in Situ

Archaeologica

vol.14

in Situ Archaeologica

ISSN 2000-4044

www.insituarchaeologica.com

Artiklar i in Situ granskas av anonyma referenter i redaktionskommittén.

Finansiärer
Bohusläns museum, Göteborgs universitet, Kulturmiljö Halland,
Statens Historiska Museer Arkeologerna

in Situ Archaeologica

vol. 14

Tema: Rogaland

in Situ
Archaeologica

in Situ vol.14
Sid 119–130
www.insituarchaeologica.com

ISSN 2000-4044

Erik Daniel Fredh
Arkeologisk museum, Universitetet i Stavanger
daniel.fredh@uis.no

Tema: Rogaland

Landscape Dynamics in the Sømmevågen Area

With Focus on the Last 8000 Years

This study is based on stratigraphical descriptions, radiocarbon dates and pollen records obtained in connection with three archaeological excavations (Sømme III, Einargården and Sola Airport). The combined data are used to infer local sediment distributions in a transect between the study sites (approx. -5 to 10 m.a.s.l.) and subsequently to infer landscape dynamics over the last 8000 years in the Sømmevågen area, southwestern Norway. The stratigraphy and the analyses show that natural processes dominated the environmental impact until c. 500 BC, after which, human activities related to an expanding agrarian society seemingly became a more important factor. The inferred landscape development provides an example on how human/nature interactions can change over time and how on-site stratigraphical analyses can contribute to the understanding of archaeological sites and their surroundings.

1. The study sites in southwestern Norway and the surrounding topography, with A) the maximum sea level (7–9 m.a.s.l.) during the Tapes transgression, and B) the present-day sea level. Modified figure originally made by Theo Gil Bell.

Introduction

The coastal landscape in southwestern Norway has changed substantially during the last c. 8000 years, as a result of both natural processes and human activities. Local sea level variations were important for sediment formation, but also determined suitable locations for hunter/gatherer settlements that were often located along the coast (Bang-Andersen 1973, Skjelstad 2011). Dense tree cover characterised the low-lying coastal areas (Hjelle et al. 2018), until the first woodland clearance was initiated, c. 4500–2500 BC, either to promote game for hunting or for animal husbandry as the first step in an agricultural economy (Hjelle et al. 2006, Høgestøl and Prøsch-Danielsen 2006). After both animal husbandry and crop cultivation had become integrated in the agricultural society c. 2400–2000 BC (Diinhoff 2005, Soltvedt 2000), various impacts on the landscape started to take place, such as deforestation, erosion, heathland expansion and aeolian sand movement.

In this paper, stratigraphical descriptions, pollen analyses and radiocarbon dates, obtained from two archaeological sites excavated in 2014 (Einargården and Sømme III), are used to analyse the landscape development in the Sømmevågen area, southwestern Norway (Figure 1). Data from a previous excavation in 1985 are also included (Selsing 1987) as well as a comparison with subsequent research related to this site (Prøsch-Danielsen 1993, Selsing and Mejdahl 1994). The study sites (up to 800 m apart) are situated near the coast on both sides of a relatively flat plain that was inundated by the sea several times in the past. The aims of this study are to reconstruct the local landscape development with a focus on the last 8000 years, and to explore human impact on the surrounding environment, by inferring a stratigraphical transect between the study sites using data obtained from both sides of the plain.

2.

Stratigraphical sections recorded during excavation at A) the Einargården site with surface level at approx. 5 m.a.s.l. (towards W), B) the Einargården site with surface level at approx. 2 m.a.s.l. (towards SW), and C) the Sømme III site with surface level at approx. 10 m.a.s.l. (towards NE). Photos: Museum of Archaeology/University of Stavanger.

The Einargården site is situated in the eastern part of the study area at approx. 2–7 m above sea level (Figure 2a, b). The excavation at Einargården revealed cultivation layers radiocarbon dated to c. 800–500 BC and remains from agrarian settlements mainly from c. AD 1–550 (Aanderaa 2015, Alqvist and Fredh 2015).

