

11. Animal bones from the basins of Sykourio and Elateia

Maaïke Groot

11.1. Methods

During the systematic surface surveys carried out in the basins of Sykourio and Elateia a total of 125 faunal remains could be collected. All of them were in fragmentary condition, some covered with sinter, others burnt. As it was not possible to have a zooarchaeologist examine the animal bones on site in Greece, 125 bones were photographed by Agathe Reingruber from different perspectives and the photographs sent to Maaïke Groot for identification. Additional information regarding size and weight was available from the project's database. The main aim was to get some idea of species representation and to identify animal bones selected for radiocarbon dating. Identification from photographs is not ideal. In some cases, identification to species and skeletal element was easy; in others, only a possible identification could be offered. For a large part of the fragments, identification was not possible at all; however, this is also normal during zooarchaeological analysis where the bones can be handled.

11.2. Elateia 1

A total of 115 fragments of faunal remains were available from the flat site of Elateia 1. Most of them are bones (95 fragments), followed by shells (11 fragments) and teeth (9). 28 fragments of mammals could be identified to species: 15 sheep or goat, 10 cattle, 2 pig (or wild boar) and 1 deer (Table 11.1 and Fig. 11.1). Two tooth fragments are probably identifiable if seen and handled, but at the moment are identified as sheep/goat or cattle. Of the 26 mammal fragments that could be attributed to a size class, 19 are from medium-sized mammals and 7 from large-sized mammals. The remaining 48 fragments could not be identified at all, but are almost certainly all from mammals. For both sheep or goat and cattle, bones from different parts of the body are represented, including the feet which contain little meat. This suggests that animals were killed and processed on site.

species	n fragments
<i>mammals</i>	
sheep/goat	15
cattle	10
pig	2
deer	1
total identified	28
sheep/goat or cattle	2
medium mammal	19
large mammal	7
mammal	48
total mammal	104
<i>molluscs</i>	
Spondylus sp.	1
Cardidae	3
Unio sp.	1
mollusc	6
total molluscs	11

Table 11.1. Faunal remains from Elateia 1.

Information on slaughter ages is limited: two epiphyses from cattle and one from pig are fused. For sheep or goat, one epiphysis is unfused and four are fused. The teeth all seem to be permanent molars.

The average weight of identified mammal fragments is 18 g and that of unidentified mammal fragments is 2 g. As expected, cattle fragments are heavier (between 17 and 133 g) than fragments of the smaller species (sheep or goat: 1-16 g; pig: 2-5.5 g; deer: 17 g).

The economy was largely based on domesticated animals, but it is possible that some meat was added by hunting. However, the only fragment that is certainly from a wild species is an antler fragment and does not provide proof for hunting, as antler can be gathered (after the animal has shed it) or traded. Due to the fragmentary condition of the bones no tools were identified among them.

Of the eleven molluscs, three could be identified as cockles (family Cardidae; marine molluscs), one

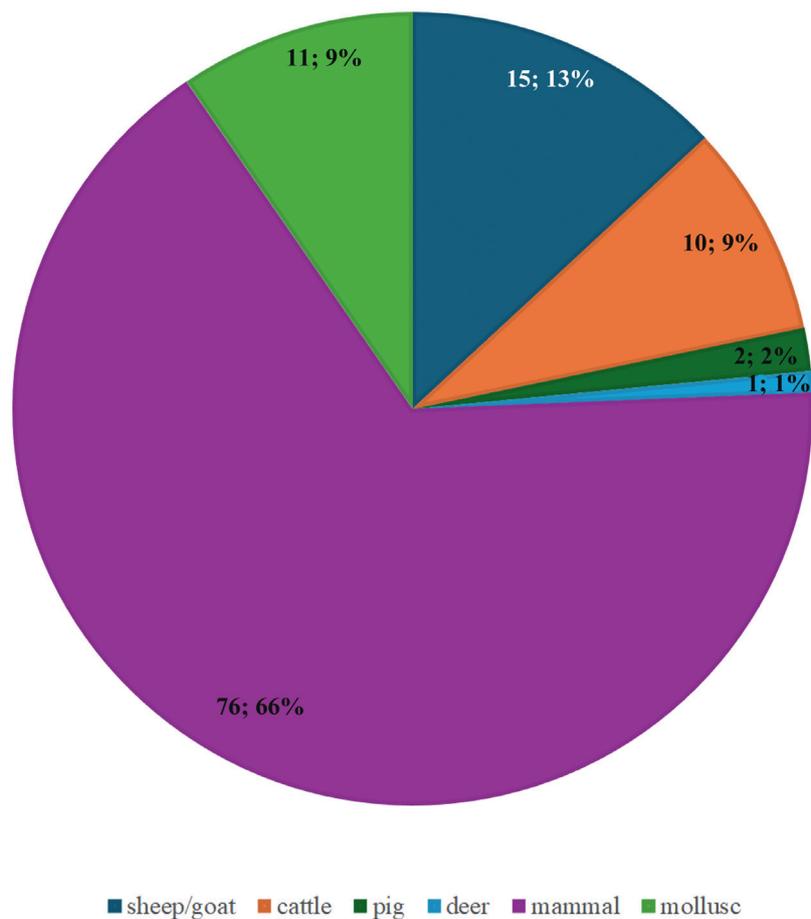


Fig. 11.1. Diagram showing the identified animal species from Elateia 1.

