Walrus Tusks & Bone
From *Aðalstræti 14-18*,
Reykjavík Iceland

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Abstract: Three tusks from large mature walrus (*Odobenus rosmarus* L.) were recovered in 2001 from excavations by *Archaeological Institute Iceland* (FSÍ) within the early settlement age hall at Aðalstræti 14-18 in downtown Reykjavík Iceland. These were made available for study at the FSÍ research center shortly after excavation and have since been included in the exhibit of the *Reykjavík 871+/-2 Museum*. These tusks showed clear signs of expert extraction from the dense maxillary bone, and apparently reflect successful hunting of Icelandic walrus by the first settlers. In 2010 the staff of the Reykjavik 871+/-2 Museum kindly aided study of large bones still embedded in the lower portion of the preserved turf wall and door sill of the hall (skáli) structure. These bones proved to be a partially articulated vertebral column and scapula of large mature walrus. This paper reports on both sets of walrus bone and tusk finds from the early hall at Aðalstræti 14-18 , which together provide an intriguing indication of walrus hunting in early Iceland.

Keywords: Walrus, Iceland, Viking Age, Marine Mammals, Reykjavik

The Aðalstræti 14-18 Archaeofauna: an overview

The excavations of the Viking Age settlement site at Aðalstræti 14-18 (Roberts 2001) recovered a substantial number of animal bones, but the site location on glacial gravel till provided rapid drainage and leaching has destroyed most of the earliest bone material within the structure that had not been burnt (Tinsley & McGovern 2001). Bone is well preserved in upper (post-medieval) layers at the site and in Viking Age deposits nearby that are probably approximately contemporary with the early structure. The better preserved Viking age collection from nearby Tjarnargata 4 included some great auk bones (*Pinguinnis impennis* L.) as well as walrus rib fragments, some of which came from very young animals (Amorosi 1997), suggesting hunting of local walrus populations thought to have been present in the Reykjanes peninsula area at first human settlement (Einarsson 2007, Petersen 1993, Pierce 2009 McGovern et al 2001) The bone finds within the Aðalstræti long house (skáli) are reported in Tinsley & McGovern 2001 (available as NABO report download from http://www.nabohome.org/publications/labreports/Norsec2AdalstrVikingPd.pdf) but it may be helpful to provide a summary overview of this collection before focusing on the walrus remains.

The occupational deposits within the skáli were sampled for micromorphological analysis and 100% bulk sampled for botanical, faunal, chemical, and magnetic analyses (for review of methods, see Milek & Gudmundsson in Roberts 2001). The majority of samples were from the floor contexts of the skáli and these were all excavated on a 1 meter square grid. All bulk samples were processed via flotation using an Ankara type apparatus. Heavy fraction (including animal bone) was collected in 1mm mesh (for details, see Guðmundsson 2001). Note that the zooarchaeological term "caprine" refers to both sheep and goats together (which are impossible to distinguish on most bone elements) and is equivalent to other authors' "Sheep/Goat" or "Ovis/Capra" categories. "Large terrestrial mammal" bones are from land mammals the size of a horse or cow but not identifiable further. "Medium terrestrial mammal" bones are from land mammals in the size range of sheep/ goat/ pig/ large dog. Table 1 below presents the taxa and identified fragment count (NISP) as well as the total of all bone fragments recovered (TNF).

Table 1.
Aðalstræti 14-18 Settlement Period
Archaeofauna Summary

Domestic Species		
Cattle *(Bos taurus*)		1
Horse (Equus caballus)		3
Pig *(Sus scrofa*)		118
Caprine		32
	total domesticate	154
Wild Species		
Walrus (*Odobenus rosmarus*)		5
Fish (Sp.Indet)		2
Mollusk (Sp. Indet.)		6
	total NISP (identifiable)	167
Large terrestrial mammal		3
Medium terrestrial mammal		16
Unidentified		4918
	total TNF (all bone fragments)	5089

