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Abstract

This paper reports on the zooarchaeological and archaeobotanical remains from the initial season of excavations at the Norse period site at Undir Junkarinsfløtti in the Faroe islands. These remains represent the first zooarchaeological analysis undertaken for the Faroes and only the third archaeobotanical assemblage published from the islands. The excavated deposits are described and the key

findings from the palaeoenvironmental remains highlighted within the context of the wider North Atlantic environmental archaeology of the Norse period.

Keywords: Faroes, North Atlantic, Landnám, zooarchaeology, archaeobotany

Introduction

The Faroes consist of a cluster of 18 small islands in the North Atlantic c. 300 km northwest of Shetland and c. 780 km southeast of Reykjavik, Iceland (Fig. 1). The climate is wet, windy, and comparatively mild for the latitude (62°N, 7°W), a function of the islands' position within the Gulf Stream. The Faroes were not settled until the late first millennium AD, perhaps by a small number of Irish ecclesiastical hermits in the 7th to early 9th century, according to contemporary literature (*De mensura orbis terrae* written in AD 825 by the Irish monk Dicuil) and equivocal palaeoenvironmental evidence (cf. Jóhansen 1985; Hannon et al. 2001). The first well-documented period of substantial settlement occurred during the ninth century AD with the arrival of Norse settlers (Arge 1991; 1993; Debes 1993). This settlement, or landnám ("land taking" in Old Norse), within pristine or near-pristine landscapes is a key feature of the archaeology of the North Atlantic islands (McGovern 2004). Norse Landnám occurred in Iceland between AD 870–880 and approximately AD 1000 in Greenland, and each island group provides opportunities to examine human-environment impacts on these near-pristine landscapes. The Faroes Iceland-Greenland "transect," from the eastern to western North Atlantic, spans an environmental continuum that grows increasingly Arctic (colder and more continental) in character as both the marine and atmospheric polar fronts are crossed. Viking and Norse period archaeology in the Faroes is therefore very important, as it represents the first temperate stepping stone in this transect and also the first pristine landscape facing the Norse settlers. This novel landscape would have posed unique questions for the survival and failure of the Norse, and their adaptation to this alien environment would inform the success of subsequent generations of Norse settlers.

Environmental archaeology has a key role in identifying the nature of this human-environment interaction. The timing and environmental impact of settlement has been investigated for over thirty years in Faroese research, through the analysis of various palaeoenvironmental records in lake sediments and peat, including palynology (Jóhansen 1971; 1975; 1982; 1985), plant macrofossils (Bennike et al. 1998), insects (Buckland 1990; Buckland and Dinnin 1998) and multiproxy investigations (Buckland et al. 1998; Hannon et al. 1998; 2001) within a chronological framework provided by radiocarbon dating and tephrochronology (Dugmore and Newton 1998; Hannon and Bradshaw 2000; Wastergård 2002). Conversely, few analyses have been published concerning ecofacts and environmental remains on archaeological sites, covering only plant macrofossils (Malmros 1990; 1994; Vickers et al. in press) and pollen and insect remains (Edwards et al. 1998).

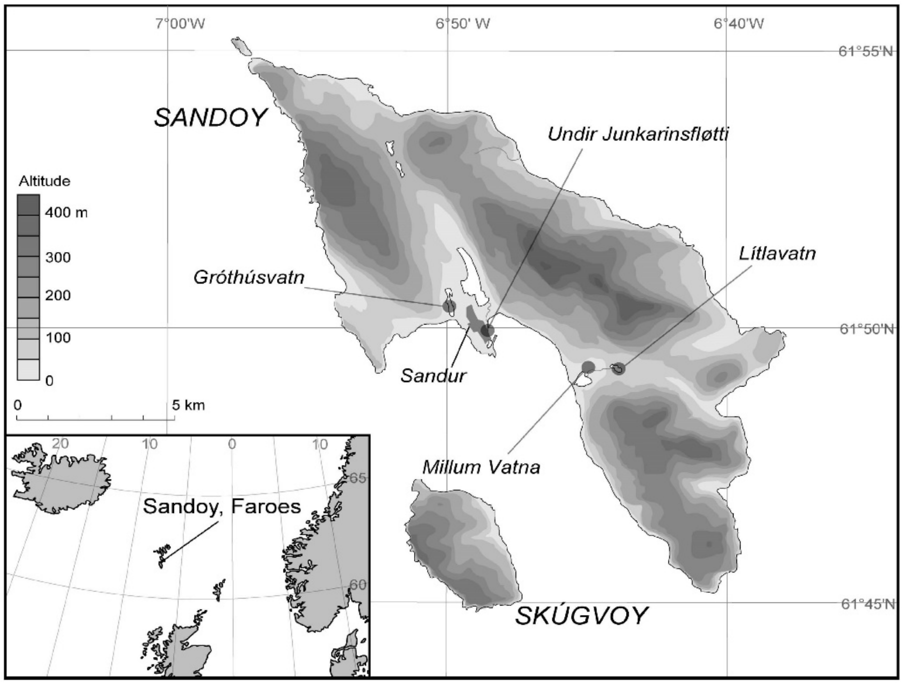

Figure 1. Location map of Undir Junkarinsfløtti.

A new international, multidisciplinary research project funded by the Leverhulme Trust investigating the impact of landnám on the pristine landscapes of the North Atlantic islands (Edwards et al. 2004; Dugmore et al. 2005) has identified the need to integrate the offsite palaeoenvironmental record of the Faroes with detailed insights into the economic practices of the Norse settlers, afforded through onsite environmental archaeology (Lawson et al. in press). The recent excavations at Undir Junkarinsfløtti on the island of Sandoy (Fig. 1) represented a key site for investigating early Faroese palaeoeconomy. The archaeology consisted of a series of Viking and Norse period middens exposed by coastal erosion in the sandy soil of the infield of the nearby village of Sandur. The middens were first identified in 2000 after slumping caused by a prolonged dry period, with an initial trial-trenching exercise by Føroya Forminnissavn (Faroes National Museum) recording a series of bone- and ash-rich middens over two meters high (Arge 2001). Two radiocarbon dates from the two lowest midden deposits produced determinations (AAR-6928 and AAR-6929, see Table 1) of the landnám period (9th–10th centuries cal. AD). The early dating of the site was reinforced by the discovery of a Viking period bronze brooch of 10th century cal. AD date in the same layer. In 2003, the sondage first excavated in 2000 was enlarged to extract zooarchaeological and archaeobotanical remains and undertake geoarchaeological analysis. A further season of excavation of the area immediately behind the eroding edge in 2004 has revealed a Late Norse structure associated with the upper levels of the eroding midden deposits. This paper presents the environmental analyses from the 2003 season and places the findings in the wider context of Norse period palaeoeconomy in the North Atlantic islands.

Table 1. Radiocarbon dates from Undir Junkarinsfløtti

Code	Context	Phase	Sample Type	^{13}C	^{14}C Age	Calibrated range (2 using Bronk-Ramsey 2003)
SUERC-3422	3	UJF3	Barley grain	–24.6	925 ± 40	1020–1210 cal AD
SUERC-3417	16	UJF2	Barley grain	–25.9	900 ± 35	1030–1220 cal AD
SUERC-3418	16	UJF2	Barley grain	–26.4	925 ± 40	1020–1210 cal AD
AAR-6927	19	UJF2	Sheep bone	–19.8	950 ± 35	1010–1190 cal AD
SUERC-3423	22	UJF1	Cow bone	–20.9	990 ± 35	980–1160 cal AD
SUERC-3424	22	UJF1	Pig bone	–21.2	1035 ± 35	890–1160 cal AD
SUERC-3400	23	UJF1	Barley grain	–23.9	1000 ± 40	970–1160 cal AD
SUERC-3401	23	UJF1	Barley grain	–26.8	980 ± 40	980–1170 cal AD
SUERC-3402	23	UJF1	Barley grain	–26.3	940 ± 45	1010–1220 cal AD
SUERC-3403	23	UJF1	Barley grain	–24.0	995 ± 35	980–1160 cal AD
SUERC-3410	23	UJF1	Pig bone	–21.4	965 ± 40	990–1190 cal AD
SUERC-3411	23	UJF1	Pig bone	–21.0	1075 ± 40	890–1030 cal AD
SUERC-3415	23	UJF1	Pig bone	–21.4	935 ± 40	1020–1210 cal AD
SUERC-3416	23	UJF1	Pig bone	–21.6	1005 ± 35	970–1160 cal AD
SUERC-3425	23	UJF1	Cow bone	–21.0	980 ± 40	980–1170 cal AD
SUERC-3426	23	UJF1	Pig bone	–22.7	1095 ± 40	880–1030 cal AD
AAR-6929	23	UJF1	Cow bone	–19.9	1115 ± 35	780–1020 cal AD
AAR-6928	24	UJF1	Sheep bone	–20.4	1190 ± 40	710–980 cal AD

Research Aims

Three main research aims were identified at the outset of the 2003 excavations:

1) To date the sequence of midden deposits through the provision of multiple AMS radiocarbon dates;
2) To establish both the site formation processes of the midden deposits and, where possible, the taphonomy of the ecofacts;
3) To undertake detailed zooarchaeological, archaeobotanical and geoarchaeological sampling and analyses throughout the excavated sequence, with a view to reconstructing Norse palaeoeconomic practices.

