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Exception proves the rule: divergent patterns in settlement locations in Central and Southern Ostrobothnia

Lauri Skantsi, Petro Pesonen, Miikka Tallavaara & Markku Oinonen

Abstract

Because of the rapid shoreline displacement during the Holocene, coastal Ostrobothnia is the most robust area in Finland to build a detailed shoreline chronology for Stone Age and Bronze Age sites based on geological and archaeological radiocarbon dates. The radiocarbon dated shoreline chronology has a further advantage: the ability to date also the sites without radiocarbon dates in the area, only with reference to the height levels of the sites. Furthermore, the local detailed chronology for several archaeological sites, site types, artefacts etc gives a potential to widen the chronology to the adjacent areas as well. The detailed shoreline curve also gives good grounds to study and interpret the settlement history of Ostrobothnia, where the village development and the complexity of the hunter-gatherer societies is visible and of particular importance. Here, we take a look at the shoreline chronology of Central Ostrobothnia and northern parts of Southern Ostrobothnia by using pond, lake and mire isolation dates added with archaeological dates. Our results show that not all sites were shore-bound, and they are indicating a resettlement pattern which is further discussed.

Keywords: Late Neolithic resettlement, shoreline chronology, Central Ostrobothnia, Southern Ostrobothnia

26.1 Introduction

The great mass of the Scandinavian Ice Sheet during the Last Glacial Period suppressed the earth's crust until c 11,700 years ago and its meltwaters initiated the progress from Baltic Ice Lake to the current Litorina Sea. The lifting of this heavy burden of ice relieved the earth's crust causing post-glacial land uplift still going on in Scandinavia. New areas of land emerged from under waters causing shoreline displacement, which is most evident in the Ostrobothnian region, close to the center and the last remnants of the former ice sheet in northern Sweden.

Shore displacement has been of tremendous help for archaeologists around the Baltic Sea. In Sweden and Finland, it has given the best relative way of dating the shore-bound hunter-gatherer settlement sites during the Stone and Bronze Age because of the constant and successive emerging and of new land (e.g. Europaeus-Äyräpää 1930; Siiriäinen 1974). The Ostrobothian coast has been especially fruitful to study the relationship between the prehistoric settlement sites and the shoreline displacement. Generally, the pattern is quite straightforward, and the sites follow the receding shoreline. However, the relatively quick pace of the shoreline retreat has also offered a possibility to spot and study the deviations in this pattern (e.g. Pesonen 2013; 2016; Pesonen et al. 2020).

During the last ten years, a number of studies have been performed focussing on the chronology and the settlement patterns on the Finnish side of the Gulf of Bothnia (Pesonen 2013; 2016; Pesonen et al. 2020; Tallavaara & Pesonen 2020; Jørgensen et al. 2022; Skantsi 2023). Traditionally shoreline calculations have been made mostly on the basis of lake and pond isolation limits, which have some issues in the accuracy. Archaeological radiocarbon dates provide parallel means to assess the shoreline curves and their accuracy.

In this paper, we first present the shoreline curve for Central Ostrobothnia and northern parts of Southern Ostrobothnia based on geological lake and mire isolation radiocarbon dates as presented recently by Vuorela et al. (2009) and Pohjola et al. (2019). Secondly, we evaluate the archaeological radiocarbon dates from the area for comparison in this curve. Thirdly, a new curve is compiled on the basis of both the isolation and the archaeological dates. The main discussion concerns the archaeological dates that are divergent from the curve.

26.2 Shoreline curve for Central Ostrobothnia and northern part of Southern Ostrobothnia

Central Ostrobothnia has been in focus only in a few geological shoreline studies in contrast to the Northern Ostrobothnia (e.g. Saarnisto 1981) and Southern Ostrobothnia (Glückert et al. 1993). The most comprehensive study of the area focuses on coastal mires and ponds, which reflect the youngest part of the shoreline curve (Glückert et al. 1998). Compilation of the data from these former studies by Vuorela et al. (2009) forms a starting point for the analyses of the present work (Table 1). Archaeologically this particular area has not been very well covered in shoreline studies, while several attempts exist to the adjacent areas both south (Salomaa & Matiskainen 1983; 1985) and north (Siiriäinen 1978; Saarnisto 1981; Okkonen 2003; Hakonen 2017; 2021; Tallavaara & Pesonen 2020). The locations of both isolation and archaeological sites used in this work are shown in Figure 1.

The archaeological radiocarbon dataset for the study consists of radiocarbon dates accumulated from Central Ostrobothnia and the northern parts of Southern Ostrobothnia over a few decades. In addition to the already existing radiocarbon dates, we had a number of new radiocarbon dates made on short-lived materials, e.g. burnt bone and charred crust. In this paper we present some new dates from Central Ostrobothnia which have been presented also in a recent PhD thesis dealing with the settlement prehistory of the region (Skantsi 2023). The details of the archaeological radiocarbon dates are presented in Table 2. All the shoreline curves have been estimated using

