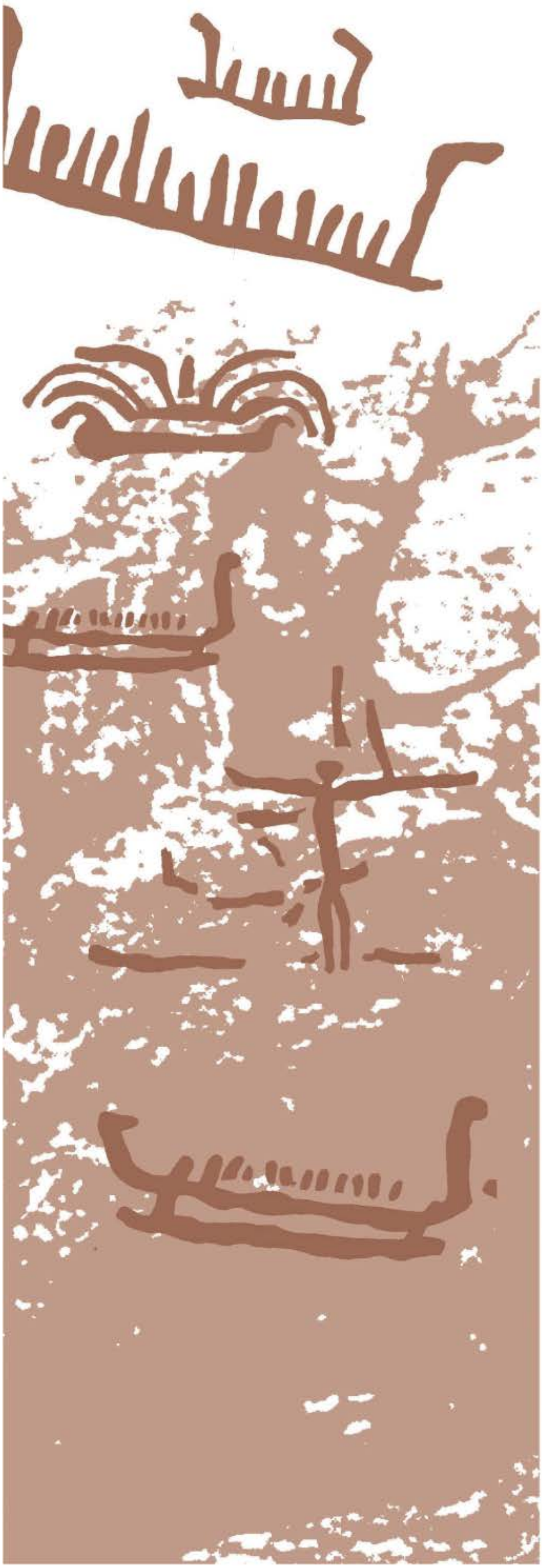
Universitetet i Stavanger / Arkeologisk museum
Oppdragsrapport 2014/19

(A) = Åpen, kan bestilles fra Universitetet i Stavanger / Arkeologisk museum
(B) = Begrenset distribusjon
(C) = Kan ikke utleveres



Osteologiske og paleobotaniske undersøkelser av skjelett og jordprøve fra Sverresborg, Trøndelag Folkemuseum, Trondheim, Sør-Trøndelag

Sean Dexter Denham
Sara Westling

AM FU saksnummer: 2014/02917
Journalnummer:
Prosjektnummer: OP-10184

Dato: 03.03.15
Sidetall: 10
Opplag: 8

Oppdragsgiver: NIKU/Riksantkvaren

Stikkord: Osteologi, paleobotani, menneskebein, birkebeiner, Sverresborg

Universitetet i Stavanger

Arkeologisk museum

Oppdragsrapport 2015/19
Universitetet i Stavanger,
Arkeologisk museum,
Avdeling for fornminnevern

Utgiver:
Universitetet i Stavanger
Arkeologisk museum
4036 STAVANGER
Tel.: 51 83 31 00
Fax: 51 84 61 99
E-post: post-am@uis.no

Stavanger 2015

Osteologiske og paleobotaniske undersøkelser av skjelett og jordprøve fra Sverresborg, Trøndelag Folkemuseum, Trondheim, Sør-Trøndelag

