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EMERGENCE OF HILLTOP SETTLEMENTS IN THE SOUTHEASTERN BALTIC: NEW AMS ^{14}C DATES FROM LITHUANIA AND REVISED CHRONOLOGY

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ABSTRACT. The emergence of hilltop settlements presents a pattern of the first enclosed sites that reflect economic development in several regions within the Southeastern Baltic Bronze Age. This novelty reflects increasing social complexity, differentiating economic relations, as well as rising tension in the region. The phenomenon has received a great deal of interpretation, but chronological problems still remain understudied. Researchers tend to seek the start of hilltop settling practice from early to late II millennium BC. This paper presents ^{14}C dates from 7 sites in inland Lithuania, where hitherto no absolute dates were published. The majority of absolute dates has been calibrated to the Hallstatt radiocarbon calibration plateau (ca. 800–400 cal BC) which is significantly later than previously presumed based on dates from Belarusian sites. However, several dates from previously dated hilltop settlements in the region predate the effect. These results indicate the start of hilltop settling practice around 11th–9th centuries cal BC. Review of new and previously published radiocarbon dates suggests a different internal development between SE Baltic coastal and inland regions, likely locating zones, where economic outside stimulus preconditioning emergence of hilltop settlements occurred earlier.

KEYWORDS: AMS ^{14}C dates, Bronze Age, hilltop settlements, Southeastern Baltic.

INTRODUCTION: SOUTHEASTERN BALTIC BRONZE AGE HILLTOP SETTLEMENTS

Hilltop settlements during the Southeastern Baltic Bronze Age (ca. 1700–500 BC[1]) were the first type of enclosed sites that had developed in the region. The pattern of these settlements reflects a changing social-economic environment (Figure 1), however the chronology of their emergence is still poorly known. Hilltop settlements were inhabited by farmers practicing intensive agriculture (Minkevičius et al. 2019), a particular lifestyle that spread amongst the local communities after the late[2] adoption of crop cultivation, from 14th–12th centuries cal BC[3] on (Grikpėdis and Motuzaite Matuzeviciute 2018). Alongside new opportunities for the social development, the economic stress caused by farming and accumulation of surplus has presented the local communities with a range of new threats and barter possibilities. Simultaneously with crop and pulse cultivation spread throughout SE Baltic in the Late Bronze Age (1100–500 BC), the more active foreign agency is tangible in the archaeological record. This is expressed by doubling of bronze consumption, appearance of stone-ship graves, early rusticated pottery, hoards with inherent Scandinavian finds and emergence of bronze production dominated by artifacts with western Baltic stylistic traits (Okulicz 1976; Sidrys and Luchtanas 1999; Sperling 2013; Wehlin 2013; Čivilytė 2014). Therefore, it is likely that communication between SE Baltic and neighboring Lusatian and Scandinavian cultures had become significantly more active compared to the previous periods. One of the dangers communities with intensive farming faced was the loss of food stock, therefore a turn to establishment of better defended settlements was inevitable (O'Brien and O'Driscoll 2017). Furthermore, the Southeastern Baltic society lacked maritime technologies to organize their own interregional contacts by long distance travels (cf. Ling et al. 2018), and all acquired wealth was highly dependent on

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[1]Based on dating of Northern European Bronze Age (Harding 2000; Vandkilde 2007; Olsen et al. 2011; Ling et al. 2014; Čivilytė 2014).

[2]The late adoption of farming in SE Baltic is a significant discrepancy compared to this process in the rest of Northern Europe. The earliest crop farming in Scandinavia had emerged in 4000–3700 cal BC (Sørensen and Karg 2014), i.e. ca. 2300–2800 years earlier than in SE Baltic.

[3]The earliest cereal (*Hordeum vulgare*) from Kvietiniai settlement was dated to UBA-30600: 3009 ± 39 BP, or cal BC 1392–1123 (2σ) (Grikpėdis and Motuzaite Matuzeviciute 2018).