Site nr	Used in curve	Municipality	Site	Con-text	Lab ID	BP
1	x	Alajärvi	Katiskalampi	pond	Su-2293	8390
2	x	Kauhava	Vähäjärvi	lake	TKU-55	6090
3	x	Kauhava (Alahärmä)	Kalliojärvi	lake	TKU-57	3370
4	x	Kokkola	Kåtö	lake		400
5	x	Kokkola	Mostroträsket	lake		600
6	x	Kokkola (Lohtaja)	Junginsivu	mire	Hel-1851	910
7	x	Kruunupyy	Jämnträsket	lake		2770
8	x	Kruunupyy	Lövmossen	mire		1300
9	x	Kruunupyy	Mjöträsket	lake	GrN-22701; GrN-22916	1940
10	x	Kruunupyy	Skalaträsket	lake		1760
11	x	Kruunupyy	Stenträsket	lake	GrN-22704; GrN-22919	850
12	x	Kruunupyy	Stoppeträsket	lake		2110
13	x	Kruunupyy	Truträsket	lake	GrN-22705; GrN-22706; GrN-22918	1780
14	x	Kruunupyy	Verkträsket	lake		600
15	x	Kuortane	Porraslampi	pond	Hel-450	7750
16	x	Kuortane	Vähäjärvi	lake	Su-2294	7030
17		Lehtimäki	Harjulammi	pond	TKU-56	7430
18	x	Luoto	Bäckströsket	lake	GrN-22697; GrN-22913	410
19	x	Luoto	Hjortermossen	mire	GrN-22921	900
20	x	Luoto	Kvänosträsket	lake	GrN-22699; GrN-22917	450
21	x	Luoto	Långa Hjortermossen	mire		1200
22	x	Luoto	Långnästräsket	lake	GrN-22700; GrN-22920	570
23	x	Luoto	Molnviken	lake		580
24	x	Luoto	Rörträsket	lake	GrN-22703; GrN-22702; GrN-22914; GrN-22915	510
25		Pihtipudas	Karvalampi	pond	Su-1407	7980
26		Saarijärvi (Pylkönmäki)	Uodinjärvi	mire	Su-82	8470
27		Viitasaari	Kolima	pond	Su-1573	8300
28	x	Äänekoski (Sumiainen)	Kaakkolampi	pond	Su-1403	8700

Table 1. The isolation dates used in the study. Table also includes isolation dates from the study area but rejected in creating the curve (see text and Vuorela et al. 2009).

± (yr)	m a.s.l.	Material	x (WGS84)	y (WGS84)	Reference
160	103.8	gyttja	63.004	23.932	Glückert et al. 1993
90	84.4	gyttja	63.053	23.135	Glückert et al. 1993
90	36.2	gyttja	63.268	22.702	Glückert et al. 1993
100	3.2	gyttja	63.883	22.854	Glückert et al. 1998
100	5.0	gyttja	63.853	22.943	Glückert et al. 1998
100	8.5	peat	64.014	23.432	Mäkilä et al. 2013
55	28.7	gyttja	63.672	23.051	Glückert et al. 1998
100	11.6	gyttja	63.742	22.929	Glückert et al. 1998
40	19.6	gyttja	63.691	23.023	Glückert et al. 1998
60	17.3	gyttja	63.719	23.049	Glückert et al. 1998
50	8.5	gyttja	63.745	22.927	Glückert et al. 1998
60	19.8	gyttja	63.753	23.246	Glückert et al. 1998
40	15.0	gyttja	63.689	23.024	Glückert et al. 1998
100	5.0	gyttja	63.741	22.941	Glückert et al. 1998
260	90.5	clay-gyttja	62.880	23.525	Eronen 1974
80	86.7	gyttja	62.896	23.506	Glückert et al. 1993
90	133.4	gyttja	62.841	23.808	Glückert et al. 1993
50	5.9	gyttja	63.833	22.827	Glückert et al. 1998
50	10.5	gyttja	63.770	22.749	Glückert et al. 1998
40	5.2	gyttja	63.826	22.751	Glückert et al. 1998
60	10.6	gyttja	63.783	22.767	Glückert et al. 1998
40	5.8	gyttja	63.837	22.747	Glückert et al. 1998
50	5.3	gyttja	63.771	22.772	Glückert et al. 1998
50	6.7	gyttja	63.778	22.740	Glückert et al. 1998
110	111.9	gyttja	63.338	25.625	Ristaniemi 1987
100	149.0		62.721	24.826	Vuorela et al. 2009
100	111.2	gyttja	63.304	25.730	Ristaniemi 1987
140	100.4	gyttja	62.670	26.043	Ristaniemi 1987

Table 1. The isolation dates used in the study. Table also includes isolation dates from the study area but rejected in creating the curve (see text and Vuorela et al. 2009).

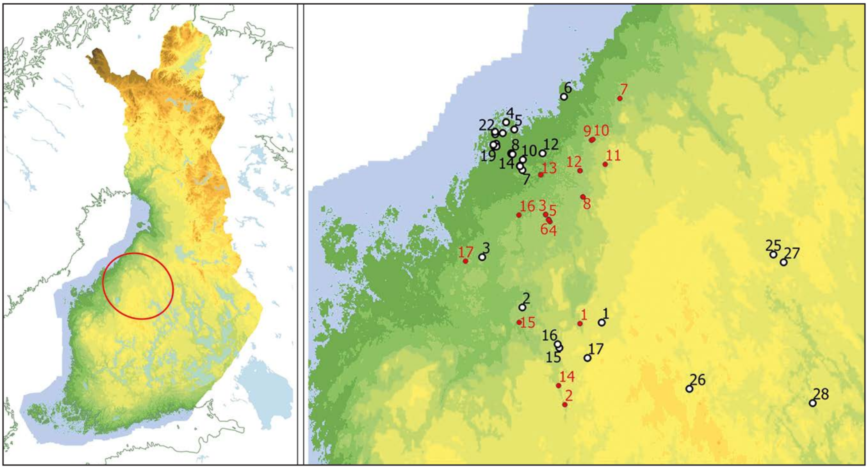


Figure 1. The study area in Central Ostrobothnia and northern parts of Southern Ostrobothnia. The isolation data sites with white symbols and black numbers, archaeological sites with red symbols and numbers. The site numbers refer to Tables 1–2.

rbacon package (Blaauw & Christen 2011) in R environment and IntCal20 calibration curve (Reimer et al. 2020). The plots include uncertainty margin estimated by the rbacon Markov Chain Monte Carlo algorithm based on given uncertainties and scattering of the individual radiocarbon dates and represents 95% credibility interval. When estimating the shore displacement curve with rbacon, we used 1 meter as a value for the section thickness parameter ('thick'). This is a computationally more intensive solution but produces a smoother curve than default settings. As a prior value for the mean accumulation rate ('acc.mean') we used 100 yr/m. The radiocarbon ages are provided in units of BP (before present) and calibrated ages in units of calBP meaning radiocarbon years and calendar years counted backwards in time from the year AD1950, respectively. In the archaeological dates, we have systematically subtracted 2 meters from the sample's height to represent the assumed water level during the habitation.