Sean Dexter Denham
Sara Westling

Universitetet
i Stavanger

Arkeologisk museum

Universitetet i Stavanger Arkeologisk museum **OPPDRAGSRAPPORT**	RAPPORTNUMMER 2014/19
Universitetet i Stavanger Arkeologisk museum, 4036 Stavanger Telefon: 51832600, fax: 51832699, e-post: post-am@uis.no	TILGANG:
RAPPORT TITTEL Osteologiske og paleobotaniske undersøkelser av skjelett og jordprøve fra Sverresborg, Trøndelag Folkemuseum, Trondheim, Sør-Trøndelag	SIDETALL: 10 sider
	OPPLAG: 8
	DAT0: 03.03.15

AM Journalnr
SAKSHANDSAMAR: Paula Utigard Sandvik
FORFATTAR(AR): Sean Dexter Denham, Sara Westling

OPPDRAGSGJEVAR NIKU/Riksantikvaren	OPPDRAGSGJEVERS REF.

REFERAT

Sverressaga records that during the siege and destruction of Sverresborg in 1197, the body of a murdered birkebeiner was cast into the well of Sverresborg in order to poison the water supply and thus make the fortress uninhabitable. Excavation of the well in 1938 identified a skeleton at a depth of approximately 5 meters. The fate of the skeleton remained unclear, as excavators in 1938 did not record how it was treated. In 2014 it was decided to attempt to locate and remove the skeleton, if it still existed.

The skeleton was located and part of it removed (safety concerns prohibited the removal of the entire skeleton). The present report details the results of both an osteological analysis of the recovered boen material as well as a palaeobotanical analysis of a soil sample taken from the area around the abdomen of the skeleton and assumed to represent stomach contents at death.

The skeleton represents an adult male, between the ages of 30 and 40 when he died, with chronic back problems and early onset arthritis of the hip. Palaeobotanical analyses did not return any significant results.

STIKKORD

Osteologi	
Paleobotani	
Menneskebein	
Birkebeiner	
Sverresborg	

Innholdsfortegnelse

1. Osteological analysis of partial human skeleton recovered from a well at Sverresborg, Trondheim

Dr. Sean Denham
Arkeologisk Museum, Universitetet i Stavanger

1.1 Introduction

Saga literature records that in the wake of a battle in 1197 AD a dead body was thrown into the well of Sverresborg, a royal fortress in Trondheim, in order to poison the water supply. During excavations at Sverresborg in the 1930s, a human skeleton was identified in the well. It was assumed to be the remains of the body referred to in the saga literature. The records of the excavation (field notes, reports, newspaper articles) do not specify what happened to the skeleton, whether it was left *in situ* or removed. In advance of re-development of the site for tourist purposes, it was decided that an attempt should be made to locate the skeleton, if indeed it was still in the well. This process was complicated by two factors. First, while the excavation records do not indicate where in the well the skeleton was found. Second, massive amounts of modern material, as well as large boulders, have been thrown into the well over the past seventy years. The boulders, in particular, made excavation difficult.

The skeleton was found ca. 4-5m below the nearest edge of the well. Modern material, specifically German munitions, were located directly above the remains, and it appears that only a minor effort was undertaken to cover the skeleton after the 1938 excavations. Due to safety concerns, only part of the skeleton was able to be recovered. While this is not an ideal solution, it was the only one available. The rest of the exposed skeleton has been covered over and will hopefully be retrieved n the near future. The following report will detail the completeness of the skeleton (both those elements recovered and those left *in situ* but visible during excavation) as well as the results of an analysis of the recovered remains. Recording of demographic data follows the standards put forward by Buikstra and Ubelaker (1994).

1.2 Taphonomy/preservation

The skeleton is generally preserved to a high standard. It has been stained uniform dark brown color, presumably due to prolonged contact with the soil. There is damage to various facets of the recovered remains, although it is not great. Most of this can be attributed to either in situ damage or recovery processes. Great care was taken by the conservation staff at Vitenskapsmuseet, NTNU, to dry the elements very slowly, preventing further destruction of material.