as *Spondylus* sp. (also marine) and one as *Unio* sp. (a freshwater species). Three molluscs were not identified from the photographs but can probably be identified if seen in real life and with access to reference material.

11.3. Nessonis II (Theocharis' excavation)

A total of 14 animal bones, mostly small fragments, were preserved from the investigations led by D. Theocharis in Nessonis I and II (i.e. Nessonis 1-East and Nessonis 2). Four of them show traces of working or use. Two of these are ribs, one probably from cattle and the second from a medium-sized mammal. A tibia from a sheep or goat is distally fused. A fragment is from a medium-sized mammal, burned, but could not be identified further.

The other ten animal bone fragments were unworked fragments, some of them selected for

C14-dating. One fragment is a sheep/goat metapodial that is distally fused. Two other fragments are probably also from sheep or goat: one fragment is almost certainly from a radius and the second probably from a metacarpus. The other seven fragments were not identifiable.

In addition to mammal bones, two shells could be identified as Noa's ark (*Arca noae*) and Mediterranean scallop (*Pecten jacobaeus*). Nessonis 2 is situated 30 km from the Aegean coast where they were probably collected.

11.4. Makrychori 3

Four bones from this site were available. One bone is a distal fragment of a sheep/goat metapodial. Another bone is probably a distal fragment of a cattle phalanx. Two fragments could not be identified.

A bead and a fragment of a bracelet are probably both made from *Spondylus* shells.

12. A conclusive reconstruction of settlement dynamics in the basins of Sykourio and Elateia

Agathe Reingruber and Giorgos Toufexis

12.1. Introduction¹

The main focus of the Greek-German survey project “Prehistoric Thessaly: Mobile and sedentary communities south of Mount Olympus” was the systematic recording of Neolithic and Chalcolithic sites and the comprehensive evaluation of their find inventories in order to gain reliable insights into the dynamics of a geographically well-defined landscape. Under the auspices of the Ephorate of Antiquities of Larissa and the Free University in Berlin, and thanks to the financial support of the German Research Foundation², as well as the dedicated team and today’s technical and computer-aided possibilities, we were able to carry out surveys in the basin area south of Mt Olympus and west of Mt Ossa and to analyse a major portion of the information collected.

The Greek archaeologist Dimitrios R. Theocharis had already conducted fundamental work in this region in the years 1958–1964³ (cf. Chapter 1, contributions by Hauptmann, Toufexis and Reingruber). Thanks to his and Kostas Gallis’ valuable preliminary work⁴, we were able to re-localise the sites known up to that point and to expand the relative chronological classifications proposed by them. The seminal studies on Thessaly’s prehistoric pottery⁵ facilitated the assignment of certain ceramic styles to a corresponding period. We

were able to examine all newly recovered finds⁶, as well as the finds already kept in the Museum of Larissa, and, based on this, we developed a robust relative chronological framework for the settlements involved (cf. Tab. 6.30). This is the basis for the population dynamics described below, which can be demonstrated for both the southern part of the Sykourio basin, and for the Elateia basin (see Chapter 2, contribution by Reingruber and Toufexis).

The fact that we can refer to our working area as a basin landscape is the result of a concerted effort by us archaeologists together with a geologist (Sotiris Valkaniotis), a hydrogeologist (Antonis Manakos) and a mineralogist (Vasilios Melfos): This area had previously not been described as a basin in any modern geographical, geological or archaeological publication. Even the maps published by the National Geological Survey (IGME) divide the basin into four different sheets. So first of all, the basin landscape, which is surrounded on all sides by the Lower Olympus and Mt Ossa, and their promontories, had to be named. Subsequently, the two main basins were called Sykourio and Elateia, to which two respective sub-basins, Pournari and Makrychori, belong (see Chapter 3, contribution by Manakos).⁷

The reconstruction of the surface waters, which have now dried up, also posed a particular

¹ The authors would like to thank Lea Hüntemann for editing the English version of the text.

² We are grateful to the directress of the Ephorate, Dr. Stavroula Sdrolia, as well to Prof. Dr. Wolfram Schier from the Free University in Berlin for their kind support. A short description of the research grant with the project number 315184342 at the Deutsche Forschungsgemeinschaft (DFG) is available at <https://karten.dfg.de/gepris/projekt/315184342>. We would like to thank the persons in charge, especially Dr. Christoph Kümmel and Sabine Thomas.