Central Ostrobothnian shore displacement has most recently been discussed by Vuorela et al. (2009), where they tested the curve with several subsets. Of these, the data from 'Kronoby plot, curve 1, version 2' with some of the deviating dates left out has been used as a reference curve (Fig. 2a). When dealing with the isolation dates, several problems are recognised, and they may also affect this study. Firstly, isolation dates are usually based on so-called bulk sediment samples that have a tendency to give older dates than e.g. plant macrofossils in the same core section (Grimm et al. 2009; Alenius et al. 2011). Secondly, isolation dates are rare for the Mesolithic era of c 10,000–7000 calBP and completely absent between 7000–4000 calBP.

According to the plot where the archaeological radiocarbon dates are plotted on the isolation curve from the same area (Fig. 2a), it is striking that most of the archaeological dates fall within the uncertainty margin of the isolation curve. Particularly the archaeological dates coincide with the era of no isolation dates during the mid-Holocene. However, some samples fall outside the curve: Ua-40894 (nr 1, Alajärvi Rasi), Ua-40898 (nr 14, Kuortane Lahdenkangas 1), Ua-61741 (nr 7, Kannus Kivineva), Hel-1725 (nr 2, Alavus Ojalankangas) and Hela-459 (nr 11, Kokkola Myllyalanko). Three of these dates and sites (nrs 1, 2 and 14) are from the Mesolithic part of the curve where the isolation dates are not in very good agreement with each other. Interestingly, these archaeological dates are systematically on higher ground with respect to the estimated shoreline. Hela-459 (site nr 11) being nearly 70 m above the estimated shoreline has obviously not been shore-bound and the same applies also to Ua-61741 (site nr 7). Three of the radiocarbon dates listed in Table 2 are not plotted on the curve at all (two from site 5, Evijärvi Timonen 4, Hel-2552, Hel-2554 and one from site 12, Kruunupyy Bläckisåsen 2, Su-1568). Timonen 4 is a probable hunting pit site and Bläckisåsen 2 date lacks the contextual information. The latter is still discussed in the next chapter as an indication of a non-shore bound settlement.

In Figure 2b selected archaeological and isolation dates are used together to estimate a new shoreline curve based on both data. The wide range of radiocarbon dates in some sites (Evijärvi Isokangas, Kruunupyy Bläckisåsen 2

Site nr	Used in curve	Municipality	Site	Med. Date calBP	Lab ID	BP	± (yr)	Elev. a.s.l.	Delta
1	x	Alajärvi	Rasi	7810	Ua-40894	6981	92	95	
2	x	Alavus	Ojalankangas	7248	Hel-1725	6340	120	90	
3	x	Evijärvi	Isokangas	5521	Hela-4434	4745	25	57.5	
3	x	Evijärvi	Isokangas	5510	Hela-4432	4738	25	57.5	
3		Evijärvi	Isokangas	5378	Hela-4429	4706	20	57.5	
3		Evijärvi	Isokangas	5385	Hela-4433	4705	25	57.5	
3		Evijärvi	Isokangas	5378	Hela-4428	4699	20	57.5	
3		Evijärvi	Isokangas	5393	Hela-4430	4675	20	57.5	
3		Evijärvi	Isokangas	5395	Hela-4425	4672	19	57.5	
3		Evijärvi	Isokangas	5405	Hela-4424	4657	20	57.5	
3		Evijärvi	Isokangas	5301	Hela-4318	4584	41	57.5	
3		Evijärvi	Isokangas	5304	Hela-4431	4572	19	57.5	
3		Evijärvi	Isokangas	5162	Hela-4426	4547	20	57.5	
3		Evijärvi	Isokangas	5151	Hela-4427	4516	20	57.5	
4	x	Evijärvi	Kotikangas	5398	Hela-4317	4680	39	64.05	
5		Evijärvi	Timonen 4	2553	Hel-2554	2480	100		-25.3
5		Evijärvi	Timonen 4	1456	Hel-2552	1560	110		-25.5
6	x	Evijärvi	Timonen 1	4913	Hela-4316	4346	32	62.36	
7		Kannus	Kivineva	4048	Ua-61741	3711	44	63.05	-23
8	x	Kaustinen	Kangas	5846	Hela-161	5115	85	63.5	-22.5
8	x	Kaustinen	Kangas	5822	Hel-4000	5090	100	63.5	-24.7
8		Kaustinen	Kangas	5762	Hela-172	5020	65	63.5	-26.2
8		Kaustinen	Kangas	5655	Hel-3999	4910	100	63.5	-26.2
8		Kaustinen	Kangas	5476	Hela-173	4740	60	63.5	-27.4
8		Kaustinen	Kangas	5315	Ua-61740	4593	32	60.9	-27.3
9	x	Kokkola	Miekkakaarat	5645	Ua-61742	4926	38	63.65	-25.5
9		Kokkola	Miekkakaarat	4700	Ua-58287	4155	29	62.55	-12.1
10	x	Kokkola	Pahanportaan-räme	5595	Ua-58288	4868	27	64.68	-26.6
11		Kokkola (Ullava)	Myllyalanko	2934	Hela-459	2820	70	91.7	-26.1
12	x	Kruunupyy	Bläckisåsen 1–3	5591	Su-1484	4860	80	64.5	-25
12	x	Kruunupyy	Bläckisåsen 1–3	5531	Hela-4418	4747	20	64.5	
12		Kruunupyy	Bläckisåsen 1–3	5399	Ua-61739	4665	34	62	-11.3
12		Kruunupyy	Bläckisåsen 1–3	5406	Hela-4417	4656	19	62	

Table 2. The archaeological dates used in the study. The radiocarbon median dates have been calibrated using OxCal software version 4.4 (Bronk Ramsey 2009) and IntCal20 calibration curve (Reimer et al. 2020).