1.3 Skeleton: position and completeness

Upon being thrown into the well, the individual came to rest on their right side, facing the side of the well. It was therefore the left dorsal aspect of the spinal column, rib cage, and pelvis which presented itself to excavators. While most of the remains appear to be *in situ*, the exposed left half of the rib cage has been disturbed. It has been suggested that this was done intentionally during the 1938 excavations in order to provide a more interesting photograph. Due to safety issues, it was only possible to expose the vertebral column up to the mid-thoracic vertebrae. It is therefore unclear how much of the upper body (upper thoracic and cervical vertebrae, clavicles, arms, should blades, and skull) remains. Photographic evidence suggests that the 1938 excavators were only able to uncover a similar amount of the skeleton. The exposed vertebrae and ribs, as well as the sacrum and pelvis were recovered. Upon removal of the pelvis, the heads of the left and right femora were visible. These clearly extend into an at-present inaccessible section of the well and give hope to the idea that the lower limbs (and by analogy the upper body) survive intact. During excavation the thoracic vertebra of a large mammal (e.g. reindeer, cow) was found in close association with the pelvis; some smaller animal remains were also recovered during sieving

1.4 Skeletal inventory: recovered elements

Both halves of the pelvis, as well as the sacrum were taken up. The five lumbar vertebra as well as the lower five thoracic vertebra were also recovered. Four semi-complete ribs were recovered, as well as one smaller rib body fragment. Size and curvature suggest that these are not sequential ribs, supporting the idea that the ribs were disturbed for the purpose of photography during the 1938 excavations. Two second manual phalanges were recovered during sieving of the surrounding soil. Finally, one thin broken fragment of bone was recovered. It has been suggested that this is part of the mandible (Holck, pers. comm.), but this is not at all certain. The coloration of this fragment is inconsistent with that of the identifiably human remains. Appendix I provides a more detailed description of the completeness of the individual recovered elements.

1.5 Sex estimation

Both halves of the pelvis were used for identification of sex. Table 1 displays the results for the various sex indicators on the pelvis. The ventral arc, subpubic concavity, and the ischiopubic ramus ridge are scored on a three point scale: 1=female, 2=indeterminate, 3=male. The greater sciatic notch is scored on a five point scale, lower scores indicating female and higher scores indicating male. The pre-auricular sulcus is scored in a similar manner on a four point scale. The left half of the pelvis has damage to the greater sciatic notch and is missing the pubis symphysis, thus there is no data from these features. With the exception of the greater sciatic notch, which was given a score of 3 (indeterminate), all sex indicators fall into the male category. That the greater sciatic notch returned an ambiguous result is of no great concern, as this falls well within the range of natural variation for individuals of both sex. It can therefore be stated that this individual was almost certainly a male.

Element	**Side**	**Ventral Arc**	**Subpubic concavity**	**Ischiopubic ramus ridge**	**Greater Sciatic Notch**	**Pre-auricular sulcus**
Pelvis	R	3	3	3	3	4
Pelvis	L	n/a	3	3	n/a	3/4

Table 1. Sex estimation results for human remains from Sverresborg, Trondheim.

1.6 Age-at-death estimation

Estimation of age-at-death is based on evaluating age-related change in the skeleton associated with either the growth/development, or the degradation of the skeleton. In the present situation the most relevant indicators of age are aspects of the pelvis, the surface of the pubic symphysis and the auricular surface. The surface morphology of these features changes over time and have been systems have been developed to equate specific morphological stages with specific age ranges (although there exists a certain amount of variability). Two separate scoring systems are used for estimating age from the pubic symphysis, the Todd system (10 point system) and the Suchey-Brooks system (6 point system). An eight point system is used to estimate age from the auricular surface. In all of these systems, lower scores indicate younger individuals, higher score indicate older individuals. As mentioned above, the left pelvis is missing the surface of the pubic symphysis, thus there is limited ageing evidence available from this element. Table 2 reports the results. The features tend to share morphological affinities with multiple categories, and have thus been assigned scores between these categories (e.g. 3-4, as opposed to 3 or 4). All of these scores may be associated with an age range of 30-40 years old at death.