³ Theocharis 1962; 1973.

⁴ Gallis 1992.

⁵ E.g., Hauptmann 1969; 1981; Wijnen 1981; Alram-Stern 1996 with older literature included.

⁶ This was possible thanks to the excellent working conditions in the building of the former District Court for Peace (Ειρηνοδικεῖον) of Sykourio: Our sincere thanks go to the authorities of the Municipality of Tempe and especially to the then vice mayor of the region, Kostas Dafoulis, who generously supported our work and shared his invaluable knowledge of the area with us. We also thank the Mayor’s Office of Sykourio and its institutions (the local Ethnographic Museum, the public library, and the local hunters’ office). The support and the friendliness of the people of Sykourio were overwhelming and we remain indebted to them, most of all to Stella Samara, Michalis Gerogiannis and Vasso Mizziou.

⁷ Reingruber et al. 2024.

challenge. We were able to show that there were two settlement areas with different water catchment systems: the (southern) basin of Sykourio forms a separate unit, with no direct connection to the plain. Its main river was the Xerias, which fed a wetland visible on historical maps. The (northern) basin of Elateia is drained by the Pinios River and therefore belongs to its catchment area. These different hydrographic catchments certainly also played a significant role in the choice of location in prehistoric times, as some settlements were located on a (presumed) lake shore and others at the confluence of two streams.

Our approach in the two basins was to carry out intensive and systematic surveys, whereby all small finds and decorated sherds encountered in the fields we frequented were measured using handheld GPS devices. All areas that were considered suitable and accessible (i.e. neither overbuilt nor fenced) were surveyed in a checkerboard pattern. Along eleven transects (Fig. 2.6) systematic surveys were carried out by our small team of three to four persons twice a year⁸, followed by intensive and in some cases even repeated surveys of the newly discovered flat settlements. The surveys are therefore not comprehensive, but still representative. Using exclusively non-invasive methods, we have been able to identify settlement areas and found that surface finds do not ‘move’ far, as no uniform ‘veil’ is spread over the habitation areas. The geophysical prospections confirmed this result, because where the finds are numerous, so are the anomalies.

The slopes around the basins were also investigated with the help of local amateur hunters in search for caves and rock-shelters: these surveys were extensive and took place in addition to and sometimes parallel to the intensive surveys (two of these campaigns involved a stone tool specialist and a mineralogist). Unfortunately, our hopes of finding traces of Mesolithic settlement were not fulfilled, but we found that there are no caves in the working area and that the rock shelters are too small for longer or repeated stays. Nevertheless, we have detected numerous traces of human activity

on the mountain slopes, whether in the form of single quartz artefacts (see Fig. 2.16) or cup-marked stones (cf. also Chapter 10.1 by Toufexis and Reingruber). Their dating is (still) undetermined and they are being investigated in the new Greek-German project “Landscape Archaeology in Thessaly (LAI_T)”, which is thankfully funded by the German Research Foundation (DFG, project number 532768457).

Most of the identified prehistoric settlements are, thanks to the efforts of the Ephorate of Antiquities of Larissa, generally well preserved despite their millennia-long exposure to the forces of nature and, more recently, to mechanical intervention. This allowed us to discover previously unknown flat settlements, which have played a decisive role in shaping the picture of settlement dynamics in the study area. From two such sites, Nessonis 1-South, the oldest site we investigated, dating to the Early Neolithic (EN), and Elateia 1, dated to the early Middle Neolithic (MN), we have obtained magnetograms (Chapter 9, contributions by Tsokas et al.). Together with the statistical analyses of the finds, they open up new perspectives on the internal settlement structures during these early periods.

On the one hand, we were very pleased that the finds at some sites were exceptionally rich, as this means that statistically relevant analyses are possible, but on the other hand, it gave us grounds for concern, as these sites are exposed to erosion. The ceramic material in particular is very abundant with around 15,000 sherds (almost 300 kg) (cf. Chapters 6 and 7, contributions by Reingruber and Hüntemann). In addition, there are 1004 chipped stone tools, of which obsidian makes up almost half of the raw material with 484 pieces (cf. Chapter 10.2, contribution by Nedelcheva), but other raw materials were also used (flint, radiolarite, quartz). Locally occurring rock types (gneiss, quartz, marble and serpentinite) are represented among the ground stone tools with almost 400 pieces (cf. Chapter 5, contribution by Melfos). Their evaluation has not yet been completed⁹, so that results from their analysis, as well as the study of clay artefacts

⁸ These took place in early spring and late autumn, i.e. after the harvest and when the vegetation is low and visibility is therefore best.

⁹ Toufexis and Reingruber 2021.