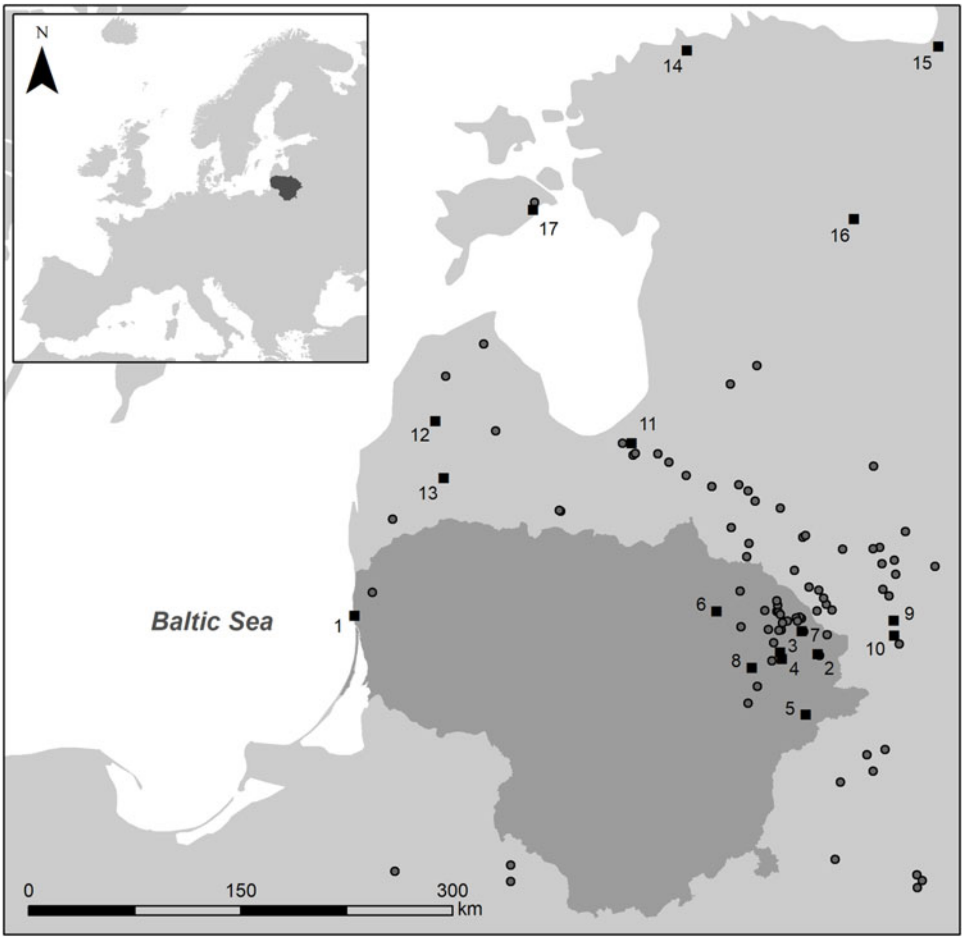

Figure 1 Map of the ^{14}C dated sites in the SE Baltic. Squares: 1 – Kukuliškiai; 2 – Sokiškiai; 3 – Garniai I; 4 – Antilgė; 5 – Nevieriškės; 6 – Kereliai; 7 – Mineikiškės; 8 – Narkūnai; 9 – Zazony; 10 – Ratjunki; 11 – Ķivutkalns; 12 – Padure; 13 – Krievu kalns; 14 – Iru; 15 – Narva; 16 – ; 17 – Asva (see Table 1). Dots – other known hilltop settlements dated to Late Bronze Age by the studies on artifact typologies (data of 105 sites from Graudonis 1967, 1974, 1989; Luchtanas 1992; Egoreichenko 2006; Lang 2007; Valk et al. 2012 with additions and modifications). Drawing by V. Podėnas. List of all localities is presented in Supplementary Material 1.

the ability to establish communication with the ones who imported bronze into the region (Earle et al. 2015). SE Baltic Bronze Age culturally distinguishes from Lusatian and Scandinavian cultures as well as from the communities settled in the Northeastern Baltic and further to Eastern Europe due to distinctly different economic prehistory (Podėnas and Čivilytė 2019). This study takes an integrated approach towards the emergence of hilltop settlements in the region that consists of data from NE Poland, Kaliningrad, Lithuania, Latvia, and Estonia.

Considering the overall scarcity of information on the Bronze Age in the SE Baltic archaeology, the hilltop settlements distinguish as the most actively investigated type of site (Krzywicki 1914, 1917; Šnore 1936; Volkaitė–Kulikauskienė 1986; Graudonis 1989;

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Luchtanas 1992; Vasks 1994; Grigalavičienė 1995; Egoreichenko 2006; Lang 2007; Vasks et al. 2011; Valk et al. 2012; Doniņa et al. 2014; Sperling 2014). These settlements were excavated on numerous occasions from the beginnings of the 20th century and thus received a great deal of interpretation. However, the discussion on chronology is yet to reach a consensus. Due to the lack of distinctive typologies, the existing chronologies tend to vary greatly as the dating of the initial phase of hilltop settling are interpreted differently by different researchers, i.e. ranging from early 2nd millennium BC to early 1st millennium BC (Kulikauskas et al. 1961; Gimbutienė 1985; Volkaitė–Kulikauskienė 1986; Grigalavičienė 1995; Lang 2018). Over the last decades the research focus had shifted towards a ^{14}C dating of the earliest hilltop settlements in attempts to solve this problem (Kriiska and Lavento 2006; Egoreichenko 2006; Lang 2007; Valk et al. 2012; Oinonen et al. 2013; Sperling 2014; Vasks and Zariņa 2014; Sperling et al. 2015). Alongside, new debates emerged on sample selection and a call for application of necessary procedures to assure the link between the sample and the archaeological context (Motuzaite-Matuzeviciute 2015). Until now, the AMS ^{14}C dates from Lithuania were scarce. Thus, the area of the most densely established hilltop settlements is a white spot on a map when discussing regional chronological development. Hitherto, it was impossible to compare and critically assess the dates from neighboring countries, nor to establish an integrated review of the emergence of hilltop settlement process in Southeastern Baltic.

Regional development models (Earle and Kolb 2010) usually indicate the active contact zones where hilltop settlements emerge. In contrast, the Bronze Age hilltop settlements are unknown in the southern and central Lithuania, and only 1 is found in inland Estonia (Valk et al. 2012). The preferred environment is a likely culprit for this pattern, for example considering the geomorphological differences between Baltic Uplands and Middle Lithuanian, Middle Gauja, West-Estonian Lowlands (Tavast 1994; Zelčs and Markots 2004; Guobytė and Satkūnas 2011). Moreover, a significant variability in soils and fertility, water network and climatic conditions existed in the area between Estonia and NE Poland. These factors affected the social-economic development (Zvelebil and Rowley-Conwy 1984), however they do not explain the settlement pattern entirely as the hilltop settlements were established in more restricted areas near probable exchange networks (Podėnas and Čivilytė 2019). Therefore, other social-economic markers must be considered in discussion of the establishment of hilltop settlements in the SE Baltic. The concentration of hilltop settlements in the NE Lithuania and the SE Latvia, River Daugava vicinities and coastal zones of Eastern Baltic are indications of active economic development in these areas. The interconnection between local communities and outside travelers stands out as one of the most probable reasons behind a specific spatial distribution of hilltop settlements.