The Viking period assemblage thus contains only 167 identifiable fragments (NISP) out of a total of 5089 bone fragments for an identification rate just above 3% (most other Icelandic Viking age archaeofauna identification rates range from ca. 25-60%). The cause of this very low rate of identification is the highly fragmented and heavily burnt condition of the collection: 60% of the Aðalstræti 14-18 Viking age remains were in the 1 cm and below size range, and 98% were heavily burnt to a white (calcined) condition and the remaining elements were mainly teeth (including the three walrus tusks). Due to the very fragmented nature of the early AST faunal sample, very few identifications were possible and meaningful discussion of species relative abundance is not possible. Table 1 should probably thus be regarded merely as an incomplete species list. The species found (interestingly including substantial numbers of pig remains) are similar to other Viking period assemblages studied thus far in Iceland and are wholly consistent with an early date for the structure and floor contexts (McGovern et al 2001, 2010).

Calcined bone is regularly recovered from other early sites in Iceland (Hicks 2009, McGovern & Perdikaris 2002, McGovern et al 2010) and is usually associated with fragments of wood charcoal and fire cracked stones. In these contexts the calcined bone appears to be a component of hearth cleaning, and suggests that early settlers regularly disposed of bone by adding it to primarily wood burning hearths. It is likely that the Aðalstræti 14-18 bone was calcined in a similar manner. Calcined bone has usually been subjected to such extreme heat that it has lost most of its organic content and (as the name suggests) has been largely reduced to its mineral components (mainly calcium and hydroxyapetite). This leaves the bone without much tensile strength, and calcined bones often shatter like glass when touched. Average shrinkage of 5 to 30% (often associated with lateral distortion) is also likely for vertebrate remains that have been calcined (Gilchrist & Mytum 1986). While calcined bone tends to shatter easily and is thus extremely vulnerable to mechanical damage, its mineralized state leaves it less subject to chemical weathering than un-burnt bone. Commonly, calcined bone and teeth are the last fragments to succumb to strongly acid soil conditions or to leaching resulting from highly permeable substrate, such as the beach gravels underlying the early Settlement Period deposits below the skáli, and these are the fragments overwhelmingly represented by the skáli interior collection. It is likely that the original bone deposit contained a mixture of burnt and un-burnt fragments similar to those documented elsewhere and that these fragmented calcined elements are the much -winnowed remainder of an archaeofauna much affected by attrition. The distribution of the bone fragments also suggests that foot traffic within the structure probably crushed bone and such traffic combined with periodic cleaning probably resulted in bone accumulation under benches and in corners. Figure 1 (from Milek in Roberts 2001) locates bone accumulation and the position of the walrus finds.

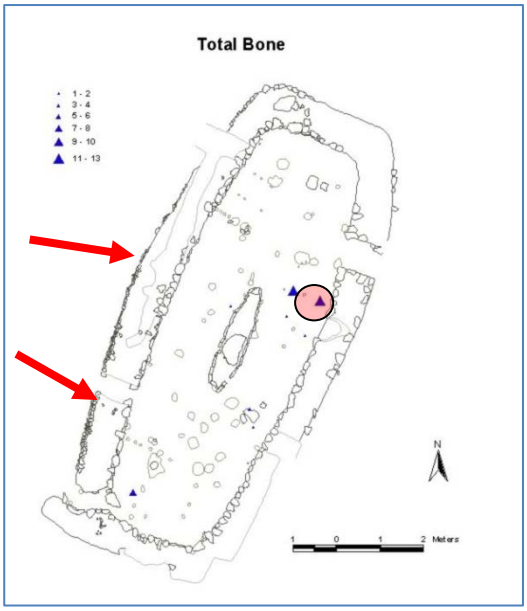

Figure 1. Location of bone fragment concentrations within the Aðalstraeti skáli. Arrows locate the vertebral (upper) and scapula (lower) walrus elements. The circle locates the three tusks.