The Sømme III site is situated in the western part of the study area at approx. 6–11 m above sea level between two bedrock outcrops (Figure 2c). The excavation at Sømme III recorded hunter/gatherer settlements and artefacts mainly from c. 6400–3300 BC, along with a small number of archaeological structures and artefacts from later periods (Fredh and Westling 2020, Meling et al. 2020, Meling 2020).

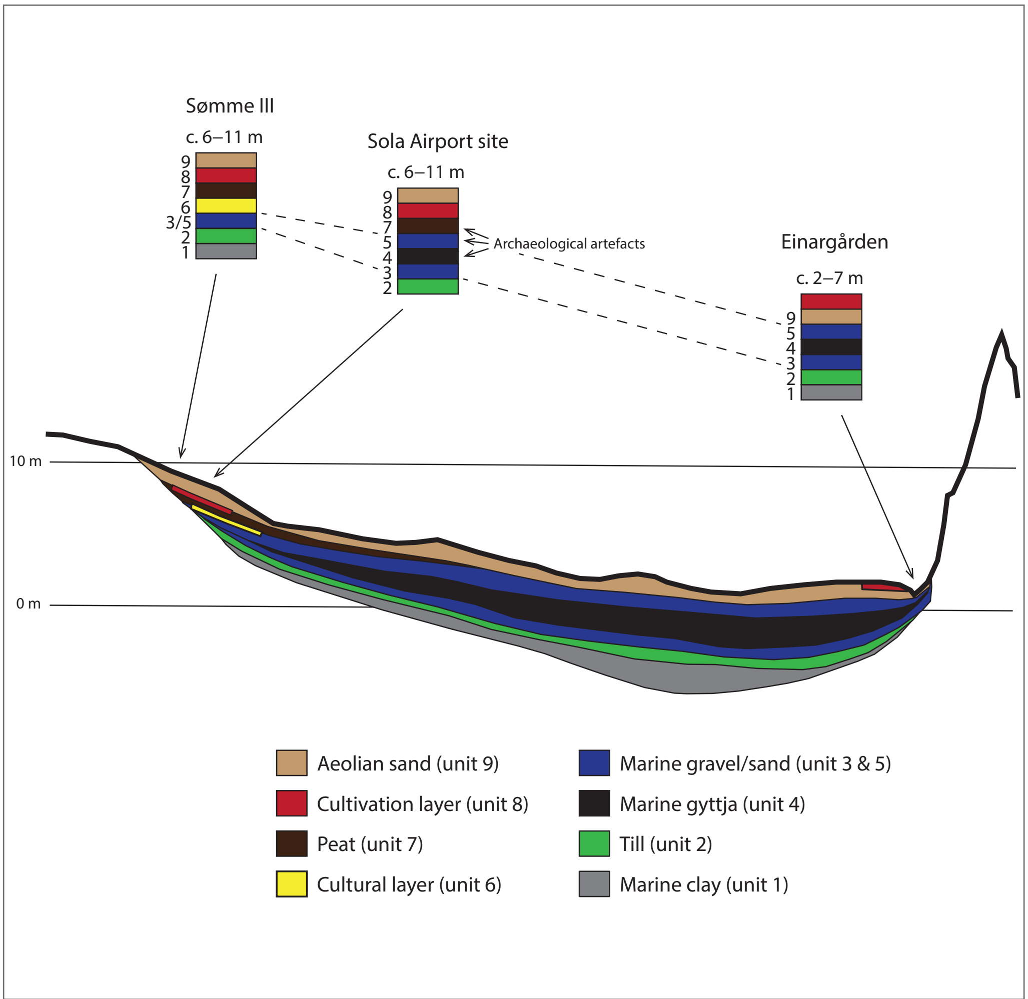
The Sola Airport site is situated in the western part of the study area (adjacent to the Sømme III site) around a bedrock outcrop at approx. 6–11 m.a.s.l. The excavation at Sola Airport recovered archaeological artefacts typologically dated to c. 6500–2400 BC. However, the main focus was on the analysis of stratigraphy, which included the investigation of 39 sediment cores (Selsing 1987).