The existence of hilltop settlements indicates several crucial aspects: rising social tensions and behavioral change in local communities, the usage and importance of the coastal and River Daugava routes. Furthermore, these sites contain one of the earliest finds of locally executed metallurgy (Čivilytė 2014; Sperling 2014) and crop-rich archaeobotanical assemblages (Minkevičius et al. 2019). However, a detailed timeline does not exist for the processes such as adoption of full agriculture (Piličiauskas 2016; Piličiauskas et al. 2017; Grikpėdis and Motuzaite Matuzeviciute 2018), beginning of metallurgy (Čivilytė 2014), appearance of new burial practices (Šturms 1936a, 1936b) and hilltop settlements in the southeastern Baltic. Consequently, this makes it hard to take relevant steps towards understanding whether the region's agricultural development has resulted in a more active interest of neighboring cultures, or have the internal developments in the foreign areas driven the neighboring cultures to explore new markets, impacting communities such as the ones settled in the SE Baltic and transferring their knowledge to them in return for an established new market[4] area.

This study aims to further the discussion of the emergence of hilltop settlements in the SE Baltic by presenting new ^{14}C dates from Lithuania and critically reviewing the earliest dates from the region.

MATERIAL AND METHODS

Table 1 presents the new dates from NE Lithuania. The samples were collected from unworked and worked animal bones. The assemblages used in the study consist of data from recently excavated Garniai I, Mineikiškės and Antilgė hilltop settlements and legacy collections of Narkūnai, Kereliai, Sokiškiai and Nevieriškės. Animal bones were identified by G. Piličiauskienė. In the Appendix, a summary of ^{14}C dates has been constructed with an objective to discuss appearance and the earliest development of hilltop settlements in the Southeastern Baltic. This paper reviews all dates from the earliest to the 400 cal BC, i.e. the approximate end of the Hallstatt radiocarbon calibration plateau.

Including new data presented in this paper, currently 60 ^{14}C dates from 17 Southeastern Baltic sites are known. First ^{14}C dates on charcoal samples were published by J. Graudonis (1989) in the monograph dealing with Ķivutkalns hilltop settlement. After a 17-yr halt, radiocarbon dating started to be routinely included into research design for this type of settlement (Egoreichenko 2006). The same year marked the start of using different kinds of samples, as A. Kriiska and M. Lavento (2006) published the first dating results of carbonized surface residues on pottery. Further studies included zooarchaeological (Oinonen et al. 2013) and archaeobotanical samples (Minkevičius et al. 2019). Supplementary Material 1 presents a more detailed review of dated sites alongside known information on the sample collection. In all, including the new data, this paper reviews ^{14}C dating results of 30 charcoal samples, 14 animal and 2 human bones, 8 grains, and 6 carbonized surface residues on pottery.

Sites and Background of Sample Collection

Inland Lithuanian hilltop settlements together with sites from SE Latvia and NW Belarus account for the largest portion of the Bronze Age hilltop settlement pattern (Figure 1). The active and socially tense region was archaeologically investigated from the very beginnings of the 20th century (Krzywicki 1914, 1917) and has provided rich archaeological collections from at least 31 sites from Lithuania alone. This study dates 4 of the most frequently mentioned cases (Kereliai, Narkūnai, Nevieriškės, and Sokiškės) in the literature (Grigalavičienė 1986a, 1986b, 1992, 1995; Volkaitė–Kulikauskienė 1986; Luchtanas 1992; Čivilytė 2014; Podėnas et al. 2016a, 2016b) and 3 recently archaeologically investigated sites (Antilgė, Garniai I, and Mineikiškės). All samples were selected from herbivore remains, found in cultural layers during archaeological excavations.

Numerous archeozoological finds form Kereliai, Narkūnai, Nevieriškės, and Sokiškiai hilltop settlements were collected during the archaeological investigations, however animal bone collections are missing[5]. Therefore, samples for this study were selected by reassessing the

[4]Meant as the demand by locals to participate in interregional exchange more actively.
[5]Most of the collections were lent by the National Museum of Lithuania, but as of the time this manuscript was submitted, animal bones were not returned, even though an active request has been made for more than 2 years by the museum.

Table 1 New ^{14}C-AMS dates of the inland (NE) Lithuania hilltop settlements. Blank = data not reported. (See the Appendix for dates from coastal Lithuania)

No.	Site	^{14}C date (years BP)	Lab code	Cal (95.4%)	Collagen (%)	%C	%N	C/N	Sample description	Context report
	Inland (NE) Lithuania									
1	Garniai I	2521 ± 24	MAMS-29320	792–546 BC	2.2				*Ovis aries*/*Capra hircus*, tooth, right M_3, individual of 3–4 years	2016, Area 1, Sq. A4, Depth 0.30 m
2	Garniai I	2498 ± 23	MAMS-29321	774–541 BC	3.1	31		3.2	*Cervidae*/*Bos*, tibia	2016, Area 1, Sq. A4, Depth 0.40 m
3	Garniai I	2492 ± 23	MAMS-29322	771–540 BC	8.6	36.1		3.2	*Bos*/*Bison*, horncore	2016, Area 1, Sq. A5, Depth 0.40 m
4	Antilgė	2461 ± 52	FTMC-38-2	764–414 BC	2.94	36.12	13.48	3.3	*Bos*/*Bison*, pelvis bone, right side.	2017, Area 3, Sq. O3, Depth 1.22 m
5	Nevieriškės	2461 ± 44	FTMC-38-5	762–415 BC	3.52	38.98	14.63	3.11	*Alces alces*, femur (bone with cut marks – AR 597: 518)	1976, Area 2, Sq. A8, Depth 0.4 m
6	Nevieriškės	2446 ± 48	FTMC-38-6	757–409 BC	3.10	38.51	14.45	3.11	*Bos*/*Bison*/*Alces*, long bone (bone with cut marks – AR 597: 346)	1976, Area 3, Sq. B7, Depth 0.45 m
7	Kereliai	2380 ± 47	FTMC-38-7	750–378 BC	1.58	30.36	11.24	3.15	*Bos*/*Bison*/*Alces*, long bone (awl – AR 726: 69)	1985, Area 3, Sq. B4, Depth 1.05 m
8	Mineikiškės	2528 ± 25	MAMS-33921	793–548 BC	5.9	32.4		2.9	*Equus caballus*, maxilla, right side, individual of 13–14 years	2017, Area 1, Sq. A1, Depth 0.40 m
9	Narkūnai	2538 ± 26	MAMS-33922	796–550 BC	3.4	31.4		2.8	*Ovis aries*/*Capra hircus*, tibia, left side, proximal part of diaphysis (bone with cut marks – AR 726: 358)	1978, Area 6, Depth 1.65–1.70 m
10	Sokiškiai	2500 ± 26	MAMS-33923	777–540 BC	3.7	34.1		2.9	*Ovis aries*, metatarsus, right side, distal part of diaphysis, individual of less than 2 years (awl)	1981, Area 1a, Sq. D5, Depth 0.75 m