These aims were investigated through the integrated use of the methods outlined in the following section.

Methods

Excavation and sampling

The 2003 excavations aimed to enlarge the small sondage first excavated in 2000. Excavation was started at the top of the eroding section, and the deposits were excavated in a series of three shored steps to ensure safe working conditions (Fig. 2). A composite section of most of the archaeological deposits is presented in Figure 3, running from the Medieval sterile sand overburden (Context 2) down to the lowest midden deposit (Contexts 23 and 24), overlying the presettlement soil interface with the glacially derived subsoil (Context 25).

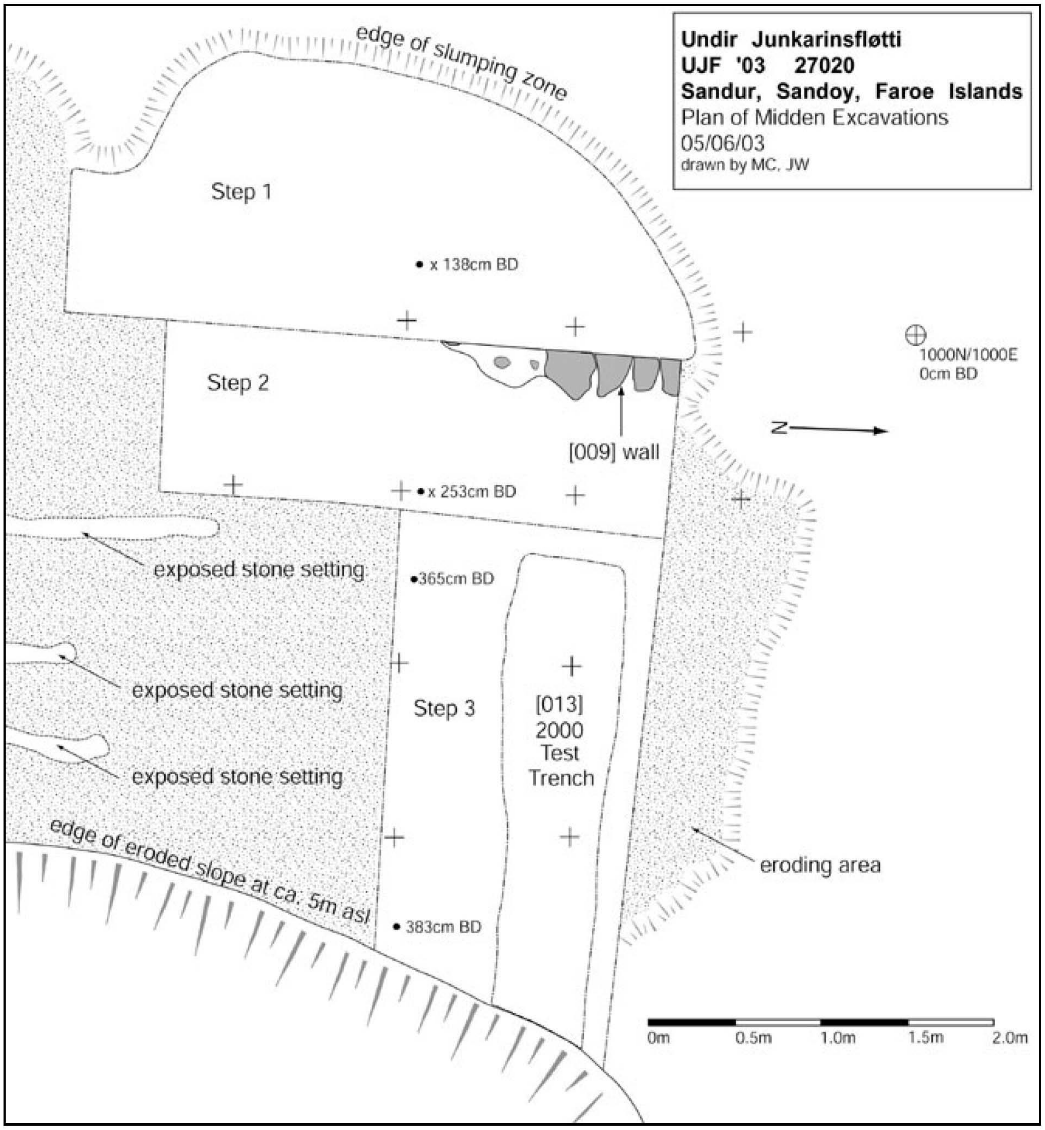

Figure 2. Site plan of Undir Junkarinsfløtti.

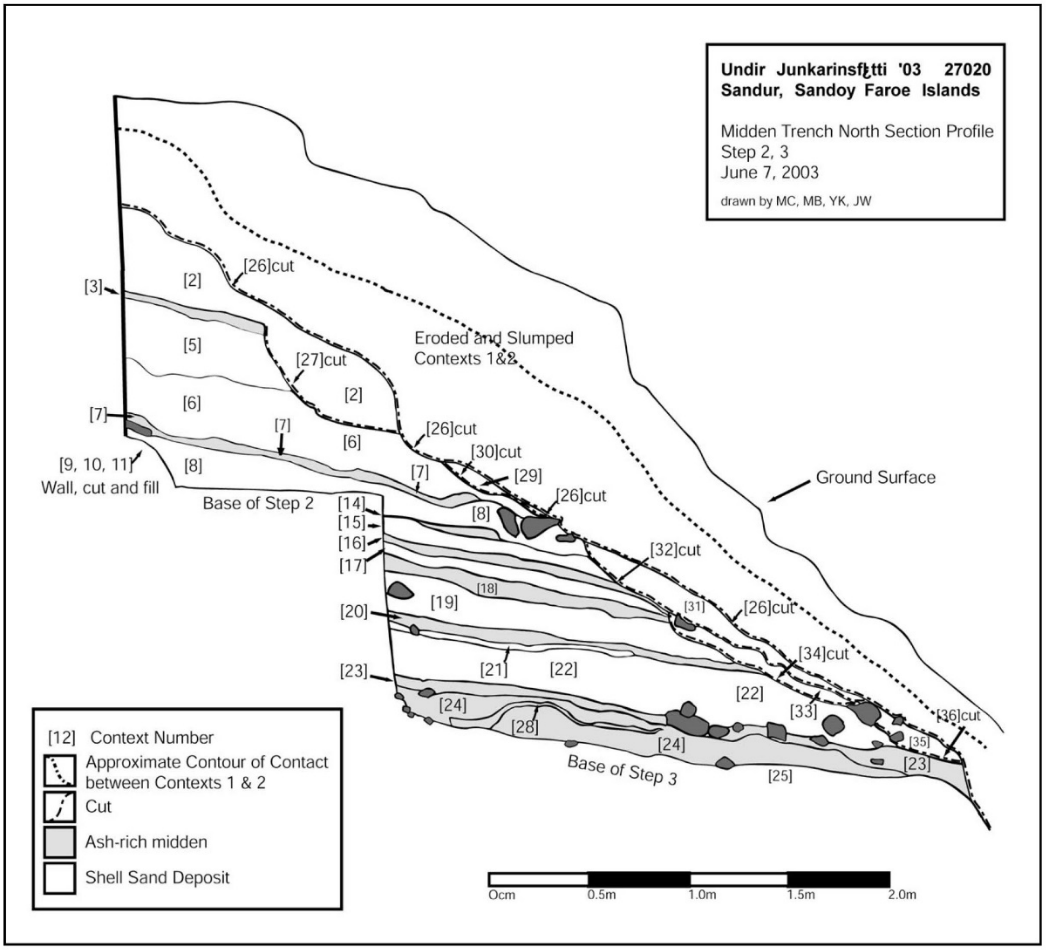

Figure 3. South-facing section of Steps 2 and 3 of Undir Junkarinsfløtti.