Results and discussion

The oldest stratigraphical unit identified at the study sites is most likely a marine clay (unit 1), (Figure 3) a type of sediment that is found at several coastal locations in the region, sometimes with a thickness of several metres (Reiersen and Fredh 2015, Sejrup et al. 1998). It is likely to have been formed during a time of high meltwater input from the Ice Sheet in deep water, c. 32 thousand years BP (Sejrup et al. 1998, Andersen et al. 1987). The upper part of this unit was uneven at the Einargården site, and was mixed with larger sediment fractions, such as gravel and boulders. This upper mixed part was therefore interpreted as the remains of a till (unit 2), probably formed in a subglacial setting during Ice Sheet retreat, which melted away from the area c. 17 000–16 000 years ago (Gump et al. 2017).

After the last glaciation, the relative sea level reached to about 20–25 m higher than present, but dropped considerably from c. 9000 BC to a level below the present sea level, before it started to rise again c. 8000–7000 BC (i.e. Tapes transgression) (Fjeldskaar and Bondevik 2020, Prøsch-Danielsen 2006, Thomsen 1982). When the sea level was close to the investigated sites, the wave action affected the sediments at their shorelines, by depositing a sorted sand and gravel layer (unit 3). The composition of this unit is highly variable within and between the study sites, which indicates variations in water depth and wave energy that probably varied temporarily and spatially (Ahlqvist and Fredh 2015, Fredh and Westling 2020, Selsing 1987).

During the Tapes transgression maximum (approx. 7–9 m during c. 6000–4000 BC), the temperature was relatively high, which probably contributed to the formation of the organically rich marine gyttja that measured up to c. 1.2 m thick



3.
Composite stratigraphy for each study site and an inferred transect across the study area. Note that the thickness and distribution of sediment units are simplified.

(unit 4) and was identified at the Sola Airport and Einargården sites. From these two sites, in total eight radiocarbon dates were obtained from the marine gyttja (Alqvist and Fredh 2015, Prøsch-Danielsen 2006, Selsing 1987), all in the interval c. 6200–3600 BC (Figure 4). This gyttja was most likely deposited in relatively shallow and calm waters and contained archaeological finds (typologically dated to c. 6500–4000 BC) at the Sola Airport site (Selsing 1987). The pollen assemblage in the gyttja was similar between the Einargården (Figure 5a) and Sola Airport sites and suggests the former existence of relatively dense woodland, dominated by birch (*Betula*), alder (*Alnus*), hazel (*Corylus*), pine (*Pinus*) and oak (*Quercus*) (Alqvist and Fredh 2015, Prøsch-Danielsen 2006), which is in general agreement with the regional vegetation cover (Hjelle et al. 2018, Prøsch-Danielsen and Simonsen 2000).