Material	Collection	p (YKJ3)	i (YKJ3)	Reference
burnt bone (mammal)	KM 11771:134	6992116	3333798	Manninen & Tallavaara 2011
charcoal (fireplace)	KM 11906:24	6951312	3326187	this paper
burnt bone (mammal)	KM 21166:945	7047065	3316500	this paper
burnt bone (mammal)	KM 21166:538	7047065	3316500	this paper
burnt bone (seal?)	KM 20603:637	7047065	3316500	this paper
burnt bone (mammal)	KM 21166:762	7047065	3316500	this paper
burnt bone (seal?)	KM 20603:630	7047065	3316500	this paper
burnt bone (seal?)	KM 20603:1363	7047065	3316500	this paper
burnt bone (seal?)	KM 20603:376	7047065	3316500	this paper
burnt bone (seal?)	KM 20603:191	7047065	3316500	this paper
birch bark pitch	KM 20603:699	7047065	3316500	this paper
burnt bone (seal?)	KM 21166:15	7047065	3316500	this paper
burnt bone (seal?)	KM 20603:483	7047065	3316500	this paper
burnt bone (seal?)	KM 20603:495	7047065	3316500	this paper
birch bark pitch	KM 19261:361	7043477	3318676	this paper
charcoal (hunting pit?)	KM 24010:6	7044589	3318027	this paper
charcoal (hunting pit?)	KM 24010:1	7044589	3318027	this paper
birch bark pitch	KM 19050:492	7044415	3317898	this paper
burnt bone	KM 41626:227	7105578	3353917	this paper
charcoal (burial)		7055998	3335286	Halinen 1997
charcoal (fireplace)		7055998	3335286	Halinen 1997
charred crust (Typical Comb Ware)	KM 29906:1967	7055998	3335286	Halinen 1997; Pesonen 2004
charcoal (fireplace)		7055998	3335286	Halinen 1997
charred crust (Typical Comb Ware)	KM 29906:1732	7055998	3335286	Halinen 1997; Pesonen 2004
burnt bone	KM 30972:65	7055998	3335286	this paper
charred crust (Typical Comb Ware)	KM 41627:18	7084549	3339610	this paper
burnt bone	KM 41338:5	7084549	3339610	this paper
burnt bone	KM 33928:37	7084942	3340332	this paper
charcoal		7072374	3346520	Vanhatalo 2000
charcoal (fireplace)		7069164	3333842	Seger 1985
burnt bone (seal)	KM 22629:77	7069164	3333842	this paper
burnt bone	KM 21938:69	7069164	3333842	this paper
burnt bone (seal)	KM 21938:100	7069164	3333842	this paper

Table 2. The archaeological dates used in the study. The radiocarbon median dates have been calibrated using OxCal software version 4.4 (Bronk Ramsey 2009) and IntCal20 calibration curve (Reimer et al. 2020).

Site nr	Used in curve	Municipality	Site	Med. Date calBP	Lab ID	BP	± (yr)	Elev. a.s.l.	Delta
12		Kruunupyy	Bläckisåsen 1–3	4720	Su-1568	4200	60		-26
13	x	Kruunupyy	Borgbacken	3177	Hel-2924	3000	90	30.91	-24.5
14	x	Kuortane	Lahdenkangas 1	8101	Ua-40898	7284	42	95	
15	x	Lapua	Pitkämäki	5472	Hela-361	4740	70	56	-27.9
16	x	Pedersöre	Hundbacken-Myllykangas	5155	Hela-4319	4492	45	59	
17	x	Vöyri (Oravainen)	Fårmossen 1–2	4353	Hela-4320	3922	42	47	

Table 2 continues. The archaeological dates used in the study. The radiocarbon median dates have been calibrated using OxCal software version 4.4 (Bronk Ramsey 2009) and IntCal20 calibration curve (Reimer et al. 2020).

and Kaustinen Kangas) indicate a prolonged continuation of habitation after the initial settlement. In these cases, we selected two earliest dates to represent the first shore-bound settlement at the site and combined them with the OxCal C_Combine function (Bronk Ramsey 2009). The younger dates from these sites were left out of the curve estimation, since they were assumed to represent latter, probably non-shore, settlements. The most obvious outliers explained earlier (e.g. Hela-459 and Ua-61741) were also left out of the curve estimation. An important amount of data points is now settled between 6000 and 5000 calBP which lacks isolation data completely. This highlights the importance of archaeological data to supplement the isolation data. This strong clustering of points in time also affects the smoothness of the curve: whereas the combined curve is within the uncertainty margins of the sole isolation-based curve, there is a drop or widening of the uncertainty margin between c 5600 and 5400 calBP (Fig. 2c). This may be due to variation in site locations this time rather than a quick isostatic phase shift. Moreover, there is a lack of data points before and after this dense period. Also, the Mesolithic part shows a systematic divergence when compared to the sole isolation curve so that the curve based on isolation and archaeological dates gives slightly younger ages. This may reflect the effect of bulk sediment samples in the isolation dates. The new Mesolithic archaeological data added, the combined

Material	Collection	p (YKJ3)	i (YKJ3)	Reference
charcoal (pithouse)		7069164	3333842	this paper
charcoal		7067091	3314025	this paper
burnt bone (elk)	KM 16856:23	6960893	3323028	Manninen & Tallavaara 2011
birch bark tar (Typical Comb Ware)	KM 14117:31	6992765	3303163	Pesonen 2004
birch bark pitch	KM 21349:29	7046815	3303038	this paper
birch bark pitch	KM 23233:5	7023600	3276120	this paper

Table 2 continues. The archaeological dates used in the study. The radiocarbon median dates have been calibrated using OxCal software version 4.4 (Bronk Ramsey 2009) and IntCal20 calibration curve (Reimer et al. 2020).

shoreline curve appears a bit smoother as compared to the isolation-based curve. With these new shoreline curves, it is now possible to calculate the ages for heights between 0 and 103 m a.s.l. with 1 m resolution in the study area (Appendix 1).