(including mainly figurines), can only be included to a limited extent in this synthesis. One type of artefact described for the first time is a spoon made from a *Spondylus gaederopus* valve – such finds also occur at other Aegean sites and would explain the widespread absence of bone spoons not only in Thessaly.¹⁰ Another category for which no frequent comparisons can be found either in the Aegean or in the Balkas or Anatolia is the oversized standing or lying stone with cupmarks (Chapter 10.1). As quartz is one of the most important raw materials in the region alongside marble and serpentinite, many tools have also been made from it. In Chapter 10.3 (Reingruber and Lehnhardt) we described a formal but not well-known implement used for pounding, pecking and grinding (German *Schlagen, Klopfen, Reiben*: SKR).

Generally surprising was the high number of faunal finds (see Chapter 11, contribution by Groot). Yet, due to their exposure to heat and water, only few contained enough collagen for dating (Chapter 8, contribution by Reingruber, Maniatis and Toufexis). Thanks to the detailed analysis of the finds, especially the ceramic sherds, we were able to propose a chronology for the period between 6400/6300 and 3300/3200 BC, which is now also supported by new ¹⁴C data. Two important findings derive from that: we now know the exact date of the oldest Neolithic settlement in the study area as of yet, dated to 6320 calBC at the transition from the Early Neolithic I to II (EN I/II). Additionally, we were able to prove that the end of the tell settlements after the Rachmani Period in the early Chalcolithic (CH I) was by no means followed by an abandonment of the area in the later phases (CH II and CH III), but rather that the stability of locations (*Ortskonstanz*) was replaced by a mobility of locations (*Ortsmobilität*).

The transition from one phase, or even period, to the next will remain a subject for further discussions. This for example concerns the continuation of pottery styles from the EN into the MN (especially the impressed decoration, cf. Chapter 6.4) – we therefore speak of the transitional phase EN III/MNI (Table 6.30), and were able to narrow it down to the time around 6100/5900 BC. As the three

stages of the MN have also not yet been sufficiently clarified, especially the third stage, the transition from the Middle to the Late Neolithic (MN III/LN I) is not well established. While we can rely on outdated but still comprehensible descriptions for the LN¹¹, the classification of the Chalcolithic, also called ‘Final Neolithic’ by other authors, needs to be reconsidered: the three stages proposed here are based on ceramic styles (cf. Chapters 6 and 7, contributions by Reingruber and Hüntemann). Only stages I and III could be defined somewhat more precisely; further material investigations are necessary, especially for stage II. As has been shown in these two chapters, it is possible not only to assign surface material to a specific stage, but these finds can also contribute to a better understanding of individual stages.

Therefore, even if the materials analysed for this study are ‘merely’ surface finds, their informative value should not be underestimated. For the first time, it was possible to evaluate this self-contained region in relative chronological terms, to identify continuities and discontinuities and to describe shifts and changes in settlement patterns. The potential of this refined chronology was displayed in the analysis using a Geographical Information System (GIS): the exact elevations of the individual settlements were linked to the chronological position of the material found there, so that a shift in the settlement areas could be traced across all prehistoric periods. We observed that in the shore area of Bara Toibasi Lake, which was modelled in QGIS (cf. Chapter 4, contribution by Mohrs), the younger settlements were founded on higher elevations, which we interpret as an adaptation to the rising lake level.

The comparison with absolutely dated climate curves showed that particularly in cold/dry phases the settlements were located at the lowest possible points in the basin, but in warm/humid periods they were settled on higher areas or even on hills.¹² It can therefore be no coincidence that there were numerous changes of locations during periods of great climatic fluctuations between 6300 and 5800 BC (in the EN and early MN) and then again

¹⁰ Reingruber 2023, 353–364.

¹¹ Mainly Hauptmann 1969 and 1981.

¹² Reingruber 2021.

between 4200 and 3300 BC (in CH II and III), but that tells were able to form in the period between 5800 and 4200 BC, a climatically very stable time. This allows us to better understand prehistoric settlement behaviour and to confirm that not only economic, cultural or social rationales, but also ecological and climatic fluctuations were triggers for change.¹³ To verify this model, targeted drillings in relevant areas are needed.

12.2. Sources and resources: the beginnings and the dynamics of Neolithic settlements in the Sykourio basin

The oldest settlements in our research area were founded in the southwest of the Sykourio basin. Nessonis 1-South dates to EN II, while Nessonis 1-East is probably a few decades older. The medians of the three dates obtained from faunal material from the excavations by Theocharis are consistent at 6320 calBC¹⁴, at the transition EN I/II (cf. Tab. 8.1). We interpret this date as a *Terminus a quo* (*TAQuo*: ‘limit from which’) for the beginning of the Neolithic in the Sykourio basin.¹⁵ Several factors contributed to this part of the basin being favoured for permanent settlements: these include the abundance of water (a lake), rock deposits (marble and serpentinite) as well as the proximity to the Thessalian Plain and the immediate vicinity to the (unfortunately destroyed) Gediki site¹⁶ from presumably EN I.