Lab-ID	Archaeological site	14C age BP ± 1 sigma	Calebrated age AD/BC (2 sigma interval)
TUa-6932A	Sola Airport	770 ± 35	AD 1217–1288
T-7042B	Sola Airport	1530 ± 80	AD 356–675
TUa-6931A	Sola Airport	1650 ± 35	AD 262–538
R-853503 (TL3)	Sola Airport		
T-7042A	Sola Airport	1790 ± 60	AD 86–385
T-6380A	Sola Airport	1820 ± 160	185 BC–AD 560
R-853501 (TL1)	Sola Airport		
T-6379A	Sola Airport	2190 ± 80	397–51 BC
R-853504 (TL4)	Sola Airport		
T-8226A	Sola Airport	2660 ± 60	976–599 BC
TUa-6929A	Sola Airport	2805 ± 40	1055–833 BC
TUa-6930A	Sola Airport	3430 ± 40	1879–1622 BC
UBA-34250	Sømme III	2073 ± 30	177–1 BC
UBA-34254	Sømme III	2232 ± 28	385–204 BC
UBA-34251	Sømme III	2261 ± 35	399–207 BC
UBA-34252	Sømme III	2272 ± 31	401–209 BC
Beta-400426	Einargården	2490 ± 30	781–511 BC
T-6598	Sola Airport	2360 ± 60	753–235 BC
T-7045B	Sola Airport	2360 ± 80	766–211 BC
T-7045A	Sola Airport	2420 ± 70	767–397 BC
T-6378A	Sola Airport	2540 ± 80	815–415 BC
T-6599	Sola Airport	2550 ± 70	825–430 BC
T-6903B	Sola Airport	3450 ± 90	2012–1531 BC
T-6903A	Sola Airport	3510 ± 70	2025–1665 BC
T-6890	Sola Airport	3540 ± 80	2132–1667 BC
T-7043B	Sola Airport	4360 ± 80	3339–2876 BC
T-7043A	Sola Airport	4540 ± 90	3517–2934 BC
T-6600	Sola Airport	4890 ± 100	3946–3382 BC
R-853502 (TL2)	Sola Airport		
T-10888	Sola Airport	3995 ± 180	3010–1979 BC
T-6891	Sola Airport	4930 ± 90	3953–3529 BC
ß-171187	Sola Airport	4950 ± 40	3896–3642 BC
Beta-400438	Einargården	5290 ± 30	4233–4005 BC
T-6893A	Sola Airport	5480 ± 90	4497–4056 BC
Beta-400439	Einargården	5890 ± 30	4836–4706 BC
Beta-400437	Einargården	6080 ± 30	5198–4856 BC
ß-171186	Sola Airport	6110 ± 40	5210–4935 BC
T-6894	Sola Airport	7080 ± 90	6200–5741 BC
T-7022	Sola Airport	7130 ± 100	6224–5798 BC

4.

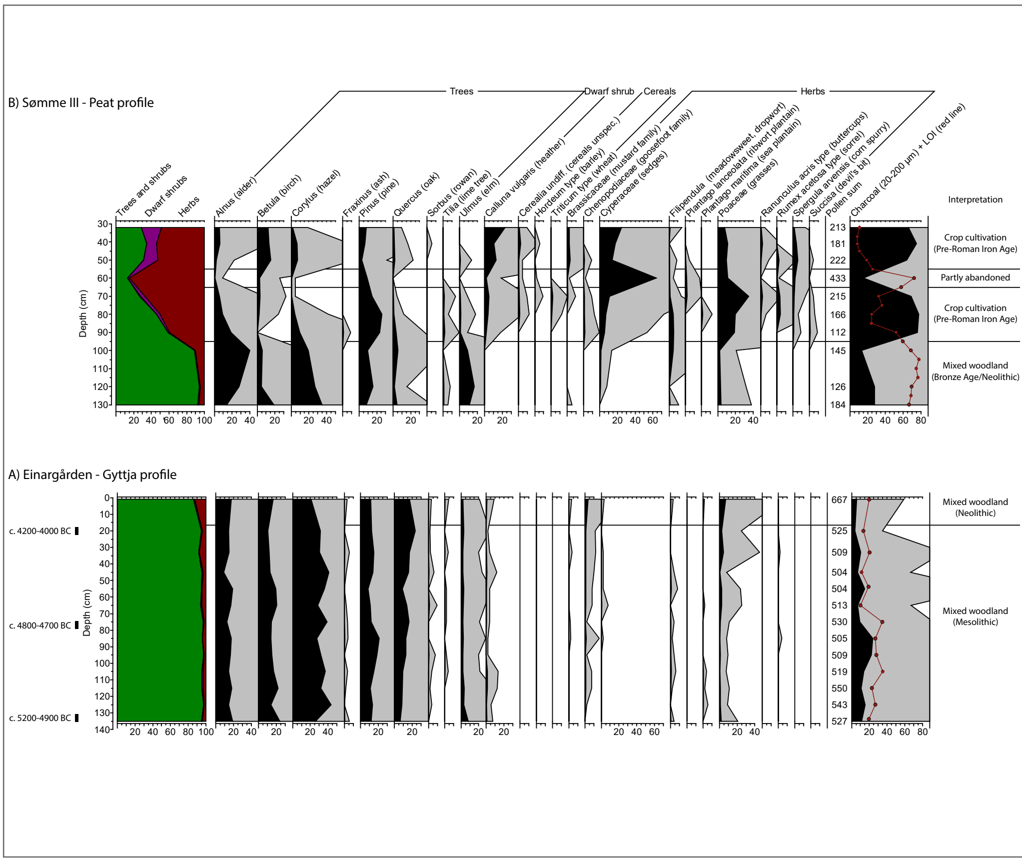
Selected radiocarbon (^{14}C) and thermoluminescence (TL) dates from the study sites (i.e. the ones obtained from stratigraphical sections) with related sample information. The dates are shown in chronological order. The inferred age range of dated sedimentological units is also included. References: 1) Selsing 1987, 2) Prøsch-Danielsen 1993, 3) Selsing and Mejdahl 1994, 4) Prøsch-Danielsen 2006, 5) Prøsch-Danielsen and Selsing 2009, 6) Alqvist and Fredh 2015, 7) Fredh and Westling 2020.