The focus of the rest of this paper is on the outliers that fall much younger than was anticipated according to either original isolation-based shoreline curve or the combined curve based on archaeological and isolation dates. Among these younger dates are the above-mentioned dates from Kokkola Myllyalanko (site nr 11, Hela-459) and Kannus Kivineva (nr 7, Ua-61741), but also the dates from Kokkola Miekkakaarat (nr 9, Ua-58287), Evijärvi Timonen 1 (nr 6, Hela-4316) and Pedersöre Hundbacken (nr 16, Hela-4319) are slightly younger, although these all are within the uncertainty margins of the isolation-based curve. Also, an interesting group of dates seem to be older compared to the combined shoreline curve. Four of these are from Kaustinen Kangas site (nr 8, Hel-3999, Hel-4000, Hela-161 and Hela-172) and one from Kokkola Miekkakaarat (nr 9, Ua-61742). The outlying dates are indicated in Figure 2d. The sites older than the combined shoreline curve are not discussed in this connection, but there may be several reasons behind their age – e.g. local tectonic deviations, reservoir effect in radiocarbon dates etc.

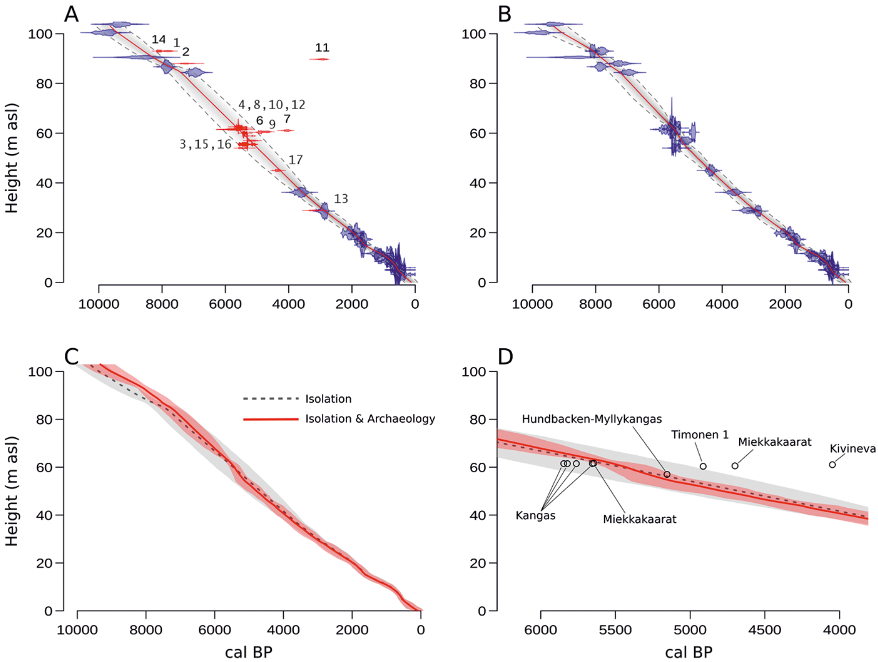


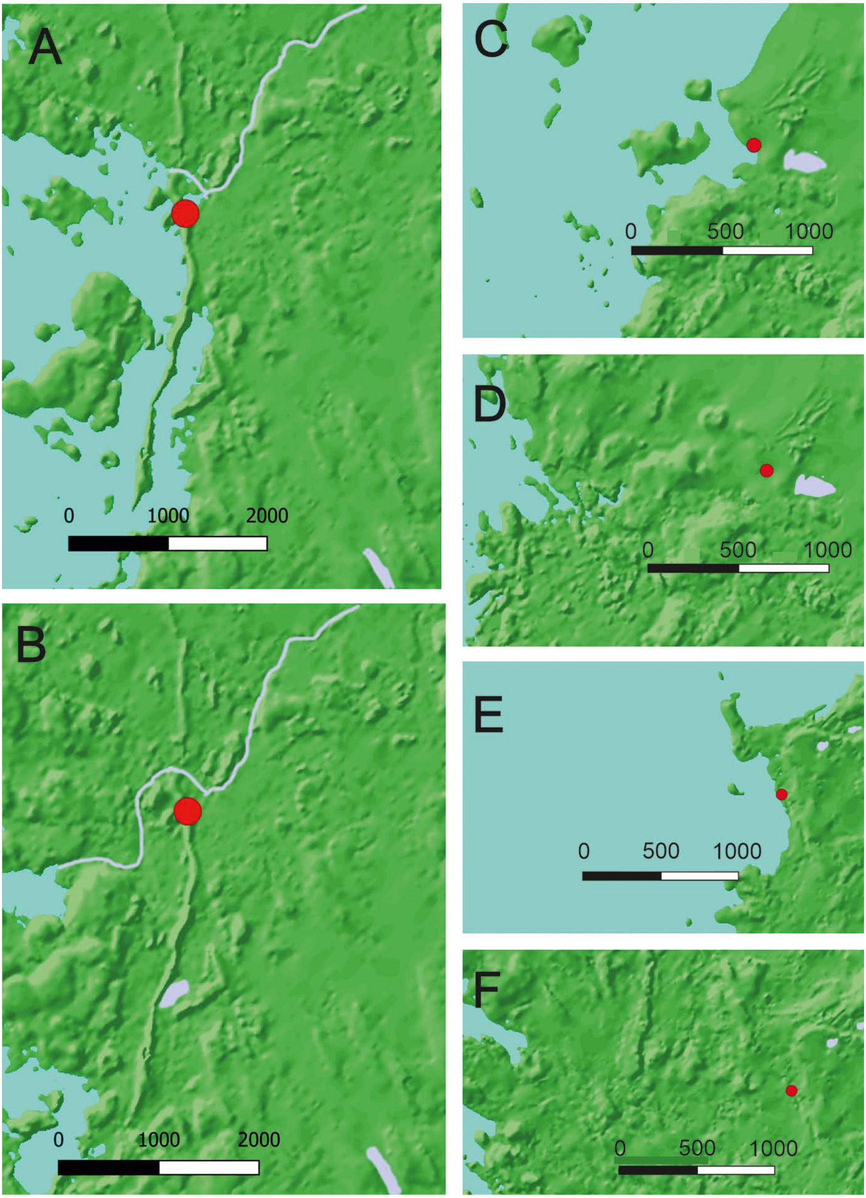
Figure 2. Shoreline curves for Central Ostrobothnia and northern parts of Southern Ostrobothnia: A – a curve created with isolation dates (Table 1) in blue with archaeological dates (Table 2) plotted on top of the curve in red. The numbers refer to archaeological sites in Table 2; B – a curve based on both, isolation dates and selected archaeological radiocarbon dates. The selection is explained in text and is indicated in Table 2; C – panel shows curves in A and B plotted on top of each other to show the effect of adding archaeological radiocarbon dates to the curve data; D – a detail of the shoreline curve C between 6000–4000 calBP with some discussed archaeological dates plotted. The shading around the curves indicates a 95% confidence interval.