All of the archaeological deposits were dry-sieved at 4mm for the extraction of zooarchaeological remains and artifacts, a sieving strategy consistent with other NABO (North Atlantic Biocultural Organization) excavations in Iceland and Greenland (McGovern 2004). The integrated use of soil micromorphology with bulk and routine soil samples was also undertaken to explore the research questions. A total sampling strategy (Jones 1991) was employed, involving the removal of bulk samples of between two and twelve liters from every excavated sediment context. Generally these samples represented less than 5% of the total volume of context excavated. Routine samples of c. 0.1 liters were taken from these bulk samples for sedimentary analysis. Kubiena tins were column sampled from layers throughout the exposed section for thin section preparation for soil micromorphological analysis. This analysis is still ongoing and will be reported elsewhere.

Laboratory and quantitative methods

Analysis of the Undir Junkarinsfløtti zooarchaeological collection was carried out at the Brooklyn College and Hunter College Zooarchaeology Laboratories using comparative skeletal collections of both laboratories and of the American Museum of Natural History. All fragments were identified as far as taxonomically possible, but most mammal ribs, long bone shaft fragments, and vertebral fragments were assigned to "large terrestrial mammal" (cattle-horse sized), "medium terrestrial mammal" (sheep-goat-pig–large dog sized), and "small terrestrial mammal" (small dog–fox sized) categories. Only elements positively identifiable as *Ovis aries* L. were assigned to the "sheep" category, with all other sheep/goat elements being assigned to a general "caprine" category potentially including both sheep and goats. Murre (*Uria aalge* L.) and guillemot (*Uria lomvia* L.) are not distinguishable except on the beak and lower jaw, and are presented together as *Uria* sp., except where positive identification of guillemot could be made. Only some fish elements allow positive species-level identification, thus creating a large cod-family or "gadid" category as well as a substantial number of unidentified fish bones. Following NABO Zooarchaeology Working Group recommendations and the established standards of North Atlantic zooarchaeology, a simple fragment count (NISP) formed the basis for most quantitative presentation (cf. Amorosi et al. 1996).

The bulk samples were processed using a Siraf type wet sieve tank (Kenward et al. 1980), using 1.0 and 0.3 mm sieves for the flot and a 1.0 mm sieve net to catch the residue. The material was air dried, and both the flot and residue fully sorted under ×6–20 magnification. The 0.3 mm flot was scanned for any different type or species of plant macrofossil not recovered in the 1.0 mm fractions, but as none were forthcoming no further sorting of the 0.3 mm flot was undertaken. Charcoal was sorted only from the > 4 mm fraction, as identification is very difficult below this size (Pearsall 2000, 130). Uncarbonized plant macrofossil preservation has been shown to exist on previous Faroese excavations (cf. Malmros 1994; Edwards et al. 1998; Vickers et al. in press), and so two 0.5 liter subsamples of Contexts 3 and 23 were wet-sorted for assessment (Kenward et al. 1980). These two contexts were chosen because they represented the most likely deposit types that may have contained uncarbonized material, with Context 3 composed of peat/turf ash and Context 23 composed of a wet, organic, and ashy midden. No uncarbonized material was recovered; therefore, all the samples were wet-sieved and dried.

All plant macrofossil identifications were checked against the botanical literature (Long 1929; Beijerinck 1947; Berggren 1969; 1981; Schweingruber 1990; Anderburg 1994) and modern reference material from collections in Geography and Archaeology at the University of Edinburgh. Nomenclature follows Stace (1994), with ecological information taken from Grime et al. (1988), Clapham et al. (1989), Stace (1994), and Fosaa (2000; 2001). The condition for each cereal grain was recorded to assess the preservation of the sample and phase assemblages, following the index devised by Hubbard and al Azm (1990). The identification criteria for the wild seeds were based on those outlined by van der Veen (1992), with the grasses (Poaceae undiff.) and sedges (Carex spp.) differentiated only as large/medium/small and biconvex/trigonous, respectively. Each seed was given a count of one, even if broken, except for those large fragments that were clearly from the same seed (following van der Veen 1992). Other miscellaneous plant parts, such as heather leaf fragments, were given a fragment count rather than a quantifiable count due to multiple fragmentation (cf. Dickson 1994). The charcoal fragments were generally identified to genus, with the number of fragments and weight in each sample for each genus recorded. The fragments were also categorized into roundwood or timber and the number of rings noted. Other miscellaneous observations, such as bore-holes or vitrification, were noted when appropriate.

A subsample of approximately 0.1 liters was taken from each bulk sample to help assess site formation processes and ecofact taphonomy. Three basic sedimentary tests were undertaken: (1) organic content as indicated by percentage of weight loss on ignition at 550°C for four hours (following Dean 1974; Heiri et al. 2001); (2) soil pH using a Fisherbrand Hydrus 100 pH meter to measure c. 20 g of wet soil in 50 g of distilled water (following Hodgson 1976); (3) basic mineral magnetic parameters of mass-specific magnetic susceptibility (χ) and frequency dependent magnetic susceptibility (κfd%) using an MS2 Bartington system on air-dried soil (following Dearing 1994).

All digital records and zooarchaeological, archaeobotanical, and geoarchaeological samples will be permanently curated at the Faroese National Museum.

Results and Discussion

Excavation results

The excavated cultural layers contained concentrations of burned peat/turf and associated ash, firecracked stone, and well-preserved bone and shell that were separated by sand layers and thin brown humified horizons. The stratigraphy, observed in both plan (Fig. 2) and profile (Fig. 3), suggested a long process of successive and repeated dumps of refuse outside of small walls, interspersed with periods of rapid sand deposit and periods of stabilized vegetation surface. A number of these wall lines were revealed (cf. Context 9) and consisted of low double- or triple-coursed features up to 0.5 m high. These have been interpreted as the equivalent of farmyard walls that perhaps were topped by turf, though no turf collapse was evident. Therefore, at this stage of the excavations, the excavated material appeared to represent the remains of a farm mound, a feature commonly associated with Norse settlements across the North Atlantic, consisting of material discarded over a number of centuries from structures upslope of the eroding edge, such as the late Norse rectilinear structure revealed in the 2004 excavations.

Table 2 presents the sedimentary results in order from top to bottom of the main section illustrated in Figure 3. The pH throughout the section was neutral to slightly alkaline, and the organic content relatively low, resulting in the preservation of the bone and shell assemblage in the freely drained sandy matrix. The neutral pH of the soil derived from the mixed fluvio-glacial sands and degraded calcareous shell that composed the matrix. This soil preservation system was significantly different from other sites recently excavated across the Faroes, such as Toftanes (Stummann Hansen 1993; Edwards et al. 1998; Vickers in press) and Argisbrekka (Mahler 1993; Malmros 1990; 1994). These sites were found in the widespread peaty and podsolized wet and acidic soils that represent the common soil type of the Faroes, in which bone and shell are very poorly preserved. Conversely, uncarbonized plant macrofossil and insect preservation was good on these sites but lacking at

Undir Junkarinsfløtti. The worst preserved shell and bone were recovered from the lowest three contexts (23, 24, and 28) where semidissolved and amalgamated "bone mush" was observed. These layers were the wettest excavated on the site, being just above the underlying minerogenic soil and glacial subsoil and within the seasonally fluctuating water table, and had the highest organic content, which further aided the retention of moisture.