Element	Side	Pubic symphysis (Todd)	Pubic Symphysis (Suchey-Brooks)	Auricular surface
Pelvis	R	6-7	3-4	3-4
Pelvis	L	n/a	n/a	3-4

Table 2. Age-at-death estimation results for human remains from Sverresborg, Trondheim.

1.7 Size estimation

It is not possible to estimate height from the recovered material. The slight gracility of the pelvis suggests an individual who was not overly robust. These points will become clearer when the rest of the skeleton is recovered.

1.8 Pathology

The vertebrae display a range of pathologies. Schmorl's nodes, infections of the intervertebral disc which burrow into the articular surfaces of vertebral bodies, appear on the inferior and superior articular surfaces of first lumbar vertebra (L1) and continue on all subsequent vertebrae as one moves up the spine to the eight thoracic vertebra (T8). The number and depth of the nodes increases as one moves up the spine. The intervertebral disc between L3 and L4 is similarly infected and nodes can be seen on the corresponding articular surfaces. Similarly, heavy osteophytic development around the dorsal, superior margin of the L4 body, as well as the erosion of the surface adjacent to that margin suggest a back injury. This was first noted by Dr. Per Holck during his review of the material. Dr. Holck further suggests prolapse as the cause and estimates that such an injury may have occurred 5-10 years prior to death. L1-T11 show slight levels of compression. Exostoses appear to a greater or lesser extent on every vertebra. The neural arches of the thoracic vertebra show a particularly heavy development of exostoses. Taken as a whole, the recovered vertebrae tell the tale of a man who engaged in heavy physical activity, particularly lifting. This is somewhat at odds with the image of him as not particularly robust, but it may be more an issue of how and the frequency with which he was lifting rather than the actual weight. A range of symptoms may be associated with these pathologies, but none of them are inevitable. So he may have experienced chronic back pain or a range of neurological symptoms, or he may have experienced nothing. There is little pathological evidence present on the pelvis, although there is some slight evidence of the early development of osteoarthritis on the acetabula.

1.9 Summary

This is an interim report. If and when the rest of the skeleton is recovered our understanding of this individual will improve. Observations in the field as well as in the laboratory indicate a high probability that the rest of the skeleton survives, articulated and intact, in the well. It is unlikely that subsequent recovered material will change the present interpretations regarding sex and age-at-death (male, 30-40 years old), as the amount of evidence already available is overwhelming. Size estimates, both stature and robusticity, cannot be estimated from present material and require the remaining parts of the skeleton to be achieved. Initial pathological observations indicate numerous spinal conditions. Although none of these were necessarily problematic for the individual, it is highly likely that he experienced some symptoms associated with them.

1.10 References

Buikstra, J. E., & Ubelaker, D.H. (eds.) (1994): *Standards for Data Collection From Human Skeletal Remains.* Fayetteville: Arkansas Archeological Survey.

Appendix I. Identified species/elements and element completeness

Element	Species	Side	Completeness	Notes
Thoracic vertebra	Large mammal (e.g *equus, cervus, bos*)	Axial	Complete	Vertebral plates unfused
Rib	*Ovis* (lamb)	Unk.	Partial	-
Rib	*Ovis* (lamb)	Unk.	Partial	-
Rib	Medium sized mammal	Unk.	Partial	-
Pelvis	Homo sap.	Right	Complete	-
Pelvis	Homo sap.	Left	Pubic symphysis missing; greater sciatic notch partially damaged	-
Sacrum	Homo sap.	Axial	Part of S1 missing	-
Unknown	Unknown	Unk.	Partial	-
Vertebra (L5)	Homo sap.	Axial	Complete (3 fragments)	-
Vertebra (L4)	Homo sap.	Axial	Ventral facet of centrum partially eroded	-
Vertebra (L3)	Homo sap.	Axial	Complete	-
Vertebra (L2)	Homo sap.	Axial	Complete	-
Vertebra (L1)	Homo sap.	Axial	Complete	-
Vertebra (T12)	Homo sap.	Axial	Complete	-
Vertebra (T11)	Homo sap.	Axial	Complete	-
Vertebra (T10)	Homo sap.	Axial	Complete	-
Vertebra (T9)	Homo sap.	Axial	Complete	-
Vertebra (T8)	Homo sap.	Axial	Complete	-
Rib	Homo sap.	Left	Partial	-
Rib	Homo sap.	Left	Partial	-
Rib	Homo sap.	Left	Partial	-
Rib	Homo sap.	Left	Partial	-
Rib	Homo sap.	Unk.	Partial	-

2. Radiocarbon dating results on human rib fragment from Sverresborg, Trondheim

Beta Analytic, Inc.