26.3 No rule without exception: outliers in the shore displacement chronology

The shore displacement chronology after the last Ice Age in Finland is based on the assumption that the hunter-gatherer societies usually dwelled in immediate vicinity of the current shoreline (e.g. Europaeus-Äyräpää 1930; Siiriäinen 1974). This general trend is well tested and accepted. However, there are also exceptions to this trend shown for several sites in southern Finland as well as in Estonia (Jussila & Kriiska 2005) and in Northern Ostrobothnia (Pesonen 2013). Here, we discuss three of the sites with younger occupation phase than assumed and given by previous shoreline curves: Kivineva in Kannus (nr 7), Miekkakaarat in Kokkola (nr 9) and Bläckisåsen 2 in Kruunupyy (nr 12), Central Ostrobothnia (Seger 1985; Pesonen 2016; Skantsi 2018a; 2018b; 2020). All of these sites consist of several Neolithic semisubterranean pithouses. In the Ostrobothnian coast these pithouse clusters have been interpreted as remains of permanent and complex village-like settlements. The number of large pithouse villages peaks around 5500 calBP, but then declines sharply after it (Pesonen et al. 2020; Tallavaara & Pesonen 2020; Skantsi 2023).

All these sites were first inhabited during the Middle Neolithic Typical or/and Late Comb Ware periods when they were situated in a close proximity to the seashore. Intriguingly, the radiocarbon dates show also a later occupancy on these sites, almost 1000 years later, when the waterfront already lay at a distance from the sites. The Bläckisåsen 2 date (Su-1568) was not included in the shoreline curve due to some uncertainties in the excavation context, but the archaeological material (e.g. Pyheensilta ceramics) indicate a later settlement phase which is in accordance with the date. At the Kivineva site we have radiocarbon date only from the inland phase, but other archaeological material fits better to the Typical Comb Ware period when the site was located near the seashore.

Similar observations have also been made in Kauniinmetsänniitty 1 site in Raahe, Northern Ostrobothnia (Pesonen 2013) but also in other areas, e.g.


A
0
1000
2000
B
0
1000
2000
C
0
500
1000
D
0
500
1000
E
0
500
1000
F
0
500
1000

Saimaa region in eastern Finland, Estonia, Finnmark in northern Norway, Skagerrak coast in southeastern Norway and also in Norrland in Sweden (e.g. Mökkönen 2002; Jussila & Kriiska 2005; Norberg 2008; Skandfer 2012; Schülke 2020; Roalkvam 2022). There are also some observations of the abandonment and reuse processes of Neolithic pithouses in Tervola, southern Lapland (Kankaanpää 2002; 2003) and Kristiinankaupunki in southern Ostrobothnia (Hertell & Manninen 2006).

In the case of Ostrobotnia these observations are particularly interesting. Due to the rapid land uplift, the environment and landscape of the sites had changed significantly between the older and younger settlement phase. The maritime open environment had been replaced by a more sheltered location 1–3 kilometres away from the seashore. Why were these sites occupied also when the seashore was no longer in the immediate vicinity of the settlement? There are probably both cultural and economical reasons in the background. Nature and purpose of the visits to the sites will have implications for how close to the shoreline the sites were located (Roalkvam 2022). It is also a question about people's relation to their environment and old settlement sites in changing coastal landscapes (e.g. Herva & Ylimaunu 2014; Schülke 2020). For example, it has been speculated that people sometimes buried their dead at an 'ancestral' or 'mythical' site, maybe to cherish a connection with past people and places. However, the tradition of reuse was limited and selective (Ahola 2019).

◄ Figure 3. A – Bläckisåsen 2 site (red dot) at seashore phase around 5500–5400 calBP (60 m a.s.l.) and B – during younger settlement phase 700–800 years later (52 m a.s.l.): C– Miekkakaarat site (red dot) at seashore phase around 5700–5600 calBP (62 m a.s.l.) and D – during younger settlement phase 800–900 years later (52 m a.s.l.); E – Kivineva site (red dot) at seashore phase around 5700–5600 cal BP (62 m a.s.l.) and F – during younger settlement phase 1500–1600 years later (42 m a.s.l.). Current water bodies are marked in gray colour. Maps National Land Survey open data attribution CC 4.0 license, QGIS 3.16 DEM-model. Maps are based on Pesonen's (2016) shoreline displacement diagram.

According to Marianne Skandfer (2012), the resettlement of the neolithic Gressbakken houses in coastal Finnmark coincides with the time of many socio-cultural and environmental changes taking place in northern Fennoscandia. Resettlement was a way for communities to structure collective memory in the time of socio-cultural change. The old remains of the houses represented the past mythical 'golden age' and their reuse may even have referred to the rights of resource exploitation and landscape use (Skandfer 2012). Also in Norrland, the resettlement of the sites located on the old shorelines has been thought to manifest some kind of relationship with the older generations, connecting the past and the present (Norberg 2008).