Table 2. Sedimentary results and archaeobotanical frequency from Undir Junkarinsfløtti

Context	Organic content (%)	χ (10^{-8} m^3 kg^{-1})	κfd%	pH	Grain/liter	Quantifiable component/liter	Burned peat-turf (g)/liter
2	1.9	0.7	0.8	7.54	0.0	0.0	0
3	1.8	8.5	1.3	6.54	0.6	4.6	4.1
5	1.5	0.3	1.3	5.69	0.2	0.5	0.2
6	1.5	7.3	1.5	6.65	0.9	1.2	0.2
7	2.5	7.0	1	7.22	0.2	1.1	0.5
8	2.4	6.8	1.1	8.49	0.2	1.1	0.9
14	7.7	8.6	3.9	8.48	0.3	2.7	27.4
15	2.4	7.0	0.9	7.4	0.4	0.9	0.6
16	2.2	7.1	1.2	8.49	0.6	1.2	0.5
17	2.1	7.2	1.8	7.2	0.6	0.9	1.1
18	1.8	7.1	2	8.64	0.1	1.0	1.2
19	2.0	6.9	2.1	8.73	0.3	0.6	0.9
20	2.4	6.9	1	8.59	9.8	10.1	0.5
21	2.1	5.7	1.4	8.45	0.1	0.5	0.1
22	3.0	6.7	0.8	8.1	2.0	2.5	2.1
23	11.6	7.9	3.2	8.53	3.5	4.4	7.0
24	10.1	7.9	0	7.07	1.2	2.3	0.9
28	10.4	8.2	2.7	7	0.5	5.5	24.3

Magnetic susceptibility (χ) was relatively high throughout the section, a function of both the mineralogy of the re-deposited offshore fluvioglacial material that composed the sand (Rasmussen 1982) and input of burned and ashy material from peat and turf that is characteristic of the middens in the North Atlantic islands (cf. Peters et al. 2001; 2004). High concentrations of burned peat and turf and the presence of carbonized plant macrofossils were recovered from the sampled layers with observed signs of burned material and ash and high χ values (Table 2), suggesting the principal taphonomic pathway was from domestic hearths and fires to sampled middens for the archaeobotanical remains. Detailed mineral magnetic and soil micromorphological analysis of the sampled layers is ongoing to test this hypothesis, with results discussed elsewhere. The carbonization of plant material in hearths burning turf and peat results in very poor preservation of plant macrofossils (cf. Church and Peters 2004), demonstrated by the poor level of grain preservation of the site assemblage, with over 50% of the grain in the worst preservation class (see Table 3).

Table 3. Archaeobotanical remains from Undir Junkarinsfløtti

	Phase	UJF1	UJF2	UJF3	Total site
	Number of samples in phase	5	6	7	18
	Total volume of samples (liters)	44	63	58.5	165.5
Charcoal					
Betula sp. timber fragment	Birch timber fragment	7F(1.02)			7F(1.02)
Calluna vulgaris (L.) roundwood (2–4 mm)	Ling heather roundwood fragment	present	present	present	present
Calluna vulgaris (L.) roundwood (> 4 mm)	Ling heather roundwood fragment	1F(0.04)			1F(0.04)
Coniferae indet. timber fragment	Conifer timber fragment		2F(0.03)		2F(0.03)
Juniperis sp. roundwood	Juniper roundwood fragment	1F(0.03)			1F(0.03)
Larix sp. timber fragment	Larch timber fragment	6F(0.15)	2F(0.04)	2F(0.05)	10F(0.24)
Picea sp. timber fragment	Spruce timber fragment	1F(0.02)			1F(0.02)
Pinus sp. timber fragment	Pine timber fragment	1F(0.03)			1F(0.03)
Quercus sp. timber fragment	Oak timber fragment	4F(0.09)			4F(0.09)
Burned peat/turf fragments	Burned peat/turf fragments	128.6 g	53.2 g	154.5 g	336.3 g
Grain					
Hordeum sp. (C)	Barley grain	17	30	7	54
Hordeum hulled (C)	Hulled barley grain	13	12	3	28
Hordeum hulled symmetric (C)	Hulled barley straight grain	3	1	3	7
Hordeum hulled asymmetric (C)	Hulled barley twisted grain	7	5		12
Avena sp. (C)	Oat grain	1	1		2
Cereal indeterminate (C)	Cereal grain	32	51	8	91
	Total grain	73	100	21	194
Chaff					
Hordeum sp. (RI)	Barley rachis internode		1	2	3
H. vulgare L. (RI)	Six row barely rachis internode	1			1
Cereal/monocotyledon (> 2 mm) (CN)	Cereal/monocotyledon culm node	1			1
Cereal/monocotyledon (> 2 mm) (CB)	Cereal/monocotyledon culm base			1	1
	Total chaff	2	1	3	6
Wild plants					
Brassica/Sinapis spp. (S)	Cabbage/Mustard	1			1
Calluna vulgaris (L.) Hull. (LF)	Ling heather			2LF	2LF
Carex spp. (trigonous) (N)	Sedge	3	1		4
Danthonia decumbens L. (C)	Heath-grass			1	1
Montia fontana L. (S)	Blinks	1		2	3
Poaceae undiff. (medium) (C)	Grass		1	1	2
Poaceae undiff. (small) (C)	Grass	1	2	1	4
Polygonum spp. (N)	Knotgrass	1			1
Ranunculus repens L. (A)	Creeping buttercup			6	6
Ranunculus spp. (A)	Buttercup	1		1	2
Rumex acetosa L. (N)	Common sorrel	1		1	2

Table 3. *Continued*

	Phase	UJF1	UJF2	UJF3	Total site
Rumex crispus/obtusifolius L. (N)	Curled dock	2		5	8
Rumex spp. (N)	Dock	1		1	2
Spergula arensis L. (S)	Corn-spurrey	1		9	10
Stellaria media L. (S)	Common chickweed	6	10	7	23
Viola sp. (S)	Violet	1			1
Cereal/monocotyledon (< 2 mm) (CN)	Cereal/monocotyledon culm node	3	3	2	8
Cereal/monocotyledon (< 2 mm) (CB)	Cereal/monocotyledon culm base	4	5	2	11
Indeterminate (> 2 mm) (R)	indeterminate rhizome	1		2	3
Indeterminate (< 2 mm) (R)	Indeterminate rhizome	1	1	4	6
Indeterminate (trigonous) (S/F)	Indeterminate trigonous seed/fruit	1		1	2
Indeterminate pericarp fragment (P)	Indeterminate pericarp fragment		1		1
Indeterminate seed/fruit (S/F)	Indeterminate seed/fruit	8	5	11	24
Moss fragments (carbonized) (LF)	Moss leaf fragment (carbonized)			1LF	1LF
	Total wild	38	30	57	125
	Total Quantifiable Components	113	131	81	325
	Grain/liter	1.7	1.6	0.4	1.2
	Quantifiable Component/liter	2.6	2.1	1.4	2.0
Grain preservation (Hubbard and Al Azm 1990)	Class 1 (best preservation—%)	0	0	0	0
	Class 2 (%)	3	3	5	3
	Class 3 (%)	10	5	0	6
	Class 4 (%)	18	12	19	15
	Class 5 (%)	22	18	33	21
	Class 6 (worst preservation—%)	48	62	43	55

Notes: Key to plant parts: Grain (C) = caryopsis; Chaff (CB) = culm base (greater than 2 mm in diameter), (CN) = culm node (greater than 2 mm in diameter), (RI) = rachis internode; Wild plants (A) = achene, (C) = caryopsis, (F) = fruit, (CB) = culm base (less than 2 mm in diameter), (CN) = culm node (less than 2 mm in diameter), (LF) = leaf fragment, (N) = nutlet, (P) = pericarp, (R) = rhizome (greater and less than 2 mm in diameter), (S) = seed. NB: The charcoal is quantified by number of fragments followed by mass in grams within brackets.

A detailed dating strategy was formulated, based on the AMS radiocarbon determinations of single entities of barley (*Hordeum* sp.) grains, cow (*Bos taurus* L.), and pig (*Sus scrofa* L.) bones and common limpet shells (*Patella vulgaris* L.) at the SUERC radiocarbon laboratory in Scotland. The strategy had three research aims:

1) To date the sequence of midden deposits, with determinations from multiple stacked contexts in order to use Bayesian statistics to refine the chronological precision (cf. Buck et al. 1996). Unfortunately, this was not possible, as nearly all the determinations were of very similar age and calibrated into the 10th to early 13th centuries

cal. AD radiocarbon plateau. Table 1 presents the radiocarbon determinations obtained from the site and calibrated using OxCal (Bronk Ramsey 2003), expressed at 95% confidence intervals. Initial analysis of the artifactual assemblage identified a bronze brooch of 10th century AD date recovered from the basal midden deposit (Arge 2001) and hand-built coarse local pottery usually considered to date to the late Viking (c. AD 950–1100) and early medieval (c. AD 1100–1200) periods recovered from the upper portion of the deep cultural deposits excavated in 2000, 2003, and 2004 (cf. Arge 1991; 1997). Scattered shards of 16th–20th century pottery were recovered from the thick amended topsoil (Context 1), relating to manuring activity of what had become a set of enclosed pastures at the edge of Sandur village. Therefore, the site was separated into three phases based on the archaeological stratigraphy, radiocarbon dates, and artifacts. UJF1 represented the earliest deposits (Contexts 21 to 28) dated to 9th–12th centuries cal. AD, UJF2 included Contexts 15 to 20 dating to 11th–12th centuries cal. AD, and UJF3 included Contexts 3 to 14 and dates to the 11th–13th centuries cal. AD.