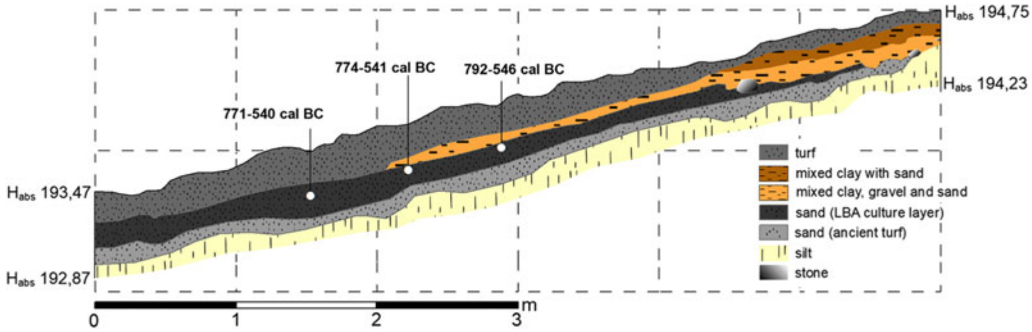

Figure 2 A section of the Garniai I site, Area 1 with the calibrated AMS ^{14}C dates. Excavations of 2016. Drawing by V. Podėnas.

significantly smaller collection of worked bone finds stored in Lithuanian National Museum. All of these four hilltop settlements were reinhabited later in the Iron Age or the Medieval period. Two samples from Nevieriškė hilltop settlement were *Alces* femur and Ruminantia's (*Bos/Bison/Alces*) long bone. *Alces* femur with cut marks was found in the topsoil disturbed by modern agricultural activity and *Bos/Bison/Alces* long bone was uncovered in the upper part of the charcoal-rich cultural layer. Bronze Age horizon in Kereliai hilltop settlement was dated by taking a sample from an awl (Ruminantia's long bone) found in charcoal-rich cultural layer. Sokiškiai was dated by taking a sample from an awl made from *Ovis aries* metatarsus found in insufficiently documented context[6]. Lastly, sample for radiocarbon dating of Narkūnai hilltop settlement was taken from *Ovis aries/capra hircus* tibia with cut marks. This was uncovered in the southern part of the settlement at the depth of 1.65–1.7 m. Assessment of the area description in the original excavation report (Kulikauskienė and Luchtanas 1978) revealed that this depth could point to the context behind the palisade, close to undisturbed soil. Notably, the find was discovered in the same area as the previously supposed typologically earliest bronze pin ever found in the hilltop settlements (Volkaitė-Kulikauskienė 1986; Luchtanas 1992). The pin resembled Central Polish Majków type (ca. 1500–1100 BC) bronze pins, but A. Čivilytė (2014) has argued that analogy is rather remote and the Narkūnai find should be assessed with a caution.

The absence of datable samples has inspired archaeological investigations of Antilgė, Garniai I and Mineikiškės hilltop settlements during 2016–2017 (Čivilytė et al. 2017a, 2017b; Podėnas 2018; Podėnas et al. 2018; Poškienė et al. 2018). Three sites share similar geomorphological characteristics. Hilltop settlements had been established on kames in Baltic Uplands that was formed by retracting Fennoscandian Ice Sheet (Rinterknecht et al. 2008; Troskosky et al. 2018). All sites lacked previous human activity. In addition, only Antilgė was inhabited later in 1st century BC–2nd century. AD. Based on the artifact typologies alone, Garniai I and Mineikiškės represent only the Late Bronze Age horizons. The samples of the two sites were collected from the edges of habitation areas, where cultural layers are were generally thicker due to the agglomeration of waste and refuse (Figure 2). Sample from Antilgė hilltop settlement was taken from the ditch that was surrounding the court. The latter sample was from the fill, moved from the habitation area. Other dates and finds from Antilgė indicated that the ditch was constructed in the Roman Iron Age (Poškienė et al. 2018).

[6]Layers are somewhat mixed therefore it is imposible to determine whether bone was found in charcoal-rich cultural layer or other layer at the edge of the settlement.

AMS Radiocarbon (^{14}C) Dating of Lithuanian Sites

Direct AMS ^{14}C dating of the 10 animal bones was undertaken at Curt-Engelhorn-Zentrum Archaeometrie, Mannheim (Germany) and Mass Spectrometry Laboratory, Center for Physical Sciences and Technology, Vilnius (Lithuania). 5 samples were selected from the collections of Lithuanian National Museum. There was no information on consolidants used for conservation of the material. Remaining samples were collected during 2016–2017 archaeological excavations in Antilgė, Garniai I and Mineikiškės hilltop settlements. The collagen extracted from the bone samples was purified by ultrafiltration (fraction >30kD) and freeze-dried. Afterwards, collagen was combusted to CO^2 in an Elemental Analyzer (EA), which later converted catalytically to graphite. In this study all radiocarbon ages were calibrated using the OxCal 4.3.2 software (Bronk Ramsey 2017) and IntCal13 atmospheric curve (Reimer et al. 2013). Calibrated dates are presented at 95.4% probability.