TL-date BP (AD/BC)	Type of material (event)	Inferred age range AD/BC	Reference
	Paleosol		5
	Peat/paleosol (top)		3
	Paleosol		5
1600 ± 150 (AD 200–500)	Sand		3
	Peat/paleosol (top)		3
	Peat/paleosol (bottom)	Unit 9: Aeolian sand/paleosol (1900 BC–AD 1300)	1, 3
2000 ± 200 (250 BC–AD 150)	Sand		3
	Paleosol		1, 2
2400 ± 250 (700–200 BC)	Sand		3
	Paleosol		3
	Paleosol		5
	Paleosol		5
	Arrhenatherum elatius ssp bulbosum		7
	Cerealia indet. Chaff		7
	Cerealia indet. Chaff	Unit 8: Cultivation layer (800–1 BC)	7
	Ranunculus acris-type		7
	Cerealia indet. Chaff		6
	Peat (top)		2
	Peat (rise of Spergula arvensis)		2
	Peat (rise of Spergula arvensis)		2
	Peat (top)		1, 2
	Peat (first apperence of Triticum-type)		2
	Peat (first apperence of P. lanceolata)	Unit 7: Peat (3900–200 BC)	2
	Peat (first apperence of P. lanceolata)		2
	Peat (bottom)		2
	Peat (bottom)		2
	Peat (bottom)		2
	Charcoal of Salix & Betula (bottom)		1, 2
3500 ± 350 (1900–1200 BC)	Sand		3
	Bone of deer (bottom)	Unit 5: Sand/gravel (4000–1200 BC)	3
	Charred hazelnut shells (top)		4
	Bone of seel (upper part)		4
	Twigs (top)		6
	Gyttja (top)		1, 3
	Leaf fragments	Unit 4: Marine gyttja (6200–3600 BC)	6
	Bark fragments (bottom)		6
	Teeth of wild boar		4
	Hazelnut shell (bottom)		1, 3
	Gyttja (bottom)		4