Just a few decades ago, not only the lake but also the entire area dried up. The abundance of water in both historical and prehistoric times is difficult to imagine nowadays, but evidence of this has been preserved not only on old maps but also in the terrain. Even after the middle of the 20th century, meltwater and rainwater accumulated at the lowest points in the Sykourio basin in spring (Fig. 12.1), and it was assumed that this was part of Lake Nessonis, as it was named in antiquity.¹⁷ However, this lake lies in the Thessalian Plain and was fed directly by the river Pinios. To the contrary, the lake inside the basin had no connection to the Pinios, as it was supplied with water by only one significant tributary, the Xerias river. As no name for this lake has survived, neither from antiquity nor from more recent periods: we have called it Bara Toibasi.¹⁸ It was possible to reconstruct it in a model created within QGIS on the basis of historical maps, information from well drillings, and calculations with GIS-tools (see Chapters 3 and 4).¹⁹ As in modern times, Bara Toibasi Lake will also have been subject to strong fluctuations in historical and prehistoric periods: the settlements in its catchment area can now provide us with information about its existence and history. Measured by the lowest values of the individual settlement sites (cf. Tab. 2.3), we determined the highest possible water level²⁰ of the presumed palaeolake.

To date, the actual stratigraphy has only been clarified by means of excavations at a single site in the Sykourio basin: in Nessonis 1-East, D. Theocharis was able to prove that the two superimposed settlement layers were separated by a sterile clay layer. This is attributed to a flooding event.²¹ There is thus evidence for the existence of the historical

¹³ With our datasets deriving from systematic and intensive survey, it is difficult to explore questions of economic order, as we lack well-founded bioarchaeological finds from excavation contexts. Yet, we will briefly touch on social and cultural questions, thanks to the well-preserved flat settlement of Elateia I.

¹⁴ We refer to the dates as ‘calBC’ when they were obtained directly from radiocarbon measurements; ‘BC’ is used for dates derived from relative chronology and comparisons.

¹⁵ We expected results around and shortly after 6500 BC, similar to the 14C dates from Sesklo and from the Argissa Magoula. Yet, these studies exclusively dated charcoal (the dates obtained on bones must be excluded from discussions – cf. Reingruber and Thissen 2017, Fig. 1: http://www.14sea.org/3_Il.c.html). Therefore, 6500 calBC can be regarded only as a *Terminus post quem* (TPQ): For the period before 6300 calBC there are no conclusive data series available from the Thessalian Plain that could be statistically modelled in order to obtain a reliable starting point for the beginning and for the duration of the EN I.

¹⁶ Theocharis 1962, 73–76.

¹⁷ Theocharis 1962; Wijnen 1981.

¹⁸ Reingruber et al. 2024.

¹⁹ Thanks to a digital elevation model (DEM) from Airbus D&S, on which our GIS was based, the analyses could be carried out with a vertical accuracy of 2 m (relative) / 4 m (absolute) in a 12 x 12 m grid.

²⁰ “Water level” is a term used to describe the vertical distance between the water surface and the water bed (Morgenschweis 2011, Chapter 2.3) – as the absolute depth of the prehistoric lake bed cannot be determined without drilling, in this context with “water level” we mean the presumed height of the lake water in relation to the measured absolute heights of the prehistoric sites.

²¹ Theocharis 1962, 77–78 with Fig. 2.



Fig. 12.1. View from the west of the area of the former Bara Toibasi Lake in March 2018, with clay extraction pits in the front and collected rainwater in the back. © Project Thessaly (photo A. Reingruber).

lake in prehistoric times as well. However, we know very little about the landscape and the actual habitat available to the prehistoric communities. Without information from systematic drillings, the interpretative reconstruction proposed here only has model character.

12.2.1. Settlement dynamics in the southern part of the Sykourio basin: The sites Nessonis 1 to 7 in the area of Bara Toibasi Lake

By integrating all the sites into a GIS and linking them with a detailed relative-chronological framework, we are able to propose a model of how the settlement activities may have shifted diachronically in an area measuring ca. 4 x 3 km, and thus how population dynamics may have unfolded in this area. Crucial is the determination of the time of the establishment and abandonment of the settlements involved.