In the case of Central Ostrobothnia, the timing of the younger settlement phases coincides with the cooling of the climate and declining population size of the Late Holocene (see Tallavaara & Pesonen 2020). The resettlement of old sites implied economical changes in a completely different environment. The topographical location of the site reflects the exploitation of resources, subsistence strategies and settlement patterns of hunter-gatherers. So, the changes in the location of the sites also indicate changes in these features (e.g. Siiriäinen 1981; Kelly 2001; 2013). During the older settlement phase, the economy was based on intensive seal hunting. During the younger settlement phase, the sites were located 1–3 km from seashore and the location was no longer ideal for maritime hunting. In fact, the location near coastal meadows at the distance from seashore was more typical for agricultural communities than hunter-gatherer societies.

For example, in Neolithic southeastern Norway, there was increasingly more variation in the location of the sites than in the Mesolithic period when the settlement was more shore-bound. There is an apparent differing attitude to the shoreline towards the end of the Stone Age. Sites associated with agricultural activity were all found to be located some distance from the sea (Roalkvam 2022). The change of settlement location to the areas more suitable for farming is interpreted as evidence of general change in economic structure, with an increased emphasis on agriculture (e.g. Bakka & Kaland 1971).

In Finland, Corded Ware culture people often dwelled at older sites already located further from the seashore in the vicinity of coastal meadows suitable for grazing (e.g. Äyräpää 1939; Holmblad 2013). Similarly, on the coast of Ostrobothnia, the Late Neolithic asbestos ceramic Pöljä culture sometimes chose to live inland at older Comb Ceramic sites (Miettinen 1998; Holmblad 2013). In Miekkakaarat site, the younger settlement phase is specifically related to the Pöljä culture, while in Bläckisåsen 2 the younger phase assigns to the Pyheensilta Ware, which is probably based on the Comb Ware cultural tradition (Seger 1985; Skantsi 2020). Both ceramic traditions are at least partially simultaneous with Corded Ware culture.

Still, there is no evidence of practicing agriculture from any of the presented sites here. It is also possible that specialization in seal hunting decreased and there was no longer a need to live close to the seashore. For example, the river and esker environment in Bläckisåsen still offered access to resources even when the seashore had retreated from the immediate vicinity. The coastal meadows, wetlands and shallow lakes between settlement and seashore were suitable not only for agriculture but also for hunting, fishing and gathering. However, this probably indicates changes in Neolithic subsistence strategies and settlement patterns. The question is fundamentally important from the perspective of the shore displacement chronology and the study of the Neolithic subsistence strategies and settlement patterns in Ostrobothnia. Therefore the so-called 'Neolithic re-settlement phenomenon' as well as the nature and purpose of different sites requires more research and new radiocarbon dates in the future.

26.4 Conclusions

The radiocarbon dating of short-lived sample materials connected to archaeological contexts now gives better estimates and accuracy for building of the shoreline curve for the coastal areas in Finland. In Central Ostrobothnia and in the northern areas of Southern Ostrobothnia, only incomplete sections of shoreline displacement curves exist, and, in this paper, we have attempted to supplement the isolation-based curve with selected archaeological radiocarbon dates from the area as a complement to the shoreline curves presented earlier for Southern Ostrobothnia/Northern Satakunta in the south and Northern Ostrobothnia in the north. During this survey, it became clear that beside the slight variation in the location and prolonged use of sites there are also radiocarbon dates that imply profoundly later resettlement periods in the sites.

Archaeological dates fill the gap in the isolation dates particularly for the mid-Holocene era (Neolithic, c 7000–4000 calBP) and supplement these also in the early Holocene (Middle and Late Mesolithic, c 10,000–7000 calBP). Most of the dates are within the uncertainty limits provided by the isolation-based model, but there are some exceptions, which are younger than expected, indicating a resettlement phase in these sites located now away from the immediate seashore. This Late Neolithic resettlement pattern has been recognized around Scandinavia, usually in connection with the changes in resources, e.g. along the introduction of agriculture. The resettlement of Central Ostrobothnia was probably not a result of agricultural expansion, but rather related to commemorating ancestral connections and taking advantage of inland resources. The most informative case of this resettlement is perhaps that seen at the site of Bläckisåsen 2 site in Kruunupyy, where the location was no longer shore-bound but still central in the crossing of river and long esker formation. Similar potential may have led to resettlement also elsewhere, depending on the local environment, ecology and the memorization of the surrounding landscapes.

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Appendix 1. Calculations for the shoreline ages in Central Ostrobothnia and northern parts of Southern Ostrobothnia: Comb = combined archaeological and isolation curve; Isol = isolation curve; ages in calBP.