RESULTS AND DISCUSSION

The ^{14}C dating results are presented in Table 1. All 10 samples proved to contain sufficient amount of collagen and C/N ratios (2.8–3.3) indicated well preserved collagen in all of them (Madden et al. 2018). Herbivore bones collected from 7 sites were dated to roughly similar timeframe between 8th and 6/4th centuries cal BC. Results have proved that the studied Inland Lithuanian sites were contemporaneous with the most of previously dated samples from other hilltop settlements. However, the identification of hilltop settlement establishment initial phase in the SE Baltic relies on the deviations from the Hallstatt radiocarbon calibration plateau (ca. 800–400 cal BC).

Reliability of the previous dates is also severely limited by the fact that none of the charcoal samples were further examined to determine the species and age of the plant. Moreover, previously dated animal bones had not been identified to be herbivores (Oinonen et al. 2013), except for *Ovis aries* bone from Asva (Rannamäe et al. 2016), which was dated to Poz-58805: 2505 ± 30, or cal BC 786–522 (2σ). Furthermore, more significant interpretational problems lie in assessing the dated samples of carbonized surface residue on pottery (Kriiska and Lavento 2006; Sperling 2014). The published dates lacked measurements of $\delta^{13}C$ and $\delta^{15}N$ stable isotopes, therefore it is impossible to estimate possible aquatic reservoir effects on samples.

Dating of the inland cluster is significantly supplemented by the studies of hilltop settlements in NE Belarus. They are separated only by ca. 50 km from the sites investigated in this study. 6 out of 13 dates stand out among them as predating the Hallstatt plateau: IGSB-645: 2925 ± 60, IGSB-648: 3170 ± 200, IGSB-697: 2920 ± 35, IGSB-1121: 2820 ± 70, IGSB-1147: 4020 ± 85, IGSB-1148: 2970 ± 190. These dates are ambiguous due to the poor sample documentation and lack of context specification. Therefore, results raise concerns that charcoal collected during the excavations was not necessarily associated with archaeological context of the hilltop settlement. The dates may in fact represent other unidentified events, such as forest fires, that occurred before the establishment of the hilltop settlement. Most of the dated samples in Ratjunki and Zazony sites came from an unspecified layer, except for one case. A charcoal from a pit in Zazony provided a date of IGSB-652: 2600 ± 50, or cal BC 895–546 (2σ). Therefore, the claims that hilltop settlement appearance in the inland cluster of NE Lithuania, NW Belarus and SE Latvia

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in early to middle 2nd millennium BC (Gimbutienė 1985; Egoreichenko 2006) rely on questionable dates and stray finds. Lastly, the only site situated in inland Estonia (Kõivuküla) was dated to first half of I millennium BC, i.e. Tln-3359: 2632 ± 60, or cal BC 923–551 (2σ). Thus, based on the 10 new dates from Lithuania and more reliable Zazony and Kõivuküla dates (Figure 3) it is most likely that inland hilltop settlements were established sometime during 10th–6th centuries cal BC.

Hilltop settlements in the coastal Southeastern Baltic and its vicinities have aided the debate significantly by providing a series of dates. Coastal Lithuania is best represented by the Kukuliškiai site with 8 AMS ^{14}C dates on the grains of cultivated plants (Minkevičius et al. 2019). These have proved to be of similar chronology as the inland sites. Possibly the earliest dated samples were collected in sites from coastal Latvia and Estonia. These include charcoal from Ķivutkalns, Krievu kalns and Padure hilltop settlements and carbonized surface residue on pottery found in Asva and Narva settlements. The aforementioned ambiguity in interpretation of carbonized surface residue on pottery samples is especially significant in the case of Narva. Therefore, it is essential to obtain more reliable data to test the hypothesis that Narva hilltop settlement was established already in 13th–10th centuries cal BC, which would indicate an unlikely scenario of the earliest enclosed settlements in the SE Baltic emerging farther away from River Daugava route, in the region's most NE corner. Otherwise, the earliest dates from Ķivutkalns situated in lower reaches of River Daugava (LE-2032: 2750 ± 40, or cal BC 996–816 (2σ), and TA-436: 2675 ± 60, or cal BC 976–771 (2σ)) correlate with the rest of the dates that were outside the Hallstatt radiocarbon calibration plateau. However, it is unlikely that dates LE-2032 and TA-436 refer to the initial phase of the settlement as stratigraphy indicated that settlement's layer was established only after the usage of the cemetary had ceased at the hilltop (Graudonis 1989). Further studies (Oinonen et al. 2013; Mittnik et al. 2018) of the burials had dated the majority of human bones to ca. 8th–5th centuries BC (Hallstatt plateau). Therefore, Ķivutkalns hilltop settlement was established later than the LE-2032 and TA-436 have dates indicated. The charcoal samples for these dates could had been collected from ambiguous contexts. More reliable data was collected in the Latvian coastal zone, specifically in Krievu kalns (Tln-3519: 2779 ± 50, or cal BC 1047–821 (2σ)) and Padure (LE-6682: 2890 ± 100, or cal BC 1381–837 (2σ)) hilltop settlements (Vasks et al. 2011; Doniņa et al. 2014). Charcoal samples from the hearth and a posthole provided reliable archaeological context with the only drawback being the lack of identification of wood species and age estimation. Thus, current evidence suggests that hilltop settlements in coastal Southeastern Baltic appeared between 11th and 9th centuries cal BC.