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD

4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Ms. Anna Petersen | Report Date: 11/3/2014

Norsk Institutt for Kulturminneforskning (NIKU) | Material Received: 10/27/2014

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 394180	810 +/- 30 BP	-17.3 o/oo	940 +/- 30 BP

SAMPLE : TA2014-22
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (bone collagen): collagen extraction: with alkali
2 SIGMA CALIBRATION : Cal AD 1020 to 1165 (Cal BP 930 to 785)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

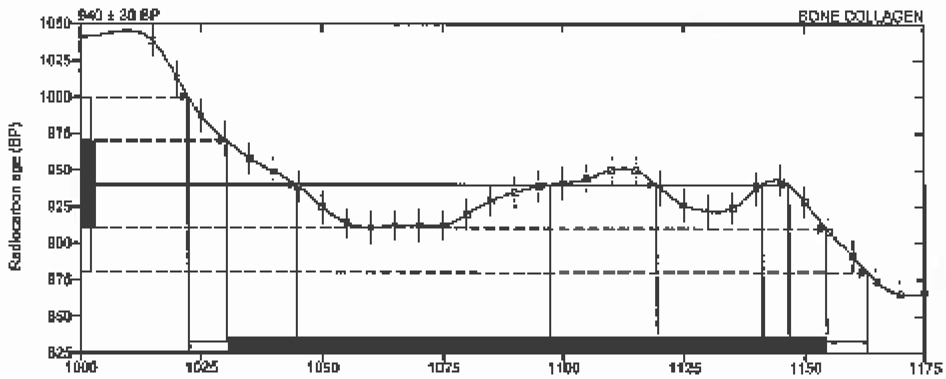
The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

Page 2 of 3

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -17.8 o/oo : lab. mult = 1)

Laboratory number	**Beta-394180**
Conventional radiocarbon age	**940 ± 30 BP**
2 Sigma calibrated result 95% probability	**Cal AD 1020 to 1165 (Cal BP 930 to 785)**
Intercept of radiocarbon age with calibration curve	Cal AD 1045 (Cal BP 905) Cal AD 1095 (Cal BP 855) Cal AD 1120 (Cal BP 830) Cal AD 1140 (Cal BP 810) Cal AD 1145 (Cal BP 805)
1 Sigma calibrated results 68% probability	Cal AD 1030 to 1155 (Cal BP 920 to 795)



Database used
INTCAL13

References

Mathematics used for calibration scenario
A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322
References to INTCAL13 database
Reimer PJ et al. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55(4):1869–1887.

3. Marine reservoir correction and calibration of radiocarbon dating results

Dr. Sean Dexter Denham
Arkeologisk Museum, Universitetet i Stavanger

The need to correct for the marine reservoir effect in radicarbon ages is well known. Differences in the rate at which carbon travels through the marine environment can cause radiocarbon dates based on carbon from the marine environment to appear younger than they actually are. The average difference is around 400 years. The method for correcting this involves calculating what percentage of the dated carbon is marine in origin, and how many years this equates to in terms of the average 400 year difference. There are local variations to this difference which should be taken into account if they vary significantly form the average (in the present case they do not).

In the present situation, the correction involves calculating the percentage of marine protein which comprised the individual's diet. The δ13C value (the ratio of carbon-13 to carbon-12 in the sample), obtained as a byproduct of the radiocarbon dating via AMS, can be taken as a proxy of this value. A higher δ13C value indicates a higher percentage marine protein in the diet and vice versa. The calculation of percentage of marine protein in the diet is as follows:

$$100 \times \frac{(x-y)}{(z-y)}$$

where *x* is the measured δ13C value for the sample, *y* is expected δ13C value for a diet with no marine component (i.e. 100% terrestrial based diet), and *z* is expected δ13C value for a diet completely composed of marine based protein (i.e. 100% marine based diet) (Schulting, pers. comm.; Rasmussen *et al.*, 2009). In this calculation, the values chosen of *y* and *z* are of critical importance, and various models have been suggested. For the present situation, two models are used as well as an average of these two. Table 1 presents the relevant information for the calculations as well as the results.