2) To establish the first marine reservoir correction factor for the Norse period in the Faroes by pairing terrestrial determinations (carbonized barley grains and cow bones) with marine determinations (limpet) from the same stratigraphic layer (Context 23), an approach successfully employed in Atlantic Scotland by Ascough et al. (2004). The results are discussed elsewhere (Ascough et al. in press).

3) To establish the presence of any significant marine component within the diet of the pigs through examination of the δ13C values produced during radiocarbon determinations of pig bones. This formed part of an international project investigating piggery practices across the North Atlantic in the Norse and early Medieval periods. It was hypothesized that the pigs may have been kept in sties and fed fish offal, keeping grass fodder for sheep and cattle use over the winter. However, the δ13C values from the pig bones from Contexts 22 and 23 (Table 1) were consistent with values expected of animals feeding exclusively within the terrestrial food web (cf. De Niro 1985; Gupta and Polach 1985; Koch et al. 1994; Arneborg et al. 1999), and so this hypothesis was rejected.

Animals and marine resources at Undir Junkarinsfløtti

The substantial, well-preserved archaeofauna collected in 2003 provided the first zooarchaeological evidence for past economic strategies in Viking age and early Medieval Faroes (for full technical report see McGovern et al. 2004). Additional large animal bone collections are now under study from the 2004 excavation season. However, enough material has been analyzed to allow a first look at major patterns in the zooarchaeology of this key site and for some comparisons to be drawn with contemporary collections from Northern Iceland and Greenland, excavated and analyzed by the same team. Table 4 summarizes the animal bone collection from the three major phases.

Table 4. Summary archaeofauna and NISP from Undir Junkarinsfløtti

	UJF1	UJF2	UJF3	Total
Cattle (*Bos taurus* L.)	18	14	25	57
Dog (*Canis familiaris* L.)			1	1
Pig (*Sus scrofa* L.)	13	20	43	76
Sheep (*Ovis aries* L.)	4	12	30	46
Goat (*Capra hircus* L.)		1		1
Caprine	41	71	142	254
Total Domestic Mammals	76	118	241	435
Whale (Cetacea sp.)	1	2		3
Grey Seal (*Halichoerus gryphus* L.)			5	5
Large Seal (probably Grey Seal)	1	2	1	4
Small Seal (probably Harbor Seal, *Phoca vitulina* L.)		1		1
Seal (Phocid sp.)		3	1	4
Total Whales/Seals	2	8	7	17
Puffin (*Fratercula arctica* L.)	451	459	995	1905
Guillemot (*Uria lomvia* L.)	2		4	6
Black Guillemot (*Cepphus grille* L.)	1			1
Murre/Guillemot (*Uria* sp.)	116	51	76	243
Razorbill (*Alca torda* L.)	6	9	5	20
Duck (Anatidae sp.)			2	2
Eider duck (*Somateria molissimus* L.)			1	1
Manx shearwater (*Puffinus puffinus* L.)	1	4	7	12
Gannet (*Sula bassana* L.)		2	1	3
Shag (*Phalacrocorax aristotelis* L.)	2	4	8	14
Gull (*Laridae* sp.)	1	1	2	4
Goose (possibly domestic: Anseridae sp.)		7	7	14
Bird sp.	488	626	1044	2158
Total Birds	1068	1167	2148	4383
Gadid Fish				
Atlantic Cod (*Gadus morhua* L.)	592	206	391	1189
Ling (*Molva molva* L.)			7	7
Cusk (*Brosme brosme* L.)	14	13	42	69
Cod family (Gadidae)	260	48	114	422
Salmonid fish				
Salmon family (Salmonidae)		3		3
Trout (*Salmo trutta* L.)	3		1	4
Flatfish				
Flatfish (*Pleuronectiformes* sp.)		7	2	9
Atlantic Halibut (*Hippoglossus hippoglossus* L.)	3			3
Other Fish				
Skates (Rajidae undiff.)		7	2	9
Wolf fish (Anarchiradidae undiff.)		2		2
Brill (Scapthalmidae undiff.)	2	1		3
Rockfish (Sebastidae undiff.)			6	6
Sculpin (Cottidae undiff.)		3	2	5
Fish indeterminate	1526	283	590	2399
Total fish	2400	573	1157	4130

Table 4. *Continued*

		UJF1	UJF2	UJF3	Total
Limpet (*Patella vulgaris* L.)		167	219	923	1309
Clam (*Mya* sp.)		7	11	10	28
Whelk (*Buccinum undatum* L.)		9	15	14	38
Mollusca undiff.			23	82	105
	Total Mollusca	183	268	1029	1480
	NISP	3729	2134	4582	10445
Medium terrestrial animal		98	176	289	563
Large terrestrial animal		16	3	11	30
Unidentified fragments		980	1128	2151	4259
	TNF	4823	3441	7033	15297

Figure 4 compares the distribution of major taxa in the three phases of the archaeofauna. In each case, bones of domestic and marine mammals made up a fairly minor portion of the collection (2–5%) compared to the amount of bird, fish, and shellfish remains recovered. Birds (mainly puffin, *Fratercula arctica* L.) came to outnumber fish bones in the upper layers, while shellfish (mainly common limpets, *Patella vulgaris* L.) also increased in the upper layers. These patterns showed some similarities with Landnám sequences from Iceland and Greenland but were unique in many respects. Figure 5 places the three major contexts from Junkarinsfløtti in comparison with contemporary archaeofauna from Iceland and Greenland. In Iceland, many Landnám era collections were also dominated by wild species, and in late Medieval–early modern times marine fish again played a major role in both subsistence and trade (Amundsen et al. in press). However, even at first settlement (Tjarnargata 4, Herjolfsdalur, Sveigakot), domestic mammal bone percentages were normally 15% or above and in the 10th–11th century AD rose to 40–70% of the total collection (Sveigakot, Hofstaðir, Hrísheimar, Selhagi, Svalbarð) (Fig. 5). While the Greenlandic Norse colonists (site W48, site W51, site E17a, GUS [Gården Under Sandet]) may have encountered significantly harsher conditions in their 11th century AD Landnám, their archaeofauna was still composed of 15–40% domesticates (McGovern 1985; Outram 1999; 2003).

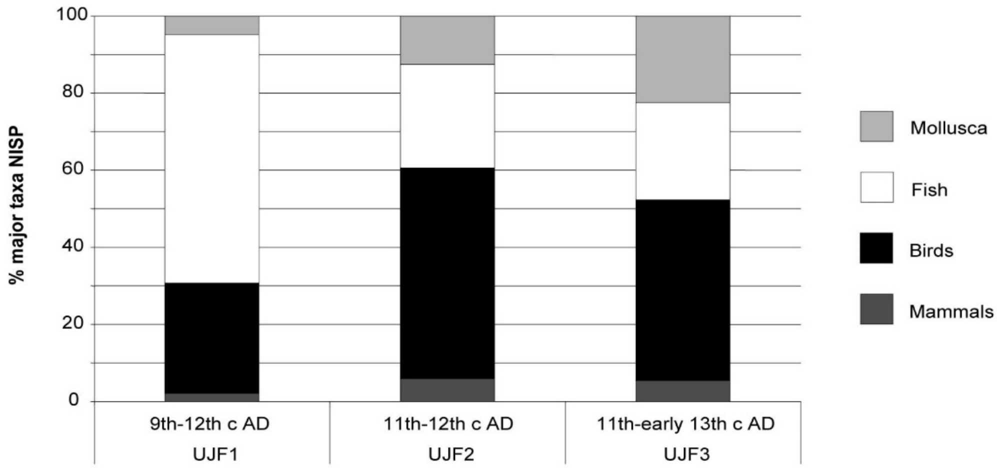

Figure 4. Distribution of major faunal taxa in the three phases from Undir Junkarinsfløtti (UJF). See Table 4 for NISP.