The knowledge on the process of emergence of hilltop settlements is blurred by the low chronological resolution. This is further complicated by the Hallstatt calibration plateau. Therefore, it is difficult to understand how enclosed sites spread throughout the SE Baltic. There are three possible interpretations of current data: (1) the earliest hilltop settlements were established and spread swiftly throughout the coastal zone and appeared in inland later; (2) the earliest hilltop settlements established in Western Latvian coastal zone where there is a significant Scandinavian influence and gradually spread throughout the region via coastal, River Daugava and less significant water network communication; or (3) the earliest hilltop settlements emerged in the SE Baltic region's west and east simultaneously were affected by the independent processes. More reliable data suggest that the second hypothesis seem the likeliest as the dates acquired from clear contexts indicate the earliest

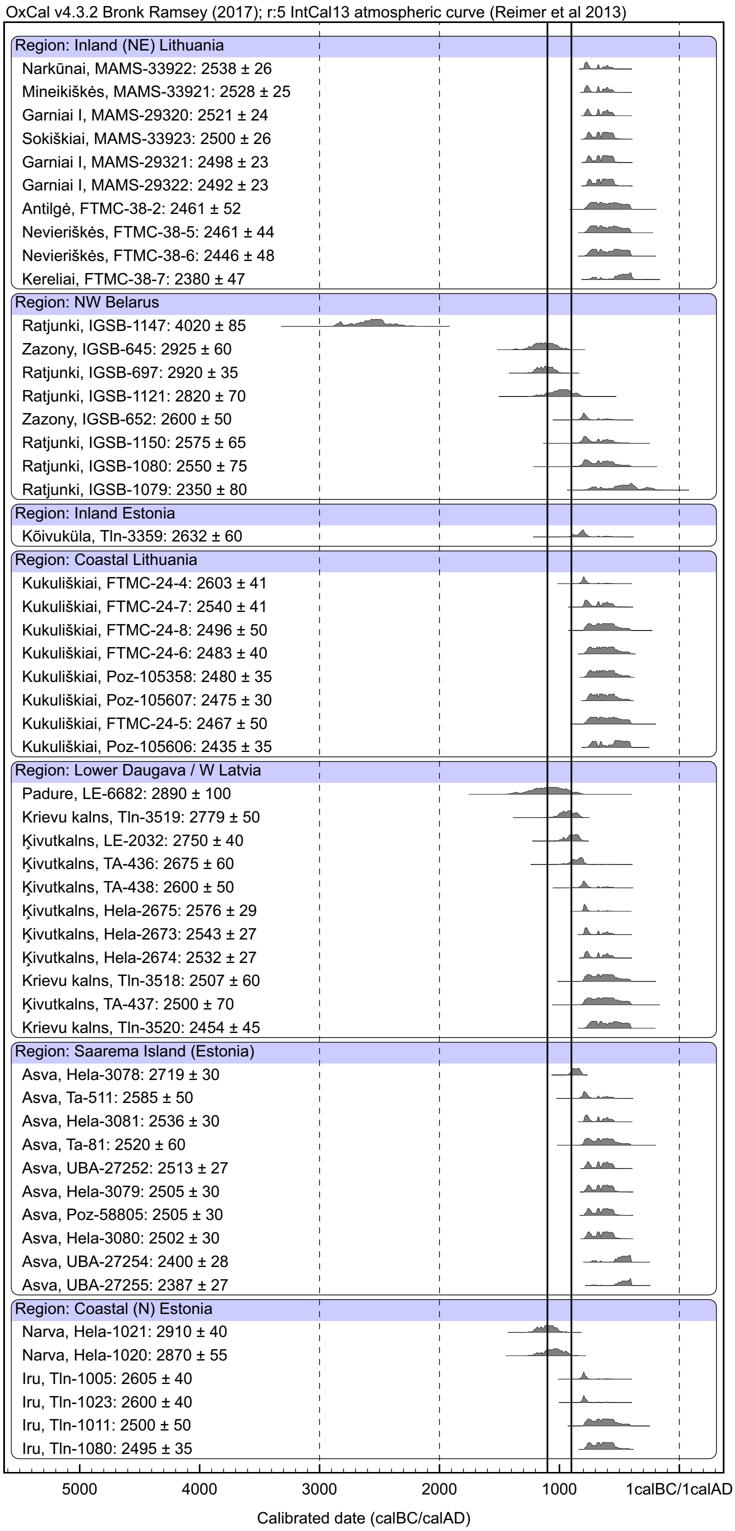

Figure 3 Diagram of calibrated ^{14}C dates of the hilltop settlements in the SE Baltic. Based on the Appendix (see further references). Dates with the greater margin of error than 100 were removed as not precise enough. Solid lines mark the likeliest period (1100–900 cal BC) of the emergence of hilltop settlements in the region.

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hilltop settlements concentrating in the vicinities of coastal Latvian zone. These sites had a significant role in developing interregional communication and exchange in the SE Baltic (Podėnas and Čivilytė 2019). Contacts with Scandinavian and Lusatian (Southern Baltic) cultures had provided further stimuli for the development of local societies after the full adoption of farming. Furthermore, the active communication had provided the Southeastern Baltic societies with stable metal supply. Even though adoption of foreign cultural elements is visible in the archaeological record, they transitioned to the Southeastern Baltic only on a limited scale. A good example is the stone-ship burial practices, inherent to the Nordic Bronze Age. These were actively used in Gotland and coastal Sweden (Wehlin 2013), and also appear in the active contact zones in the SE Baltic, such areas as Saarema Island (Lang 2007) and Western Latvia (Graudonis 1967). These burial rites were not adopted by the local communities and had not spread to the inland region. However, it is likely these communities had established the hilltop settlements due to active usage of trade networks that were stimulated by Scandinavian settlements near the localities of stone-ship burials (Šturms 1947; Podėnas and Čivilytė 2019).