A dense woodland dominated the landscape when the Sømme III and Sola Airport sites were inhabited by hunter/gatherer groups (roughly between c. 6500 and 2400 BC). The settlements were situated near the shore at a time when the western part of the study area was part of an island (Figure 1a). The occupation was on top of beach sediments (i.e. sand/gravel, unit 3 or 5), and generated a build-up of cultural layers (unit 6) up to approx. 20 cm thick, which contained a substantial amount of archaeological artefacts. Artefacts were also deposited at lower elevations (in unit 4 or 5), partly outside the settlements towards the sea (Meling et al. 2020, Selsing 1987). After the Tapes transgression maximum, the relative sea level fell again, and the wave action eventually formed the gravel/sand unit 5 in a near shore environment, dated at the Sola Airport site to c. 4000–1200 BC (Selsing and Mejdahl 1994, Prøsch-Danielsen 2006).

After the hunter/gatherer settlements were abandoned at the Sømme III and Sola Airport sites, and during continued sea level regression, peat (unit 7) started to accumulate in the wetter terrestrial areas, which later expanded to cover a larger area. The peat layer was up to approx. 1 m thick and probably contributed to the preservation of archaeological remains in the underlying cultural layers. At different levels and sections, peat from the Sola Airport site was radiocarbon dated, yielding dates between 3900 and 200 BC (Prøsch-Danielsen 1993, Selsing 1987). The lowermost peat contained pollen assemblages dominated by trees (Figure 5b), such as alder (*Alnus*), hazel (*Corylus*) and elm (*Ulmus*) (Fredh and Westling 2020, Prøsch-Danielsen 1993), which probably overlapped in time with the last phase of the hunter/gatherer settlement.

The pollen composition in the peat also record the first agriculture, starting with animal husbandry at c. 2100–1500 BC, indicated by expanding grassland plants, such as ribwort plantain (*Plantago lanceolata*) (Prøsch-Danielsen 1993). Higher up in the peat a more substantial woodland clearance was identified simultaneously with the introduction of crop cultivation (Figure 5b), shown by the appearance of cereal pollen and common weeds (Fredh and Westling 2020, Prøsch-Danielsen 1993). Cereal cultivation was also confirmed at all study sites by preserved cultivation layers (unit 8) and their pollen assemblages. The existence of an agricultural landscape is further suggested by plough marks found at the Sola Airport site. Radiocarbon dated macroscopic plant remains from the cultivation layers, combined with dates from selected peat levels, suggest cultivation was carried out c. 800–1 BC in the area. In the western part of the study area, the organic rich peat became partially mixed with the underlying cultural layer during cultivation, while aeolian sand was the main component in the cultivation layer at the Einargården site. Expanding crop cultivation during the pre-Roman Iron Age is often associated with the general expansion of manured permanent arable fields that were probably established during this time period (Fredh et al. 2018, Halvorsen and Hjelle 2017).



5.

Pollen records showing selected taxa from A) a gyttja section at Einargården, and B) a peat section at Sømme III. The diagrams also show results from the analysis of Loss on Ignition (LOI), i. e. the organic content in the sediment. Inferred archaeological periods in the section from Sømme III are based on dated macrofossils from nearby cultivation layers (Fredh and Westling 2020) and a comparison with dates obtained from peat sections at the Sola Airport site (Prøsch-Danielsen 1993).

Due to the expanding cultural landscape, in combination with a slowly receding relative sea level, former beach areas became more exposed to wind, which resulted in aeolian sand movement and the formation of sand layers (unit 9) up to approx. 2 m thickness, in particular at the Sømme III and Sola Airport sites (Meling et al. 2020, Selsing 1987). Radiocarbon dates from palaeosols and a thin peat layer (up to 0.4 m thick) within the sand, along with thermoluminescence dates of the sand itself, suggest that the sand was deposited between 1900 BC and AD 1300 (Prøsch-Danielsen and Selsing 2009, Selsing and Mejdahl 1994). The thin peat layer within the sand (dated to 200 BC–AD 700) indicates a temporary period of reduced sand transport, with more continuous vegetation cover, or possibly variation in groundwater levels (Selsing and Mejdahl 1994). An intensification of aeolian sand movement during the last few thousand years has been identified at many sites along the coast of southwestern Norway (Prøsch-Danielsen and Selsing 2009), which has substantially reshaped the topography of these coastal landscapes.