Height (m a.s.l.)	Min. age Comb	Max. age Comb	Median age Comb	Mean age Comb	Min. age Isolat	Max. age Isolat	Median age Isolat	Mean age Isolat
0	-79	247	102	94	-74	327	121	123
1	-22	425	203	199	-5	427	217	215
2	125	500	295	301	111	491	303	301
3	203	561	394	392	201	551	381	380
4	322	610	481	476	318	610	472	468
5	475	667	545	554	461	658	536	543
6	514	696	573	584	511	699	573	584
7	556	761	641	644	550	745	631	635
8	603	835	704	709	602	829	702	706
9	682	943	788	796	664	955	786	790
10	744	1095	889	896	733	1068	877	883
11	821	1198	1013	1016	826	1211	998	1006
12	984	1386	1191	1190	943	1391	1157	1162
13	1108	1527	1330	1329	1060	1551	1324	1321
14	1234	1659	1472	1464	1216	1667	1470	1460
15	1395	1743	1616	1608	1378	1749	1607	1596
16	1512	1834	1683	1682	1478	1819	1671	1667
17	1568	1908	1739	1740	1555	1885	1729	1728
18	1644	1993	1810	1811	1644	1961	1794	1796
19	1716	2044	1879	1879	1727	2038	1873	1874
20	1831	2149	1974	1977	1818	2127	1960	1964
21	1918	2299	2064	2075	1893	2249	2058	2062
22	1994	2451	2176	2193	1959	2387	2159	2163
23	2067	2563	2283	2295	2038	2504	2262	2265
24	2145	2680	2404	2406	2120	2613	2368	2368
25	2261	2795	2509	2511	2224	2726	2475	2475
26	2365	2884	2614	2617	2323	2821	2581	2577
27	2457	2969	2721	2716	2430	2907	2684	2681
28	2568	3046	2821	2817	2564	2994	2786	2785
29	2765	3144	2943	2945	2721	3078	2888	2891
30	2852	3268	3042	3045	2814	3199	2981	2988
31	2931	3405	3134	3144	2898	3306	3073	3080
32	3008	3511	3233	3240	2965	3424	3170	3176
33	3090	3600	3318	3324	3035	3525	3261	3267
34	3195	3694	3407	3413	3122	3612	3357	3359
35	3283	3765	3507	3510	3215	3705	3447	3450
36	3382	3842	3596	3600	3323	3794	3535	3542

Height (m a.s.l.)	Min. age Comb	Max. age Comb	Median age Comb	Mean age Comb	Min. age Isolat	Max. age Isolat	Median age Isolat	Mean age Isolat
37	3468	3924	3687	3689	3403	3886	3623	3630
38	3556	4006	3768	3772	3468	3986	3703	3709
39	3627	4088	3853	3856	3528	4096	3782	3791
40	3706	4202	3939	3942	3586	4205	3859	3869
41	3773	4267	4030	4026	3650	4303	3941	3952
42	3859	4353	4121	4114	3721	4391	4020	4029
43	3945	4421	4202	4195	3784	4479	4103	4109
44	4012	4493	4269	4262	3849	4582	4183	4189
45	4159	4562	4364	4361	3912	4674	4258	4266
46	4271	4650	4455	4459	3978	4774	4341	4347
47	4352	4767	4533	4542	4042	4876	4422	4429
48	4402	4840	4610	4613	4110	4950	4504	4508
49	4490	4935	4692	4696	4174	5041	4586	4587
50	4562	5058	4775	4781	4251	5129	4664	4667
51	4614	5157	4851	4857	4316	5203	4740	4746
52	4685	5231	4926	4930	4390	5290	4818	4825
53	4780	5318	5003	5013	4462	5381	4901	4907
54	4878	5389	5092	5104	4530	5479	4982	4985
55	4975	5421	5149	5169	4603	5558	5058	5063
56	5060	5443	5206	5226	4676	5630	5142	5142
57	5110	5479	5266	5281	4750	5721	5216	5220
58	5156	5508	5328	5333	4824	5803	5299	5299
59	5199	5541	5384	5384	4901	5902	5380	5379
60	5245	5570	5428	5427	4964	5977	5458	5458
61	5298	5617	5489	5485	5035	6052	5540	5538
62	5402	5672	5544	5545	5123	6135	5620	5619
63	5527	5731	5616	5618	5200	6209	5702	5699
64	5580	5838	5697	5700	5289	6283	5783	5779
65	5633	5970	5769	5779	5356	6369	5864	5858
66	5689	6074	5853	5858	5441	6444	5943	5938
67	5742	6169	5929	5936	5522	6526	6020	6020
68	5790	6288	6003	6013	5599	6596	6100	6099
69	5841	6376	6074	6085	5677	6664	6180	6179
70	5896	6461	6148	6159	5766	6735	6259	6259
71	5957	6557	6226	6235	5835	6820	6340	6339
72	6015	6640	6304	6311	5919	6890	6420	6419
73	6074	6731	6381	6386	5992	6969	6500	6500
74	6141	6818	6451	6459	6090	7049	6575	6579
75	6218	6896	6529	6535	6171	7130	6658	6659
76	6298	6964	6599	6607	6261	7200	6740	6740
77	6366	7032	6669	6678	6339	7283	6821	6818
78	6441	7103	6748	6752	6428	7348	6901	6897

Height (m a.s.l.)	Min. age Comb	Max. age Comb	Median age Comb	Mean age Comb	Min. age Isolat	Max. age Isolat	Median age Isolat	Mean age Isolat
79	6509	7175	6820	6822	6520	7424	6980	6977
80	6583	7246	6892	6897	6608	7486	7062	7056
81	6658	7316	6965	6971	6696	7560	7140	7133
82	6741	7400	7040	7049	6781	7622	7213	7209
83	6822	7471	7109	7119	6877	7690	7291	7290
84	6919	7545	7185	7199	6975	7767	7373	7371
85	7022	7629	7278	7294	7099	7845	7476	7476
86	7117	7737	7405	7415	7301	7930	7640	7631
87	7209	7847	7521	7528	7541	8037	7812	7806
88	7289	7916	7588	7599	7693	8224	7953	7953
89	7378	7993	7684	7687	7808	8412	8082	8091
90	7490	8056	7797	7794	7928	8559	8216	8225
91	7611	8128	7900	7891	8033	8710	8343	8350
92	7726	8188	7992	7982	8118	8848	8459	8467
93	7862	8242	8084	8073	8213	8989	8581	8584
94	7989	8412	8191	8191	8305	9108	8692	8694
95	8095	8620	8315	8326	8410	9236	8801	8806
96	8186	8820	8448	8461	8505	9347	8913	8917
97	8277	8995	8581	8597	8591	9462	9025	9028
98	8380	9174	8726	8736	8695	9578	9141	9139
99	8494	9354	8871	8876	8798	9682	9260	9252
100	8600	9522	9015	9016	8922	9797	9384	9366
101	8705	9643	9139	9132	9028	9903	9489	9465
102	8804	9765	9232	9231	9108	9998	9575	9554
103	8908	9858	9328	9330	9191	10090	9655	9638