CONCLUSIONS

New AMS dates obtained from Bronze Age hilltop settlements have helped to refine the chronology of their appearance and early development in the Southeastern Baltic. They have provided comparative material to challenge previously constructed chronologies that dated emergence of hilltop settlements in the NE or SE areas of the SE Baltic region during early-mid II millennium BC. The securely dated contexts indicates contrastingly that these inland sites emerged significantly later during 10th–6th centuries cal BC. A review of all dates in the SE Baltic have indicated that coastal sites were established earlier than the inland ones, i.e. 11th–9th centuries cal BC. This points to the significance of coastal communication and western or southwestern directions of economic influence related to Nordic and Lusatian cultures.

This study highlights the necessity of further application of systematic AMS ^{14}C dating, meticulous recording and thorough examination of the relations between the samples and specific archaeological context. This paper illustrated that data from the legacy excavations is plagued by the lack of proper documentation. The earliest dates were acquired by dating charcoal samples collected in ambiguous contexts exclusively. However, the existing dataset is considerably modest, therefore it is expected that further studies into the field would alter and correct the model proposed in this paper.

Archaeological evidence presents an intriguing case of societal change following the adoption of agriculture which took place significantly later than in neighboring Western and Southern Baltic regions. Local communities were subjected to significant economic advantages in metal trade and confronted the Bronze Age culture on an unprecedented scale. We are on the threshold of understanding how these communities responded to the external stimuli and explored the changing social, economic, and technological landscape.

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SUPPLEMENTARY MATERIAL

To view supplementary material for this article, please visit https://doi.org/10.1017/RDC.2019.152

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APPENDIX

^{14}C dates of the Southeastern Baltic hilltop settlements from the earliest to the end of the 5th century cal BC (end of the Halltsatt radiocarbon calibration plateau). Numeration continues from Table 1.

No.	Site	^{14}C date (years BP)	Lab code	Cal (95.4%)	Sample description	Context report	Reference
Coastal Lithuania							
11	Kukuliškiai	2603 ± 41	FTMC-24-4	887–556 BC	*Hordeum vulgare* (grain)	2017, Area 1, Sq. 1–2 B, Posthole 1, Depth 1.44–1.49 m	Minkevičius et al. 2019
12	Kukuliškiai	2467 ± 50	FTMC-24-5	767–416 BC	*Hordeum vulgare* (grain)	2017, Area 1, Sq. 1–2 B, Posthole 1, Depth 1.49–1.82 m	Minkevičius et al. 2019
13	Kukuliškiai	2483 ± 40	FTMC-24-6	780–430 BC	*Hordeum vulgare* (grain)	2017, Area 1, Sq. 4–5 B, Hearth 1, Depth 0.75–0.78 m	Minkevičius et al. 2019
14	Kukuliškiai	2540 ± 41	FTMC-24-7	803–540 BC	*Hordeum vulgare* (grain)	2017, Area 1, Sq. 4–5 B, Hearth 1, Depth 0.79–0.82 m	Minkevičius et al. 2019
15	Kukuliškiai	2496 ± 50	FTMC-24-8	793–431 BC	*Hordeum vulgare* (grain)	2017, Area 1, Sq. 5 A, Posthole 5, Depth 0.77 m	Minkevičius et al. 2019
16	Kukuliškiai	2480 ± 35	Poz-105358	775–431 BC	*Vicia faba* (grain)	2017, Area 1, Sq. 4–5 A, Hearth 1, Depth 0.79–0.82 m	Minkevičius et al. 2019
17	Kukuliškiai	2435 ± 35	Poz-105606	752–406 BC	*Lens culinaris* (grain)	2017, Area 1, Sq. 5 A, Posthole 5, Depth 0.77 m	Minkevičius et al. 2019
18	Kukuliškiai	2475 ± 30	Poz-105607	771–431 BC	*Pisum sativum* (grain)	2017, Area 1, Sq. 5 A, Profile 1, Depth 0.54–0.59 m	Minkevičius et al. 2019

Coastal / W Latvia							
19	Ķivutkalns	2543 ± 27	Hela-2673	799–551 BC	Animal bone (*unspecified*), splinter	1966–1967, Area 10, Depth 0.75 m	Oinonen et al. 2013
20	Ķivutkalns	2532 ± 27	Hela-2674	796–547 BC	Animal bone (*unspecified*), awl	1966–1967, Area 12, Depth 1.53 m	Oinonen et al. 2013
21	Ķivutkalns	2576 ± 29	Hela-2675	811–591 BC	Animal bone (*unspecified*), awl	1966–1967, Area 10, Depth 1.90 m	Oinonen et al. 2013
22	Ķivutkalns	2750 ± 40	LE-2032	996–816 BC	Charcoal	1966–1967, Area 7, Depth 1 m	Graudonis 1989
23	Ķivutkalns	2675 ± 60	TA-436	976–771 BC	Charcoal	1966–1967, Area 12, Depth 1 m	Graudonis 1989
24	Ķivutkalns	2500 ± 70	TA-437	795–428 BC	Charcoal	1966–1967, Area 1, Depth 1–1.1 m	Graudonis 1989
25	Ķivutkalns	2600 ± 50	TA-438	895–546 BC	Charcoal	1966–1967, Area 1, Depth 0.8–1 m	Graudonis 1989
26	Ķivutkalns	2482 ± 150	Ri-220	925–206 BC	Charcoal	1966–1967, Area 5, Depth 0.85–1.1 m	Graudonis 1989
27	Padure	2890 ± 100	LE-6682	1381–837 BC	Charcoal	2003, Area 1, Hearth 2, Depth 0.5 m	Bērziņš et al. 2009 Vasks et al. 2011
28	Krievu kalns	2779 ± 50	Tln-3519	1047–821 BC	Charcoal	2012–2013, Area 4, sq. 3–4/B, posthole	Doniņa et al. 2014
29	Krievu kalns	2507 ± 60	Tln-3518	797–430 BC	Charcoal	2012–2013, Area 4, sq. 7–8/A-B, pit	Doniņa et al. 2014
30	Krievu kalns	2454 ± 45	Tln-3520	760–411 BC	Charcoal	2012–2013, Area 1, (storage?) pit	Doniņa et al. 2014
Inland (NW) Belarus							
31	Zazony	2925 ± 60	IGSB-645	1288–934 BC	Charcoal	1995–2000, “layer” 4 (Depth 0.3–0.6 m)	Egoreichenko 2006
32	Zazony	3170 ± 200	IGSB-648	1919–924 BC	Charcoal	1995–2000, “layer” 5 (Depth 0.3–0.6 m)	Egoreichenko 2006
33	Zazony	2600 ± 50	IGSB-652	895–546 BC	Charcoal	1995–2000, Pit, *unspecified*	Egoreichenko 2006