The Walrus Tusks from the Skáli

For convenience the tusks are referred to here as specimen numbers 1, 2, & 3, their full context information is:

Specimen 1) AST 01 SF 355 747 NW 4/6/01 (best preserved),

Specimen 2) AST 01 SF 337 747 30.05.01,

Specimen 3) AST 01 SF 388 778

All three tusks showed the effects of soil conditions, and all are in fair to poor condition, with significant exfoliation and fragmentation especially evident in specimens 2 and 3. These two tusks were left incompletely cleaned to prevent disintegration in handling, but the third (specimen 1) was solid enough to allow partial cleaning and full inspection of the surface for markings (all three have since been successfully conserved). All three tusks are upper left canines, thus representing at least three separate walrus. Specimens 1 and 2 have most of the hollow root section preserved and are missing portions of the tusk tip, while specimen 3 (worst preserved) has most of the root missing but preserves most of the tip.

Figure 2 Tusk 1 from the right side, root to photo right

Specimen 1) (AST 01 SF 355 747 NW 4/6/01) This best preserved tusk is a left, from a large probably male individual (figure 2: note strong curvature typical of males). It has a nearly complete tooth root and the gum line is well marked. The original tusk was probably ca 7-10 cm longer than the surviving section, for a total length of approximately 42- 50 cm. On both the lingual (inner) and buccal (outer) surfaces of the tusk root are tool marks left by the extraction of the tusk from the walrus maxillary bone (figure 3) . These tool marks are similar to those observed on fragments of walrus ivory from Greenland.

Measurements: Tusk 1 total surviving length 35.5 cm, Maximum diameter 6.5-7.0 cm

Figure 3 Tool marks just above gum line of tusk 1

Figure 4. Walrus tusk 2, root at photo bottom left

Specimen 2) AST 01 SF 337 747 30.05.01 This poorly preserved specimen is also a left side tusk, and also probably comes from a large mature walrus (figure 4) . Most of the root is intact, but much of the tusk tip has been lost (ca 5-8 cm). Some tool marks observed just above the gum line as in specimen 1, but were less clearly observed due to less complete cleaning.

Measurements: Tusk 2 total surviving length 38 cm, Maximum diameter 6.5-7.25 cm

Figure 5. Tusk 3 root is at photo left

Specimen 3) AST 01 SF 388 778 Very badly preserved tusk tip, again from a large mature animal, sex indeterminate. While much of the tusk root has disintegrated, the gum line is still evident. Any tool marks are impossible to detect given the condition of the enamel surface (figure 5).

Measurements: Tusk 3 total surviving length 29.5 cm, Maximum diameter 6 – 6.5 cm

***Discussion*:**

These once-complete walrus tusks were very competently extracted from large fully mature walrus skulls and may well represent unused craft material. The extraction method is well documented from extensive finds of walrus skull fragments from Greenland (McGovern 1985, McGovern et al 1996). Immediate *post mortem* extraction or sawing at the gum line tends to break the tusk or at least lose a major portion of the roots. The more effective approach involved the careful breaking out of the deeply rooted tusk from the dense maxillary bone surrounding it. This is best accomplished a few weeks after the walrus has been killed to allow for partial decomposition. Then the extraction was carried out with narrow bladed cutting tools (probably chisels or similar implements) carefully breaking apart the root cavity to allow full extraction of the undamaged tusk root. The tool marks observed above the gum line of Specimen 1 clearly reflect this careful approach, which in this case was completely successful in preserving the large (and potentially valuable) tusk root intact. This competent extraction suggests that the first settlers included craft workers experienced in handling walrus ivory and in walrus butchery. Interestingly, these three tusks represent some of the largest pieces of walrus ivory (rather than bone) in Iceland or Greenland, as in later time periods the material was too valuable as a trade or tribute item to remain in the western North Atlantic and most was sent to continental Europe (Keller 2010, McGovern 1985, Roesdahl 2005, Pierce 2009).

The Exterior Walrus bones

In June 2010 during a visit to the remarkable Aðalstræti 14-18 skáli preserved in situ beneath the streets of modern Reykjavik as the center piece of the ***Reykjavik 871+/-2 Museum*** our guide Jón Páll Björnsson pointed out two areas in the external eastern wall where large bones were preserved at the base of the turf wall and in one of the corners of the eastern door entrance. Both bone concentrations did not appear to be from land mammals, nor did they appear to come from large whales (whose bones have been used for construction in Iceland in many periods). Given the finds of walrus ivory within the skáli during excavation and the find of walrus post-cranial bones in the deposits at Tjarnargata 4 nearby the possible identification of these large mammal bones as walrus was immediately raised by several of the zooarchaeology team present. We made arrangements to return to better examine the bones with fuller taxonomic references and comparative materials later in the summer, and the museum staff and administration were tremendously helpful in arranging access for measurements and photography.