The oldest pottery inventories we have identified are from the EN II, from the south-westernmost area of the Sykourio basin. The proximity to the Thessalian Plain may have played an important

role here (Figs. 12.2 and 1.2.2) because just beyond the range of hills formed by the mountains Erimon, Patoma/Mopsion and Chassambali lay one of the oldest sites in Thessaly: Gediki. Theocharis assigned its lowest layer to the so-called Preceramic Period, an interpretation subjected to considerable doubt. This site, together with the other settlements further upstream for which initially also a Preceramic Period had been suggested (Souphli and Argissa Magoula), could at the earliest be assigned to the EN I (around/after 6500–6300 BC).²² Theocharis found no evidence of a Preceramic Period in the basin itself, but attributed the finds from Nessonis I to the ‘Early Pottery’ (EN I). According to our analysis, these materials can be dated to the transitional phase, the EN I/II, around and after 6300 BC (cf. Chapters 1.3 and 8.2).

After a short initial settlement phase, there was an interruption in the sequence in the form of a sterile clay layer at both sites, Gediki²³ and Nessonis I²⁴,

²² Gallis 1992, 140; Reingruber 2008.

²³ Theocharis 1962, 73–76 and Fig. 1; Wijnen 1981, 62–63.

²⁴ Theocharis 1962, 77–81; Wijnen 1981, Fig. 21; Reingruber 2008, 296–298.

which could be attributed to flooding by the nearby lakes Nessonis (in the case of Gediki) and Bara Toibasi (in the case of Nessonis I) (cf. Fig. 12.3). However, the same locations were subsequently inhabited again, and at least one further EN settlement phase is stratigraphically documented at both locations. Thus, for both areas, inside and outside the basin, a flooding event by a neighbouring lake was stratigraphically documented, and the existence of both lakes at the beginning of the Neolithic confirmed. This forms the basis of the model developed for the Sykourio basin concerning the dependency of the lakeshore settlements on the fluctuating water levels of Bara Toibasi Lake. In addition, there are signs of flooding also in the Elateia basin in the period around/after 5800 calBC (cf. Chapter 6, Fig. 6.36 and Chapter 9.3.3.2).

The locations of oldest settlements on the southwestern (Nessonis 1 and 2) and southern (Nessonis 7) shorelines of Bara Toibasi Lake can be explained not only by the abundance of both running and standing water.²⁵ The repopulation of these sites at a later date (Nessonis 3 and Nessonis 7-South in the LN), despite the recurring very high water levels, may also have been motivated by another reason: the location directly at the foot of the Chassambali with important rock deposits of both marble and serpentinite was certainly advantageous. The fact that these deposits were used from the very beginning of Neolithic presence is proven by numerous such finds in Nessonis 1 and 2. Whether these raw materials or rather the final products were exchanged with other sites in the region must be clarified by future investigations.

12.2.2. *The lakeshores and the lakeside settlements: a diachronic view*

With the help of handheld GPS devices, we measured the absolute heights of each settlement, and verified them for accuracy with the high-resolution DEM from Airbus D&S. The ascertained values were then connected to the detailed chronological evaluation of the pottery finds in the GIS (Tables 2.3; 6.30 and 12.1), from which the ‘history’ of

Bara Toibasi Lake and its influence on the lakeside settlements can be inferred. The lowest elevation value from a settlement area theoretically corresponds to the maximum water level just below it. A shift in the settlement area or even the abandonment of a settlement can suggest how the lake might have changed over the course of time since its fluctuations presumably affected the settlements (Fig. 12.2–3).

A comparison of the true altitude in meters above sea level (masl, the z-values of the DEM) with the 2D-locations in space (x and y values of the DEM) and time (relative or absolute chronology) leads to the following results (Fig. 12.4 and Table 12.1, cf. also Table 2.3):

- At the transition EN I/II (around 6300 calBC), the site of Nessonis 1-East (which we only know from Theocharis’ excavations) was established at ca. 86.20 masl at the southwestern margin of the basin. As this was demonstrably a lakeside settlement, the water level of the lake must have been lower accordingly, at a maximum of 86 masl (comparable with the contours of the watercourse preserved on historical maps).

- Only after the so-called 8.2 ka event²⁶ the water level is likely to have risen gradually by up to 50 cm, because in EN II–III (6300/6200 to 6000 BC), Nessonis 1-South was founded some 200 m farther west of Nessonis 1-East at 86.90 masl, and Nessonis 7-North at 86.70 masl at the southeastern margin of the basin.

- In the early MN, the two settlements were abandoned and Nessonis 2 was established on a higher position, 200 m west of Nessonis 1-East²⁷ and ca. 100 m north of Nessonis 1-South, at 88 masl. But even the magoula, which remained inhabited for 300–400 years, was abandoned towards the end of the MN (before 5500 BC). We have not found any pottery styles from the late MN or from the MN/LN transition (e.g. the grey-on-grey pottery) during our investigations.

- The oldest finds from Nessonis 6 can be attributed to the late MN, although most of the finds belong to the LN I and LN II. This site is located much further north and at 96.90 masl is also situated much higher than all previous sites.

²⁵ Toufexis and Reingruber 2021, 7–24.

²⁶ Weninger et al. 2005, 75–117.