Conclusion

The combined evidence obtained in relation to archaeological excavations in the Sømmevågen area provide a relatively clear picture of sediment formation and local landscape development during the last c. 8000 years. Natural processes were the main drivers behind environmental change between c. 8000 and 2000 BC, i.e. relative sea level changes influenced the sediment distribution whereas climate was the main factor controlling vegetation cover. Woodland clearance was recorded in the area from c. 2000 BC to establish grazing areas for animals as the first step in an agricultural economy. Human activity had a dominant impact on the landscape from c. 500 BC, including further woodland clearance and the introduction of crop cultivation across the study area, which is likely to have triggered aeolian sand movement. The similarity between study sites suggests that most sediment units can be traced across a wider area, although the same units were sometimes positioned at different elevations and therefore probably deposited at somewhat different times. However, the stratigraphy inferred across the study area is useful for locating pre-historic settlements and to understand their environmental settings, as well as to explore natural and human influences on the past landscape.

Acknowledgements

I want to thank Sara Westling and Jenny Ahlqvist for discussions during sampling/analyses, and Trond Meling and Lisbeth Prøsch-Danielsen for providing useful comments on the manuscript.

References

Aanderaa, F. 2015. *Arkeologiske undersøkelser av treskipet hus og øvrige bosetningsspor fra elder jernalder, Einargården, Sande gnr. 33, bnr. 8, Sola kommune, Rogaland* (Oppdragsrapport 2015/6).

Ahlqvist, J. & D. Fredh. 2015. *Makrofossil- och pollenanalys av långhus, profil och dyrkningslager på Einargården, gnr. 33, bnr. 8, Sola kommun, Rogaland* (Oppdragsrapport 2015/9).

Andersen, B.G., Wangen, O.P. & Østmo, S.R. 1987. Quaternary geology of Jæren and adjacent areas, southwestern Norway, *NGU Bulletin*, 411, pp. 2–55.

Bang-Andersen, S. 1973. Steinalderboplasser ved Storamos og Holmavatnet på Høg-Jæren, *Frá haug ok heiðni*, 3, pp. 35–43.

Diinhoff, S. 2005. Den vestnorske agrarbosætning. Fra sen stenalder til folkevandringstid. Arkeologiske resultater fra et tiår med fladeafdækninger på Vestlandet, *AmS Varia*, 43, pp. 75–85.

Fjeldskaar, W. & Bondevik, S. 2020. The Early-Mid Holocene transgression Tapes at the Norwegian coast – comparing observations with numerical modelling, *Quaternary Science Reviews*, 242, pp. 1–12, DOI: 10.1016/j.quascirev.2020.106435.

Fredh, E.D. and Westling, S. 2020. *Stratigrafiske og botaniske undersøkelser av id 150773, id 150775, id 150776 på Sømme Sømme III. Sømme gnr. 15, bnr. 161 m.fl. i Sola kommune, Rogaland fylke* (Oppdragsrapport 2020/19).

Fredh, E.D., Prøsch-Danielsen, L. & Jensen, C.E. 2018. A synthesis of pollen composition in prehistoric cultivation layers in southwestern Norway, *Environmental Archaeology*, DOI: 10.1080/14614103.2018.1536499.

Gump, D.J., Briner, J.P., Mangerud, J. & Svendsen, J.I. 2017. Deglaciation of Boknafjorden, south-western Norway, *Journal of Quaternary Science*, 32, pp. 80–90.

Halvorsen, L. & K.L. Hjelle. 2017. Prehistoric Agriculture in Western Norway – Evidence for Shifting and Permanent Cultivation Based on Botanical Investigations from Archaeological Sites, *Journal of Archaeological Science: Reports*, 13, pp. 682–696.