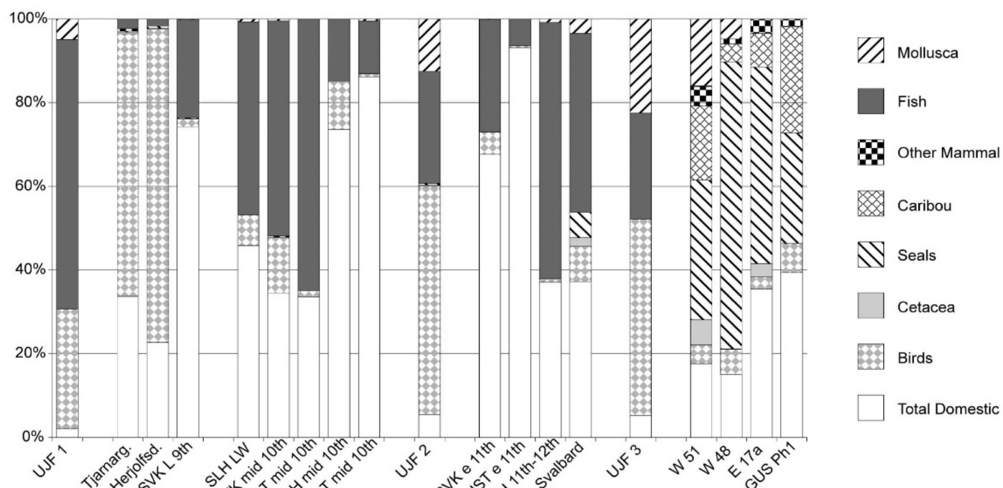

Figure 5. The archaeofauna of Undir Junkarinsfløtti in comparison with contemporary archaeofauna from Iceland and Greenland. Abbreviations and zooarchaeological references as follows: Faroes–UJF1, UJF2, and UJF3 = Undir Junkarinsfløtti phases; Iceland–Tjarnarg. = Tjarnargata 4, Herjolfsd. = Herjolfsdalur (Amorosi 1996), SVK L 9th = Sveigakot late 9th century AD phases, SVK mid 10th = Sveigakot mid 10th century AD phase, SVK e 11th = Sveigakot early 11th century AD phase, SLH LW = Selhagi Lower 9th–10th century AD phase, SLH 11th–12th = Selhagi 11th–12th century AD phase, HST mid 10th = Hofstaðir mid 10th century AD phase, HST e 11th = Hofstaðir early 11th century AD phase, HRH mid 10th = Hrísheimar mid 10th century AD phase (McGovern et al. 2001), GST mid 10th = Granastaðir mid 10th (Einarsson 1994), Svalbarð = Svalbarð (Amorosi 1992); Greenland—W 51 = Site W 51 (McGovern et al. 1996), W 48 = site W 48 (McGovern et al. 1983), E 17a = Site E 17a (McGovern et al. 1993), GUS Ph1 = Gården Under Sandet Phase 1 (Enghoff 2003).

One of the most striking aspects of the Undir Junkarinsfløtti archaeofauna was the large proportion of bird bones in all phases (Table 4). Puffins and related alcids (guillemot, black guillemot, and razorbill) constituted the overwhelming majority of these remains, and most of the unidentified bird bones could have been small alcid from their size. The presence of Manx shearwater bones suggested the exploitation of nesting cliffs, a practice widespread in modern times in Faroes. Goose (*Anser* sp.) bones are notoriously difficult to positively identify as wild or domestic (Benecke 1993), but it is known that domestic geese were part of the Viking age farmyard (Hutton-Macdonald et al. 1993), and it is possible that these bones, one of which contains medullary bone characteristic of egg laying females, came from domestic animals. One puffin bone came from a fledgling chick, again suggesting exploitation of nesting colonies.

The very high percentages of bird bones in the Junkarinsfløtti archaeofauna had parallels in archaeofauna from southern Iceland (McGovern et al. 2001), where predation upon sea bird colonies probably helped sustain settlers until imported stock could multiply. After the initial Landnám, birds provided a fairly minor supplement to fishing and domestic mammal products in Iceland. In Greenland, sea birds were also taken regularly, but seals and caribou were far more important wild resources. Only at Junkarinsfløtti was there such a definite pattern of sustained, and clearly sustainable, use of wild bird colonies. Issues of biogeography, marine productivity, and social management of a wild resource all require further investigation. We can now state that the Faroese remained dependent upon bird resources, especially puffins, far longer, and to a far greater degree than any of the other Viking age settlers of the North Atlantic islands, even if we cannot yet explain how and why.

Figure 6 presents the changing proportions of domestic mammal bones from the 2003 Junkarinsfløtti collection. The relative proportion of cattle decreased between the earliest and subsequent phases, a pattern widely observed in most North Atlantic Landnám sites where early hopes for high status cattle rich holdings may have been regularly frustrated by the realities of island farming (McGovern et al. 2001). "Caprine" refers to the many bones that may have come from either sheep or goat but could not be further speciated. With the exception of a single bone in UJF2, all the identified caprines were in fact sheep. In Landnám-era Iceland and Greenland, goats were far more common. In Iceland goats declined to their modern "trace" levels only in the early 13th century AD (McGovern et al. 2001), and in Greenland goats remained nearly as common as sheep in many collections down to the end of the colony in the 14th–15th century AD (cf. McGovern et al. 1983; 1993; 1996; Enghoff 2003). As goats are more effective at metabolizing twigs and leaves than sheep, their early reduction in the Faroes may have been tied to the absence of significant woodland.

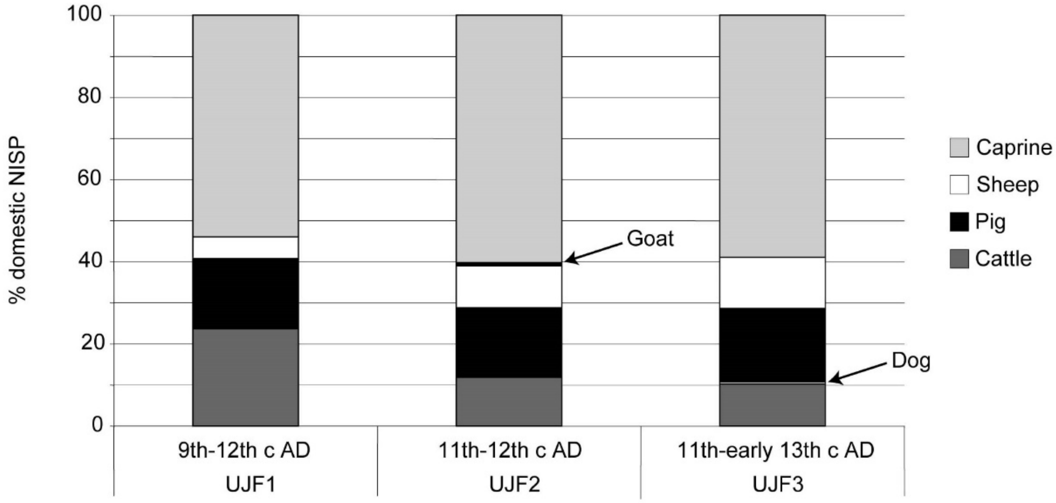

Figure 6. Changing proportions of domestic mammal bones in the three phases from Undir Junkarinsfløtti (UJF). See Table 4 for NISP.

The presence of substantial numbers of pigs was also commonplace in Landnám sites in Greenland (cf. Enghoff 2003) and Iceland (McGovern et al. 2001), but pigs rarely survived as a major element in the domestic economy much beyond the mid 11th century AD in either of these islands. Pigs became extinct in the Faroes later in the Middle Ages (Arge in press), with a few place names reflecting earlier piggery around the area of Lítlavatn (Fig. 1: see Lawson et al. in press for further discussion). In Arctic Norway, however, pigs remained economically important into early modern times and never became entirely extinct (Perdikaris 1999; Amundsen 2004). Pigs reproduce rapidly and have been favored "Landnám" domesticates in both Atlantic and Pacific islands, but economic pig keeping requires either substantial unmanaged woods or marshland for free ranging pannage or some source of feed for penned sty kept animals (Ward and Mainland 1999). In Medieval England, many communities had already converted from open pannage to sty piggery by the 1086 Domesday survey, with improving monasteries taking a lead in raising legumes mainly as pig fodder (Biddick 1984). The isotopic data from the pig radiocarbon samples (Table 1) indicated that they fed on terrestrial material, not marine-based feed such as fish offal. The actual strategy for pig husbandry followed in Viking age and early Medieval Faroes, and the reasons for the abandonment of pig keeping after the 13th century remain topics for further collaborative investigation.

While sample sizes of intact tooth rows and long bone epiphyses were too small for statistical analysis, the large number of newborn (neonatal) cattle bones (20–50% of all cattle) strongly suggested the same sort of dairy economy already documented in Greenland, Iceland, and Atlantic Scotland (cf. McGovern 1985; McGovern et al. 2001; Bond 2002). Sheep and caprine bones were too rare to even tentatively reconstruct a management strategy.

Marine resources were also very common in all three phases. Molluscs recovered were mainly the common limpet (*Patella vulgaris* L.), which retained its dominance even if only complete specimens were counted (Table 4). Some fragments of a clam and of whelk were also present but as trace species. As the anthropogenic status of any common shellfish should be questioned in a beachfront setting, it is interesting to report that whenever the complete shell of the limpet survived it invariably showed a notch left by a pry-stick used by a human collector to remove them from rocks. These were therefore almost entirely deliberately gathered shellfish, either as human food or for use as bait.