²⁷ Theocharis 1962, 77.

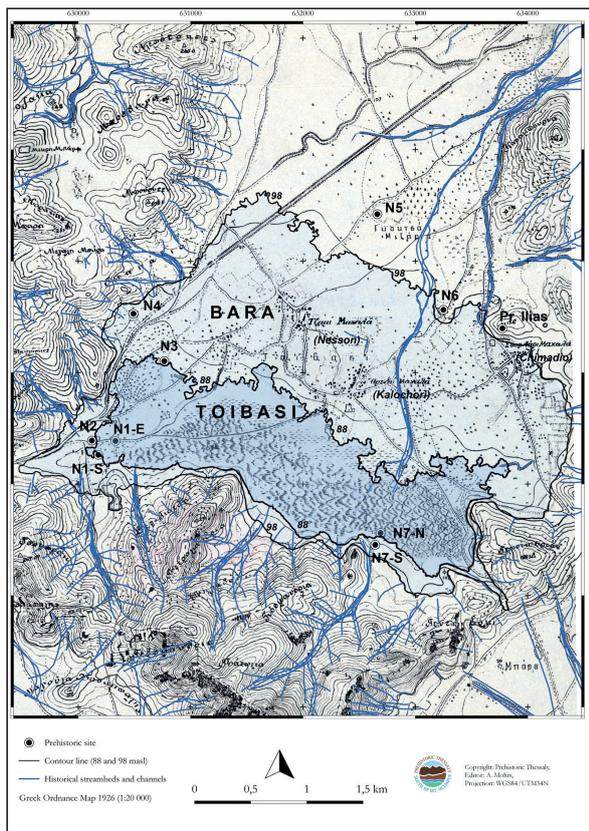


Fig. 12.2. Historical riverbeds in the southern part of the Sykourio basin, with the reconstructed Bara Toibasi Lake plotted onto the Greek Ordnance Map 1:20 000 from 1926, sheet 3 of 6, “Nechali”. Inserted are also the prehistoric sites N1–7 (Nessonis 1–7) and Pr. Ilias, the modern place names and the contour lines at 88 and 98 masl (copied from a DEM). Note that the cut in the SE, “Gedik Eski” only occurred after 1926 to a depth of less than 100 masl – before that the pass was at 120 masl.

- A short time later, with the foundation of Nessonis 7-South at the beginning of the LN (after ca. 5500 BC) and Nessonis 3²⁸ in later LN I (after ca. 5300 BC), the area was re-settled.
- It is possible that the settlement Nessonis 6 continued to exist in LN I, but in this period, another one was also founded northwest of it: Nessonis 5 lies at the northernmost and highest point in this area at ca. 100 masl. Nessonis 6 was abandoned

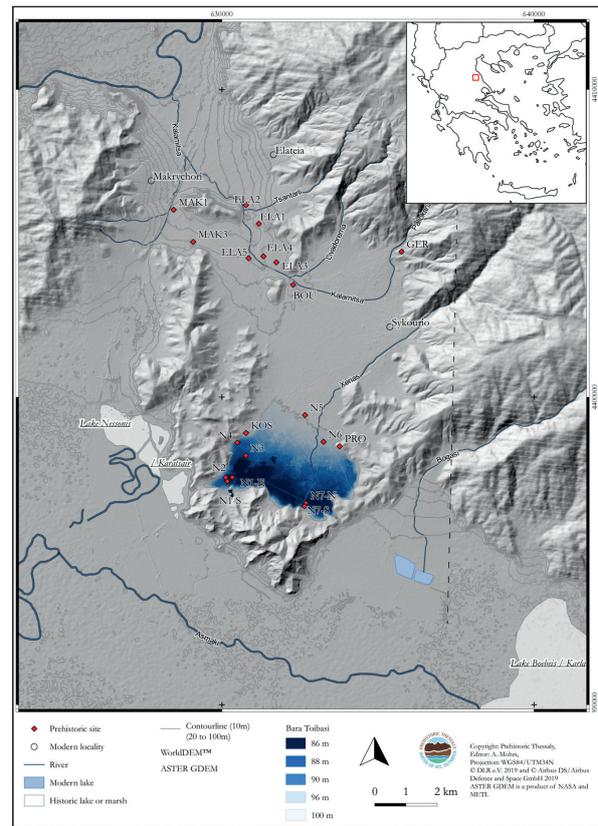


Fig. 12.3. Map of the study area as a result of combining different sources: All rivers and the two lakes in the plain (Nessonis and Karla) were re-drawn from historical maps whereas Bara Toibasi is reconstructed in QGIS at different depths indicated with different shades of blue. In prehistory, it may never, or only in catastrophic cases, have exceeded the height of 100 masl (light blue hue) as most of the sites would have been covered by water then. The oldest sites (N1, N2, N7-N) are the lowest and may have been abandoned because of rising water levels.