Figure 6. Compressed scapula at base of doorway corner.

At the southern corner of the doorway in the southeastern wall of the skáli near the base of the wall deposit just above the natural beach cobble surface was a large highly compressed mammal scapula (shoulder blade) visible in Figure 6. While compressed by the wall and stone door frame above, this bone was far too large to come from either horse, cow, or seal, and the exposed cancellous interior and preserved surface showed characteristic sea mammal structure. Enough blade and spine shape survives to rule out any comparably sized small cetacean (such as porpoise, narwhal, or pilot whale) and the overall profile is a close match to walrus in all visible details. Despite the partial view available and the compression, we are confident that this scapula can be identified as belonging to an adult walrus.

Figure 7. Vertebral column in base of turf wall.

Approximately 4 meters to the north along the base of the eastern wall of the skáli is an exposed series of vertebrae, some with cancellous interior exposed. It is not clear if the entire vertebral column is present, as both ends are embedded in the conserved turf. Clearly visible were 5 lumbar and 2 thoracic vertebrae, all showing characteristic sea mammal structure in both compact surface and exposed cancellous interior. The vertebrae again were too large to come from cattle or horse or large seal, and completely different in structure from porpoise or small whale vertebrae, but a good match for walrus vertebrae. Measurement of the exposed vertebral body maximum dorsal length (following Piérard & Bisaillon 1981) was possible for one of the thoracic vertebrae and 5 of the lumbar (Mitoyo 15 cm digital caliper):

Thoracic 2: 6.22 cm

Lumbar 1: 6.23 cm

Lumbar 2: 5.79 cm

Lumbar 3: 5.56 cm

Lumbar 4: 5.41 cm

Lumbar 5: ~ 5.20 cm (difficult to measure)

These measurements were not taken in ideal circumstances, and some damage has occurred to most of the vertebrae, but they are consistent in placing the individual in the upper end of the range of values provided by Piérard & Bisaillon (1981) for modern Atlantic Walrus.

Discussion: While whale bone has been identified in structures in several parts of Iceland (notably the Keflavik site in Skjalfjandi Bay in the north) and small flat fragments of large whale vertebral spines and scapula were used as footing supports for light turf booth structures at the seasonal fishing station at Akurvík in the West Fjords (Amundsen et al 2005), none of these structural uses of whale bone duplicate the use of walrus bone at the Aðalstræti 14-18 skáli. In neither location would the bone have added structural strength or stability to the wall or door frame (stones such as those used elsewhere in the footings would have been far more durable and effective), and the smaller size and different structure of the walrus skeleton generally makes it far less useful for building or tool making in comparison with whale bone. It is difficult not to speculate about some ritual significance to these walrus bones (whose stratigraphic position in the first stages of construction make them resemble foundation deposits), but it is possible that these highly visible large bones might equally (or additionally) serve to advertise the walrus hunting and ivory preparing skills of the household at Aðalstræti to visitors. It may also be significant that these large post-cranial bones were brought home at all: in Greenland where kill sites were normally far from the home farm walrus bone fragments found in farm deposits are nearly all from the maxilla around the tusk root. This may suggest that walrus meat as well as ivory was being brought to the early Icelandic farm sites, and that the kill sites may not have been very distant. These external display pieces in combination with the tusk ivory within and the walrus post cranial bones in the nearby Tjarnargata 4 midden deposits add intriguing new material to ongoing discussions of Viking age and medieval marine hunting (Arneborg 2000, Dugmore et al 2005, 2007, 2009, Keller 2010, Perdikaris & McGovern 2007, Roesdahl 2005, Vesteinsson et al 2002).

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