Whale and seal bones were present but rare in all three phases. The whalebone specimens were probably tool-making debris, as all the fragments were relatively small and all showed cut marks and one was sawn. Species identification was not possible from these fragments, nor was it possible to be certain if the bones came from great whales (such as black right whale, *Eubalaena glacialis* L., or humpback, *Balaenoptera musculus* L.) or from smaller toothed whales and porpoise. Seal bones included some elements that could be positively identified as grey seal (*Halichoerus gryphus* L.) as well as some bones of smaller seals, which were almost certainly from harbor seal (*Phoca vitulina* L.), including one from a newborn animal.

Identified fish bones included rays, salmon, trout, and flatfish, but the great majority were from the cod (gadid) family (Table 4). While a few deepwater ling and cusk were present, the great majority of the gadids were Atlantic cod (*Gadus morhua* L.). Following Wheeler and Jones (1989), it was possible to reconstruct live length of the Undir Junkarinsfløtti cod based on measurements of the dentary and premaxillary bones (Fig. 7). Fish between 60 and 110 cm in live length were best suited for the preparation of air-dried stockfish, while smaller fish (40–70 cm) were more typically used for the production of a flat-dried product similar to modern Norwegian klippfisk (Bigelow 1985; Cerón-Carrasco 1998; Perdikaris 1999; Barrett et al. 2001; Perdikaris et al. 2002; Amundsen 2004). While sample size was modest for gadids (n for the site = 1687), it was apparent that most of the cod landed at Junkarinsfløtti were too small to be effectively air dried as stockfish. Cod skeletal element distribution in the current sample indicated a high frequency of mouthparts and upper (thoracic and precaudal) vertebrae (usually discarded at fish processing sites) relative to a low frequency of cleithra and thoracic vertebrae (usually exported in the preserved fish product). While more analysis on remains recovered from the 2004 season is underway, this pattern from the 2003 collection raised the issue of a possible production of some sort of preserved fish product at the site during the Norse period.

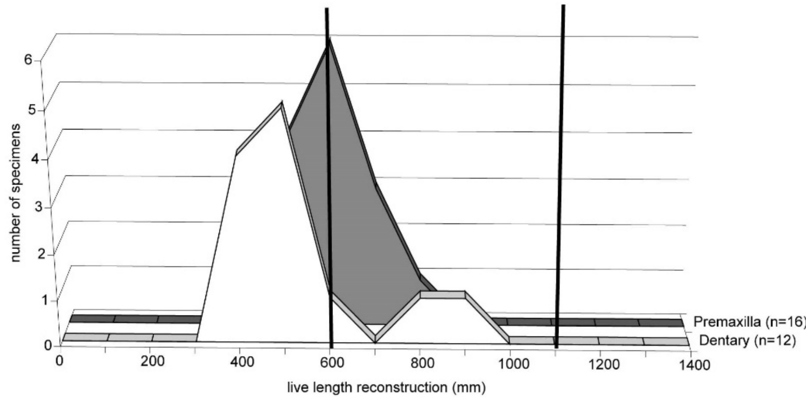

Figure 7. Cod size reconstruction from all phases from Undir Junkarinsfløtti.

The use of plants at Undir Junkarinsfløtti

Archaeobotanical material from the three phases were very low in concentration and consisted of carbonized plant macrofossils of cereal grains, a little cereal chaff, various plant parts from wild species, a few small pieces of charcoal and abundant fragments of burned peat and turf (Table 3). The abundance of carbonized peat and turf fragments, coupled with the very low concentrations of charcoal, suggested that peat and turf were the primary fuel sources, a hypothesis to be tested by micromorphological analysis of the midden material. Also, some of the wild species, such as ling heather (*Calluna vulgaris* L. Hull), and small culm bases/rhizomes, could have been introduced by the use of peat and turf as fuel (McLaughlin 1980; Dickson 1994; 1998; Church 2002a) or even from the burning of dung of animals grazing the Faroese outfield (cf. Miller and Smart 1984; Charles 1998). To extract peat from areas of blanket bog such as Lítlavatn and Millum Vatna (see Fig. 1) required planning, social organization, and equipment. The planning involved gathering enough people in the right place at the right points in the year for the cutting, stacking, collecting, and storing of peat. The social organization provided an infrastructure needed to mobilize labor to do the job effectively and also to maintain rights of extraction from an area. Peat procurement was obviously a key component in the Faroese Norse economy, and its extraction would have had an impact on the wider landscape, mobilizing organic-rich runoff into the hydrological system (see Lawson et al. in press). This fuel procurement strategy had been in place for thousands of years within the Atlantic Scottish islands (Church and Peters 2004) since the widespread encroachment of blanket bog from the mid Holocene. However, in Iceland peat and turf became used as the primary fuel source only once birch became scarce following the settlement period, and their use was not uniform across sites, depending on the status and location of the settlement (Simpson et al. 2003).

The cereal remains were dominated by six-row hulled barley (*Hordeum vulgare* var. *vulgare* L.), identified by the presence of rachis internodes and the symmetric-asymmetric grain ratio of close to 1:2 for the whole assemblage (following Renfrew 1973). Six-row hulled barley was the staple cereal of the Norse period in the North Atlantic, from Atlantic Scotland (Boyd 1988; Dickson and Dickson 2000) to Iceland (Sveinbjörnsdóttir et al. 2004). A few grains of oat (*Avena* sp.) were also recovered from the site. These could not be identified to species without the preservation of floret bases, and so it was impossible to determine if the oat was the wild or cultivated species and if it was grown in its own right.

It was also an important research question to assess whether the barley was grown in the Faroes or was imported, as recorded in the later Medieval and modern times in the Faroes. This question was particularly pertinent when comparing cereal concentrations from Junkarinsfløtti and midden contexts from three contemporary Norse period sites in the Western Isles of Scotland (Table 5), the homeland of some of the Norse settlers (Debes 1993). At the settlement sites of Barvas (Cowie 1987), Bostadh (Neighbour and Burgess 1997), and Galson (Neighbour and Church 2001), local cultivation was indicated by proxies independent of the archaeobotanical remains, such as pollen analysis of the surrounding landscape and the presence of artifacts for cereal cultivation (Church 2002a). The cereal remains from each Western Isles site were similar, with grain in high concentrations (grain/liter averages from 7.2 to 27.7) and small amounts of chaff present (straw culm nodes and bases, barley rachis internodes, and oat floret bases). It was probable that at least subsistence-based cereal cultivation was undertaken at each of these settlements. However, the assemblage from Junkarinsfløtti was different, with much lower concentrations of grain (average 1.2 grains/liter), trace levels of straw-sized culm nodes/bases and barley rachis internodes, and no oat floret bases. Does this mean that cereal cultivation was not practiced in the area and rather the small amounts of grain were imported? Again, independent proxies were analyzed. Figure 8 presents summary taxa from a core taken by Lawson et al. (in press) from a small lake called Gróthúsvatn, approximately 1 km west of Undir Junkarinsfløtti (Fig. 1). The impact of landnám was seen with the increased frequency of ribwort plantain (*Plantago lanceolata* L.) and microcharcoal, coupled with the first appearance of barley type pollen. This indicated that local barley cultivation was in evidence from the time of settlement. Therefore local cultivation was likely but arguably on a smaller scale and of less importance to the overall economy than established practices in the areas inhabited throughout the Holocene in the eastern North Atlantic, such as the Western Isles of Scotland.