(*Continued*)

No.	Site	^{14}C date (years BP)	Lab code	Cal (95.4%)	Sample description	Context report	Reference
34	Ratjunki	2920 ± 35	IGSB-697	1218–1011 BC	Charcoal	1978–1981, 1999 or 2001–2006, "layer" 3	Egoreichenko 2006
35	Ratjunki	2320 ± 120	IGSB-930	779–113 BC	Charcoal	1978–1981, 1999 or 2001–2006, "layer" 9	Egoreichenko 2006
36	Ratjunki	2840 ± 500	IGSB-933	2457 BC – 84 AD	Charcoal	1978–1981, 1999 or 2001–2006, "layer" 13	Egoreichenko 2006
37	Ratjunki	2820 ± 70	IGSB-1121	1193–827 BC	Charcoal	1978–1981, 1999 or 2001–2006, "layer" 9	Egoreichenko 2006
38	Ratjunki	4020 ± 85	IGSB-1147	2871–2306 BC	Charcoal	1978–1981, 1999 or 2001–2006, "layer" 9	Egoreichenko 2006
39	Ratjunki	2970 ± 190	IGSB-1148	1638–798 BC	Charcoal	1978–1981, 1999 or 2001–2006, "layer" 9	Egoreichenko 2006
40	Ratjunki	2460 ± 120	IGSB-1149	834–234 BC	Charcoal	1978–1981, 1999 or 2001–2006, "layer" 10	Egoreichenko 2006
41	Ratjunki	2575 ± 65	IGSB-1150	894–486 BC	Charcoal	1978–1981, 1999 or 2001–2006, "layer" 6	Egoreichenko 2006
42	Ratjunki	2550 ± 75	IGSB-1080	826–428 BC	Human bone	1978–1981, 1999 or 2001–2006, "layer" 8 (Depth 0.7–0.8 m)	Egoreichenko 2006
43	Ratjunki	2350 ± 80	IGSB-1079	758–209 BC	Human bone	1978–1981, 1999 or 2001–2006, "layer" 8 (Depth 0.7–0.8 m)	Egoreichenko 2006
Coastal / N Estonia							
44	Iru	2605 ± 40	Tln-1005	890–565 BC	Charcoal?	*Unspecified*	Lang 2007
45	Iru	2500 ± 50	Tln-1011	791–511 BC	Charcoal?	*Unspecified*	Lang 2007
46	Iru	2600 ± 40	Tln-1023	839–556 BC	Charcoal?	*Unspecified*	Lang 2007
47	Iru	2495 ± 35	Tln-1080	790–490 BC	Charcoal?	*Unspecified*	Lang 2007
48	Narva	2910 ± 40	Hela-1021	1224–980 BC	Carbonized surface residue on pottery	*Unspecified*. Textile pottery context	Kriiska and Lavento 2006
49	Narva	2870 ± 55	Hela-1020	1211–911 BC	Carbonized surface residue on pottery	*Unspecified*. Textile pottery context	Kriiska and Lavento 2006

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Inland Estonia							
50	Kõivuküla	2632 ± 60	Tln-3359	923–551 BC	Charcoal	2011, Area 1, Grey layer under the rampart	Valk et al. 2012
Saarema Island (Estonia)							
51	Asva	2585 ± 50	Ta-511	840–541 BC	Charcoal?	*Unspecified*	Lang 2007
52	Asva	2520 ± 60	Ta-81	802–431 BC	Charcoal?	*Unspecified*	Lang 2007
53	Asva	2719 ± 30	Hela-3078	917–811 BC	Carbonized surface residue on pottery	1949, Area E, *unspecified*	Sperling 2014
54	Asva	2505 ± 30	Hela-3079	787–540 BC	Carbonized surface residue on pottery	1965–1966, Area F, *unspecified*	Sperling 2014
55	Asva	2502 ± 30	Hela-3080	787–539 BC	Carbonized surface residue on pottery	1965–1966, Area F, *unspecified*	Sperling 2014
56	Asva	2536 ± 30	Hela-3081	799–546 BC	Carbonized surface residue on pottery	1965–1966, Area F, *unspecified*	Sperling 2014
57	Asva	2513 ± 27	UBA-27252	790–542 BC	Charcoal	2014, Area G, charcoal concentration between casting moulds (horizon Asva IIb)	Sperling et al. 2015
58	Asva	2400 ± 28	UBA-27254	728–400 BC	Charcoal	2014, Area G, the upper part of charcoal rich horizon Asva IIb	Sperling et al. 2015
59	Asva	2387 ± 27	UBA-27255	703–397 BC	Charcoal	2014, Area G, horizon Asva IIb	Sperling et al. 2015
60	Asva	2505 ± 30	Poz-58805	786–522 BC	*Ovis aries*, metacarpus	1965, Area F, *unspecified*	Rannamäe et al. 2016