	Source	***x***	***y***	***z***	**% marine diet**
Model 1	Schulting, pers. comm.	-17,3	-21	-12	41,1
Model 2	Rasmussen et al., 2009	-17,3	-19,8	-10,9	28,1
Model 3	Average Model 1 & Model 2	-17,3	-20,4	-11,5	34,8

Table 3. Calculation of percentage of marine component in diet of individual recovered from Sverresborg, Trondheim

The conversion of these percentages into corrections for the marine reservoir effect as well as calibration/conversion of the corrected radiocarbon age into calendar dates was achieved using the CALIB program (Stuiver *et al.*, 2015). Table 2 displays the results. As can be seen, the expected date of 1197 AD falls well within the 2σ ranges for all three models. There is, therefore, strong evidence to suggest that this individual is, in fact, the individual mentioned in *Sverressaga* as having been cast into the well during the siege of Sverresborg.

	Conventional radiocarbon age BP	cal Calendar age AD (2σ)
Model 1	940 ± 30	1190-1285
Model 2	940 ± 30	1154-1268
Model 3	940 ± 30	1170-1273

Table 4. Calibrated/marine reservoir corrected calendar ages, based on three separate models for calculation of percentage marine diet, for human remains recovered from Sverresborg, Trondheim.

3.1 References

Rasmussen, K. L., Bjerregaard, P., Gommesen, P. H., and Jensen, O. L. 2009. Arsenic in Danish and Swedish Mesolithic and Neolithic human bones – diet or diagenesis? *Journal of Archaeological Science*, 36, 2826–2834.

Stuiver, M., Reimer, P. J., and Reimer, R. W. 2015. CALIB 7.1.

4. Paleobotanisk rapport Sverresborg

Sara Westling
Arkeologisk Museum, Universitetet i Stavanger

En makrofossilprøve ble tatt ut fra mageregionen av skjelettet fra brønnen på Sverresborg.

4.1 Analyse av makrofossil

Prøvens volum var ca. 100 ml og 50 ml ble tatt ut til analyse. Prøven ble våtsiktet og fraksjonert på sikter med maskevidde 1 mm, 0,5 mm og 0,25 mm. Den ble siden sortert og oppbevart i vann. Preparering og sortering ble utført av Tamara Virnovskaia. Til både sortering og analysearbeidet ble stereolupe med forstørrelse 7,5x til 112,5x brukt.

I makrofossilanalyse er identifisering basert på det at diasporer, dvs. frø, frukter, nøtter samt andre plantedeler har morfologiske særtrekk som kan danne grunnlag for identifikasjon til art, slekt eller familie. Ved identifiseringa utnyttes referansesamlingen ved AM samt bøker og digitale oppslagsverka med illustrasjoner og beskrivende tekst. Følgende hjelpemidlene er relevante for identifisering av førhistoriske planterester fra Nord-Europa: Anderberg (1994), Beijerinck (1947), Berggren (1969; 1981), Bertsch (1941), Cappers et al. (2006), Dombrovskaja et al. (1959), Katz et al. (1965; 1977), Korsmo (2001) og Schoch et al. (1988). Nomenklaturen for vitenskapelige og norske navn på planter benyttet i tekst, diagram og tabeller er etter Lid & Lid (2005) og for sopp http://webtjenester.artsdatabanken.no/Artsnavnebasen. Analysen er utført av paleobotaniker Sara Westling.

Både utsorterte planterester og restmaterialet etter sortering er tatt vare på med tanke på eventuell senere utnyttelse til analytiske formål og som en mulig kilde til forsking innen norsk paleobotanikk, miljøhistorie og landskapsutvikling i framtida. 50 ml av prøven gjenstår også ubehandlet.

