., Andersson, H., Bodvarsson, H. & Richter, S.H. (1973) *Surtsey, Iceland. The Development of a New Fauna, 1963-1970. Terrestrial Invertebrates.* Entomologica Scandinavia Suppl. 5, Lund.

Lloyd, J.E. (2002) 'Louse Flies, Keds, and Related Flies (Hippobiscoidea)'. In G. Mullen & L.A. Durden (eds), *Medical and Veterinary Entomology,* pp. 349-362. Academic Press, San Diego.

Ólafsson, B. & Pálsson, E. (1805) *Travels Performed in Iceland by Order of His Danish Majesty Containing Observations on the Manners and Customs of the Inhabitants, a Description of the Lakes, Rivers, Glaciers, Hot-Springs, and Volcanoes; of the Various Kinds of Earths, Stones, Fossils, and Petrifactions; as well as of the Animals, Insects, Fishes, &c. Translated from the Danish.* Barnard & Sultzer, London.

Ólafsson, E. (1991) *Íslenskt Skordýratal.* Fjölrit Náttúrufraeðistofnunar, Reykjavík.

Price, M.A. & Graham, O.H. (1997) *Chewing and Sucking Lice as Parasites of Mammals and Birds.* Technical Bulletin No. 1849, US Department of Agriculture.

Roberts, H.M. (2004) *Garðlag á Möðruvöllum í Eyjafirði, Fornleifarannsókn.* Fornleifastofnun Íslands - FS254-04251, Reykjavík.

Sadler, J.P. & Dugmore, A.J. (1995) 'Habitat Distribution of Terrestrial Coleoptera in Iceland as Indicated by Numerical Analysis'. *Journal of Biogeography 22 (1): 141-148.*

Séguy, E. (1944) *Insectes Ectoparasites (Mallophaga, Anopleures, Siphonaptera).* Faune de France 43, Lechevalier, Paris.

Vickers, K. & Buckland, P.C. (2012) 'Medieval Deposits. Context [577]'. In G. Sveinbjarnadóttir (ed.), *Reykholt: Archaeological Investigations at a High Status Farm in Western Iceland*, pp. 218-223. National Museum of Iceland, Reykjavík.

Appendix 1. Table summarizing the status of the archaeoentomological analyses of the Möðruvellir samples.

Sampling column	Sample #	Details	Location	Status of analysis			
				Washing	Floatation	Sorting	Identifications
A	08-86	0-10 cm	Iceland (FSI garage)				
A	08-87	10-20 cm	Iceland (FSI garage)				
A	08-88	20 - 30 cm	Iceland (FSI garage)				
A	08-89	30-40 cm	Iceland (FSI garage)				
A	08-90	40-50cm	Iceland (FSI garage)				
A	08-91	50-60cm	Iceland (FSI garage)				
A	08-92	60-70cm	Iceland (FSI garage)				
A	08-93	70-80cm	Iceland (FSI garage)				
A	08-94	80-90cm	Iceland (FSI garage)				
A	08-95	90-100cm	Iceland (FSI garage)				
A	08-96	100-110cm	Iceland (FSI garage)				
A	08-97	110-120cm	Iceland (FSI garage)				
A	08-98	120-130cm	Iceland (FSI garage)				
A	08-99	130-140cm	Iceland (FSI garage)				
A	08-100	140-150cm	Iceland (FSI garage)				
A	08-101	150-160cm	Iceland (FSI garage)				
A	08-102	160-170cm	Iceland (FSI garage)				
A	08-103	170-180cm	Iceland (FSI garage)				
A	08-104	180-190cm	Iceland (FSI garage)				
A	08-105	190-200cm	Iceland (FSI garage)				
A	08-106	200-210cm	Iceland (FSI garage)				
A	08-107	210-220cm	Iceland (FSI garage)				
B	08-108	0-10cm	Canada (U. Laval)	√	√	√	√
B	08-109	10-20cm	Canada (U. Laval)	√			
B	08-110	20-30cm	Canada (U. Laval)	√			
B	08-111	30-40cm	Canada (U. Laval)				
B	08-112	40-50cm	Canada (U. Laval)	√			
B	08-113	50-60cm	Canada (U. Laval)	√	√	√	√
B	08-114	60-70cm	Canada (U. Laval)	√			
B	08-115	70-80cm	Canada (U. Laval)	√			
B	08-116	80-90cm	Canada (U. Laval)	√	√	√	√
B	08-117	90-100cm	Canada (U. Laval)	√			
B	08-118	100-110cm	Canada (U. Laval)	√			
B	08-119	110-120cm	Canada (U. Laval)	√			
B	08-120	120-130cm	Canada (U. Laval)	√			
B	08-121	130-140cm	Canada (U. Laval)	√			
B	08-122	140-150cm	Canada (U. Laval)	√			
B	08-123	150-160cm	Canada (U. Laval)	√			
B	08-124	160-170cm	Canada (U. Laval)	√			
B	08-125	170-180cm	Canada (U. Laval)	√			
B	08-126	180-190cm	Canada (U. Laval)	√			
A	08-132	220-230cm	Iceland (FSI garage)				
A	08-133	230-240cm	Iceland (FSI garage)				