Table 5. Cereal remains from Faroes and Western Isles of Scotland (data taken from Dickson 1979 for Barvas and Church 2002a for Bostadh and Galson)

Site	UJF	Barvas	Bostadh	Galson
Number of midden samples	18	27	11	10
Average Quantifiable Component/liter	2.0	9.8	7.8	34.5
Culm nodes/bases	trace	present	frequent	frequent
Barley rachis	trace	present	trace	present
Oat floret bases	none	trace	trace	trace
Number of identifiable cereal grains	103	1694	1533	1764
Average grain/liter	1.2	8.9	7.2	27.7
Barley (%)	98	71	72	79
Oat (%)	2	27	27	20
Flax (%)	none	2	1	1
Rye (%)	none	none	trace	trace
Wheat (%)	none	none	trace	trace

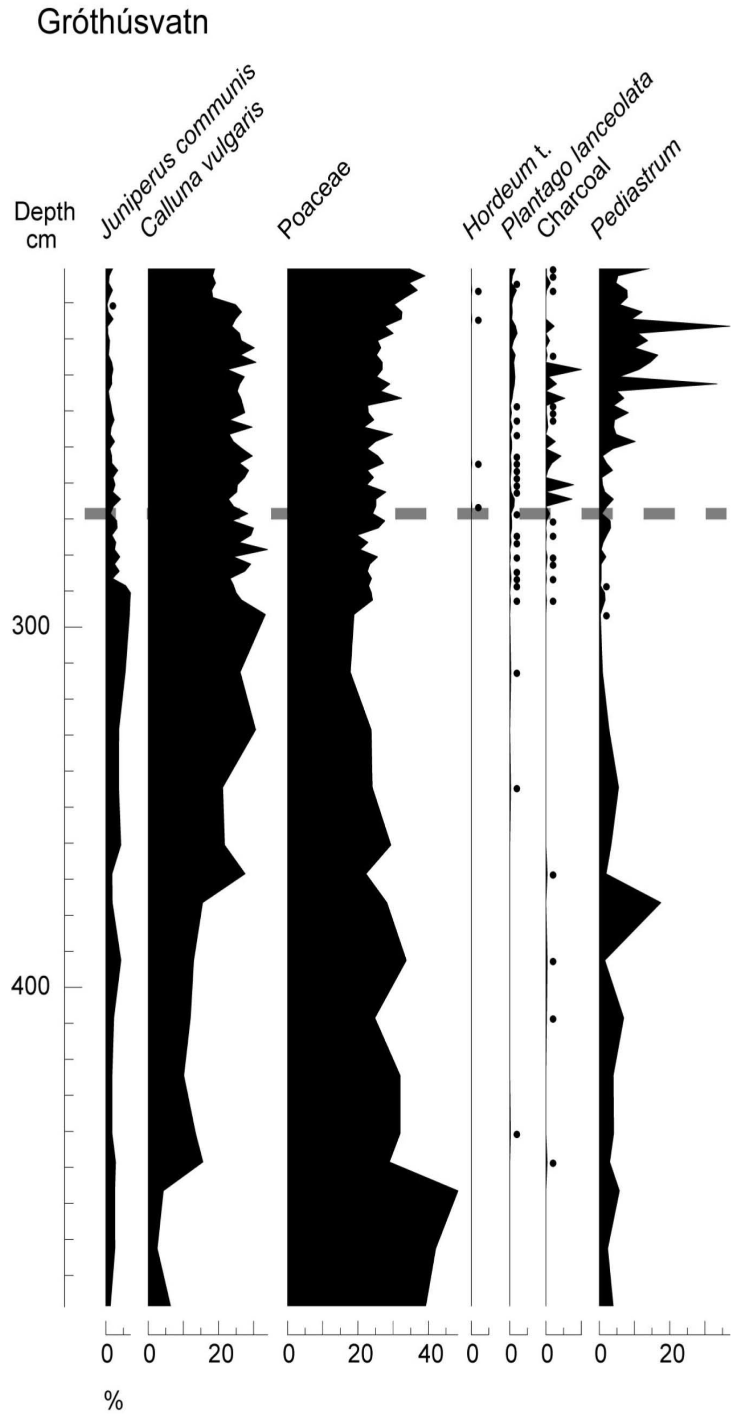

Figure 8. Summary pollen diagram for Gróthúsvatn. The dotted line indicates the approximate position of settlement (dating pending) based on presence of barley pollen and increased microcharcoal.

Another feature of the Western Isles assemblages was the presence of other cereals (Table 5), such as oat (*Avena strigosa* type) and traces of rye (*Secale cereale* L.) and wheat (*Triticum* sp.) as well as flax (*Linum usitatissimum* L.). Only two grains of oat were found in the Junkarinsfløtti assemblage, and these may have been weeds of the barley crop. In the Faroes, only barley grains were recovered from the landnám period farm at Toftanes (Vickers et al. in press). Also, most of the cereal grains found in settlement period pollen diagrams have been of barley type (cf. Jóhansen 1985; Hannon et al. 2001). Though more archaeobotanical assemblages need to be analyzed, it seems that a barley monoculture was in place and that a deliberate decision was made not to grow other crops clearly known to the settlers. It is probable that flax and rye would perform very poorly in the soil and climatic conditions of the Faroes (Zohary and Hopf 1994). However, this would not be the case for oat, which could have been economically viable in the soils of the Faroes and was becoming an increasingly important crop throughout Atlantic Scotland during the Norse period (Boyd 1988; Dickson and Dickson 2000; Church 2002a; Bond 2002). This concentration on barley cultivation may have been due to the positive response of barley (in terms of increased yields) to deliberate amendment of the soil. In comparison, oat does not increase yield significantly with soil amendment (Bond 2002). Through detailed analysis of palaeosols, Adderley and Simpson (in press) demonstrated that soils of infield areas across the Faroes were routinely amended since the settlement period. Therefore, it is possible that the labor investment that could be afforded for cereal cultivation was exclusively channeled into barley cultivation in small fields of heavily fertilized soils.

The ubiquitous presence of chickweed (*Stellaria media* L. Vill.) in all three phases at Junkarinsfløtti indicated relatively nitrogenous soil conditions (Sobey 1981) in certain areas. Assuming that the chickweed was a weed of the barley crop (but note that the plant is also associated with other plant communities as well as cultivated land, Fosaa 2000; 2001), this may have indicated field rotation between pastoral and arable agriculture, on a seasonal or spatial basis, or the deliberate incorporation of dung into the soil as a fertilizer and stabilizer. However, the other wild species represented a mix of species from cultivated ground, wet pasture, and moorland (Grime et al. 1988; Stace 1994; Fosaa 2000; 2001). These plants, from mutually exclusive ecological niches, would have been mixed together in the domestic hearths burning peat/turf or dung as fuel and then dumped down slope onto the middens sampled. This mixing is a common feature of archaeobotanical assemblages in the North Atlantic (Church and Peters 2004) and greatly complicates detailed analysis of specific plant ecologies, such as the weeds associated with the barley crop.

The procurement of wood would have been a major consideration for the Norse in the Faroes. The islands never sustained extensive woodland (Jóhansen 1985; Hannon et al. 2001), and heather and juniper were the only wood resource available on Sandoy at settlement (Fig. 8 and see Lawson et al. in press). The few charcoal remains included ling heather and juniper (*Juniperus* sp.) roundwood that presumably represent native growth (Fosaa 2000), a few birch (*Betula* sp.) timber fragments that are doubtfully native (see Malmros 1990; 1994 for further discussion), and various coniferous timber species of larch (*Larix* sp.), pine (*Pinus* sp.), and spruce (*Picea* sp.) that would have arrived on the island as driftwood. This driftwood was presumably picked up from the shore and would have been a prized resource in the treeless landscape, needing social controls in place for its distribution through the local population. Driftwood use is well documented in this area of the North Atlantic during the Norse period in the Faroes at Argisbrekka (Malmros 1990; 1994) and Atlantic Scotland (Dickson 1992; Church 2002b), and its exploitation was regulated by legislation in early medieval Iceland (Dennis et al. 2000, 321–43). A few fragments of oak timber (*Quercus* sp.) were also recovered from the earliest phase that could not have grown locally and may represent imported material.

Conclusions

This paper has reported on the first zooarchaeological analysis undertaken for the Faroes and only the third archaeobotanical assemblage published from the islands. The preliminary analysis of these remains presents a diverse range of economic practices employed by the Norse settlers at a key time and geographical position in their expansion across the North Atlantic. Their economic strategy appears to have relied heavily upon the exploitation of a broad spectrum of local wild resources to supplement a mixed agricultural base of animal husbandry and cereal cultivation.

Domestic mammals recovered included sheep, cows, and pigs with single bones of goat and dog. Significant numbers of pig bones were recovered throughout the site sequence, indicating sustained pig keeping up to and beyond the 13th century, a situation unique compared to Iceland and Greenland. Birds composed a relatively large proportion of the archaeofauna. The Faroese at Junkarinsfløtti remained dependent upon bird resources, especially puffins, far longer and to a greater degree than any of the other Viking age settlers of the North Atlantic islands. A wide range of marine resources were also recovered, suggesting the Norse settlers of Faroes were heavily reliant on natural resources to sustain their economy.

Wood charcoal was very rare and consisted of locally derived roundwood, coniferous driftwood, and imported oak. Peat and turf were the main fuel sources in the treeless landscape. A hulled six-row barley monoculture was in place, with small-scale yet intensive cultivation undertaken. Cereal cultivation seems to have played a lesser role in the economy than other areas of the eastern North Atlantic, and some of the barley may have been imported.

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