4.2 Resultat

Alle frø var uforkullete. Det ble også funnet fragmenter av trekull, plantestengler, brente og ubrente bein og meitemarkkokonger. En større ubrent beinbit var også i prøven. Den ble tatt om hand av Dr. Sean Dexter Denham og inkludert i den osteologiske analysen.

Norsk navn	Latinsk navn	Antall frø
Linbendel	Spergula arvensis	3
Vassarve	Stellaria media	2
Fiol, uspesifisert	Viola	2
Marikåpe, uspesifisert	Alchemilla	1
Krekling	Empetrum nigrum	1
Starr, trekanta nøtt	Carex tristigmaticae	4
Starr, flat nøtt	Carex distigmaticae	2
Gress, uspesifisert	Poaceae	2
Ikke identifisert frø	Varia	7

Tabell 5. Frømateriale fra prøver tatt fra Sverresborg.

4.3 Tolkning

Blant frømateriale i funnet er det kun krekling som framstår som en mulig matplante. Den er dokumentert på boplasser fra steinalder og oppover og er omskreven også i kulturhistoriske kilder (Høeg 1976, Henriksson 1978). Linbendel og vassarve er åkerugress som kan ha blitt spist sammen med dårlig rensket korn men de er også vanlig forekommende på annen mark og kan ha vokset i området rundt brønnen. Starr, gress, marikåpe og fiol har sannsynligvis ikke vært del av mageinnholdet men har vokset i eller rundt brønnen.

Prøven inneholdt også en del sand og silt og det er tydelig at det ikke er snakk om rent mageinnhold. Skjelettet har ligget relativt ubeskyttet i brønnen i lang tid og sannsynligvis har frø og annet fra omgivelsene blitt vasket ned gjennom jordmassene og blandet seg med mageinnholdet og det som allerede lå på bunn når det havnet der.

4.4 Litteratur

Anderberg, A-L. 1994. *Atlas of seeds and small fruits of Northwest-European plant species: Part 4. Resedaceae-Umbelliferae.* Swedish Museum of Natural History. Stockholm. 281 s

Beijerinck, W. 1947. *Zadenatlas der Nederlandsche Flora.* Wageningen.

Berggren, G. 1969. *Atlas of seeds and small fruits of Northwest-European plant species: Part 2. Cyperaceae.* Swedish Natural Science Research Council. Stockholm. Lund. 68 s.

Berggren, G. 1981. *Atlas of seeds and small fruits of Northwest-European plant species: Part 3. Salicaceae - Cruciferae.* Swedish Natural Science Research Council. Stockholm. 261 s.

Bertsch, K. 1941. *Früchte und Samen: ein Bestimmungsbuch zur Pflanzenkunde der vorgeschichtlichen Zeit. Handbücher der praktischen vorgeschichtsforschung*. Stuttgart. F. Enke. 247 s.

Cappers, R.T.J., Bekker, R.M. & Jans, J.E.A. 2006. *Digitale Zadenatlas van Nederland (Digital seed atlas of the Netherlands)*. Barkhuis Publishing & Groningen University Library. Groningen 2006.

Dombrovskaja, A. V., Korenyeva, M. M. & Turemnov, S. N. 1959. *Atlas of the Plant Remains Occurring in Peat.* Leningrad & Moskva.

Henriksson, J. 1978. *Vartill våra växter duga*. Kroppefjälls hembygdsförenings förlag Dals-Rostock.

Høeg, O.A. 1976. *Planter og tradisjon.* Universitetsforlaget.

Katz, N. Ya., Katz, S.V. & Kipiani, M.G. 1965. *Atlas and keys of fruits and seeds occuring in the Quaternary deposits of the USSR*. Nauka, Moskva. 365 s (Russisk tekst)

Katz, N. Ya., Katz, S.V. & Skobeyeva, E.I. 1977. *Atlas of Plant Remains in Peat*. Nedra, Moskva & Leningrad. 371 s (Russisk tekst).

Korsmo, E., Videm, T. & Fykse, H. 1981. *Korsmos ugrasplansjer*. Landbruksforlaget. 295 s.

Schoch, W. H., Pawlik, B. & Schweingruber, F.H. 1988. *Botanical macro-remains*. Paul Haupt Publisher, Bern & Stuttgart. 227 s.