Hjelle, K.L., Halvorsen, L.S., Prøsch-Danielsen, L., Sugita, S., Kaland, P.E., Mehl, I.K., Overland, A., Paus, A, Danielsen, R., Høeg, H.I. & Midtbø, I. 2018. Long-term changes in REVEALS-estimated vegetation cover along the west coast of southern Norway: the importance of human impact, *Journal of Vegetation Science*, 29, pp. 404–415.

Hjelle, K.L., Hufthammer A.K. & K.A. Bergsvik. 2006. Hesitant Hunters: A Review of the Introduction of Agriculture in Western Norway, *Environmental Archaeology*, 11, pp. 147–170.

Meling, T. 2020. Hverken grav eller rydning – rituelle røyser fra yngre bronsealder–førromersk jernalder på Sømme i Rogaland, *AmS-Varia*, 61, pp. 87–97.

Meling, T., Fyllingen, H. and Denham, S.D. 2020. *Arkeologiske undersøkelser av bosetningsspor fra seinmesolitikum og tidligneolitikum, samt aktivitetsspor fra bronsealder og førromersk jernalder id 150773, id 150775, id 150776 på Sømme Sømme III. Sømme gnr. 15, bnr. 161 m.fl. i Sola kommune, Rogaland fylke* (Oppdragsrapport 2020/17).

Prøsch-Danielsen, L. 1993. Prehistoric Agriculture Revealed by Pollen Analysis, Plough-marks and Sediment Studies at Sola, South-western Norway, *Vegetation History and Archaeobotany*, 2, pp. 233–244.

Prøsch-Danielsen, L. 2006. Sea-level studies along the coast of southwestern Norway, with emphasise on three short-lived Holocene marine events, *AmS-Skrifter*, 20, pp. 7–94.

Prøsch-Danielsen, L. & Selsing, L. 2009. Aeolian activity during the last 9200 calendar years BP along the southwestern coastal rim of Norway, *AmS-Skrifter*, 21, pp. 7–96.

Prøsch-Danielsen, L. & Simonsen, A. 2000. Palaeoecological investigations towards the reconstruction of the history of forest clearances and coastal heathlands in south-western Norway, *Vegetation History and Archaeobotany*, 9, pp. 189–204.

Reiersen, K. & Fredh, D. 2015. *Arkeologisk undersøkelse av steinalderboplass på Gramstad, gnr. 1, bnr. 8 & 10, Sandnes kommune* (Oppdragsrapport 2015/7).

Sejrup, H. P., Landvik, J. Y., Larsen, E., Janocko, J., Eiriksson, J. & King, E. 1998. The Jæren area, a Border Zone of the Norwegian Channel Ice Stream, *Quaternary Science Reviews*, 17, pp. 801–812.

Selsing, L. 1987. Stavanger Lufthavn Sola, som tilholdssted for jegere/fangstfolk/fiskere i yngre steinalder. Resultater fra de geologiske undersøkelsene (*Riksantikvarens Rapporter*, 17), pp. 10–19.

Selsing, L. & Mejdahl, V. 1994. Aeolian stratigraphy and thermoluminescence dating of sediments of late Holocene age from Sola, southwest Norway, *Boreas*, 23, pp. 1–13.

Skjelstad, D. 2011. Steinalderboplasser på Fosenhalvøya. Arkeologiske og naturvitenskapelige undersøkelser 2004–2007, T-forbindelsen, Karmøy kommune, Nord-Rogaland, *AmS Varia*, 52, pp. 7–71.

Soltvedt, E.-C. 2000. Carbonised Cereal from Three Late Neolithic and two Early Bronze Age Sites in Western Norway, *Environmental Archaeology*, 5, pp. 49–62.

Thomsen, H. 1982. Late Weichselian shore-level displacement on Nord-Jæren, south-west Norway, *GFF*, 103, pp. 447–468.