- at the transition LN/CH, as some sporadic finds could be dated to the Rachmani period (CH I). Nessonis 5, on the other hand, remained inhabited during CH I and possibly even during CH II.²⁹
- Two sites dating to after 4200 BC, Nessonis 4 and Nessonis 7-South, are both situated on a slope. The finds from these two flat settlements lie at an altitude of 91.30 m. While we encountered a

²⁸ This low magoula is closest to the clay extraction pits from which the lake sediments of the Bara Toibasi were taken for the production of bricks.

²⁹ Nessonis 6 is not shown as an elevation on the 1926 map, but the 100 m contour line runs around the area of the magoula. In Nessonis 5 there is also no indication of a magoula on the same map, although the symbol for an elevation point is shown here.

single-phased flat settlement in Nessonis 4, the situation in Nessonis 7-South is more complex. According to the pottery styles, at least two episodic settlement events could be determined there. Finds from the LN I and CH II were found in close proximity, but unrelated to each other.

- The three most recent sites are hilltop sites. Whether the hilltop site Profitis Ilias at 128.3 m indeed date to the CH I is not supported by the single ¹⁴C date (see Tab. 8.1). The lower one, Agios Kosmas, is in close vicinity to Nessonis 4 and less than 25 m higher (at 114.40 masl) – this constellation may be indicative of a continuation of settlement activity in this area from CH II to III (cf. also Table 6.30 and Fig. 12.4). The other site, Germazi, is the highest-lying hilltop-site at 259.7 masl. Due to its location in the far north of the Sykourio basin, it is more likely to be seen in connection with the CH III sites of the Elateia basin and with the Magoula Bounarbasi.

12.2.3. *Impact of lake level fluctuations on settlement behaviour*

Looking at the relocation of settlements over time in response to the rising or falling water levels of Bara Toibasi Lake, one can infer the influence and impact of environmental changes on prehistoric settlement behaviour.³⁰ During the first settling of the area around 6300 calBC at the maximum height of 86 masl (comparable to that of 1926), we can conclude that the water surface was at the lowest possible at the beginning of the Neolithic. A slow but continuous rise may have led to the horizontal shifts described above, first further away from the shore of the lake (from Nessonis 1-East to Nessonis 1-South) and later to an elevated point above 88 masl (Nessonis 2). The 63rd century BC was the coldest after the Ice Age and therefore also the driest, so Bara Toibasi Lake may not have held much water. Soon after the 8.2 ka event, the water level was still low since a higher location for Nessonis 2 was sought only later. In addition, the settlement Nessonis 7-North was abandoned in the early MN. The level of the lake must therefore have risen slowly but constantly since the beginning of the

Neolithic habitation in this area, as the settlements moved away from the shore and onto a terrain that was one meter higher.

Afterwards, we observe a stability of settlements in a limited space over several generations: Magoula Nessonis 2 grew to a height of almost 5 m in the 400 years of its use until it was abandoned before the end of the MN. In the late MN an important decision was made, as the advantageous settlement area at the foot of the Chassambali with its valuable resources (water and rocks) was abandoned. Whether a climatically induced event caused the abandonment of Nessonis 2 and the new foundation of Nessonis 6 around or shortly after 5800/5700 BC³¹ is speculative and only one among several possible explanations. Yet, a rapid rise of the water levels combined with flood events around 5800 BC may have been the decisive factor for the move 3.5 km further away from the southern bank to the northern, higher-lying area (Nessonis 6). An eventual move further north during LN I led to the establishment of the magoula with the longest habitation: Nessonis 5.

It seems as though the water level dropped again at the beginning of the LN I, since the old locations in the south were resettled: Nessonis 7-South was founded in the immediate vicinity of Nessonis 7-North, albeit three meters higher (at 90.20 masl). A further drop in the water levels at the end of the LN I may have favoured the foundation of Nessonis 3 around 5300/5200 BC not far from the former area of Nessonis 2 and at about the same height (87.50 masl). This spot remained inhabited over some 600 years until the end of the LN II around 4600 BC, and thus a small tell formed here. Nessonis 3, a low magoula, was presumably abandoned before the end of the LN II, but the two northern and highest-lying settlement mounds, Nessonis 5 and 6, provided evidence of continuity into the CH I, the Rachmani period. The northernmost tell,

³⁰ Cf. also Marks 1987.

³¹ In the Adriatic region, such fluctuations were detected around 5700 BC on the basis of pollen analyses from boreholes: “Two important shifts in vegetation occur at 7700 cal yr BP (calendar years before present) and between 7500 and 7000 cal yr BP and are correlated with increased river inputs around the Adriatic Basin respectively from the northern (7700 event) and from the central Adriatic borderlands (7500–7000 event).” Combourieu-Nebout et al. 2013, 2023–2042.

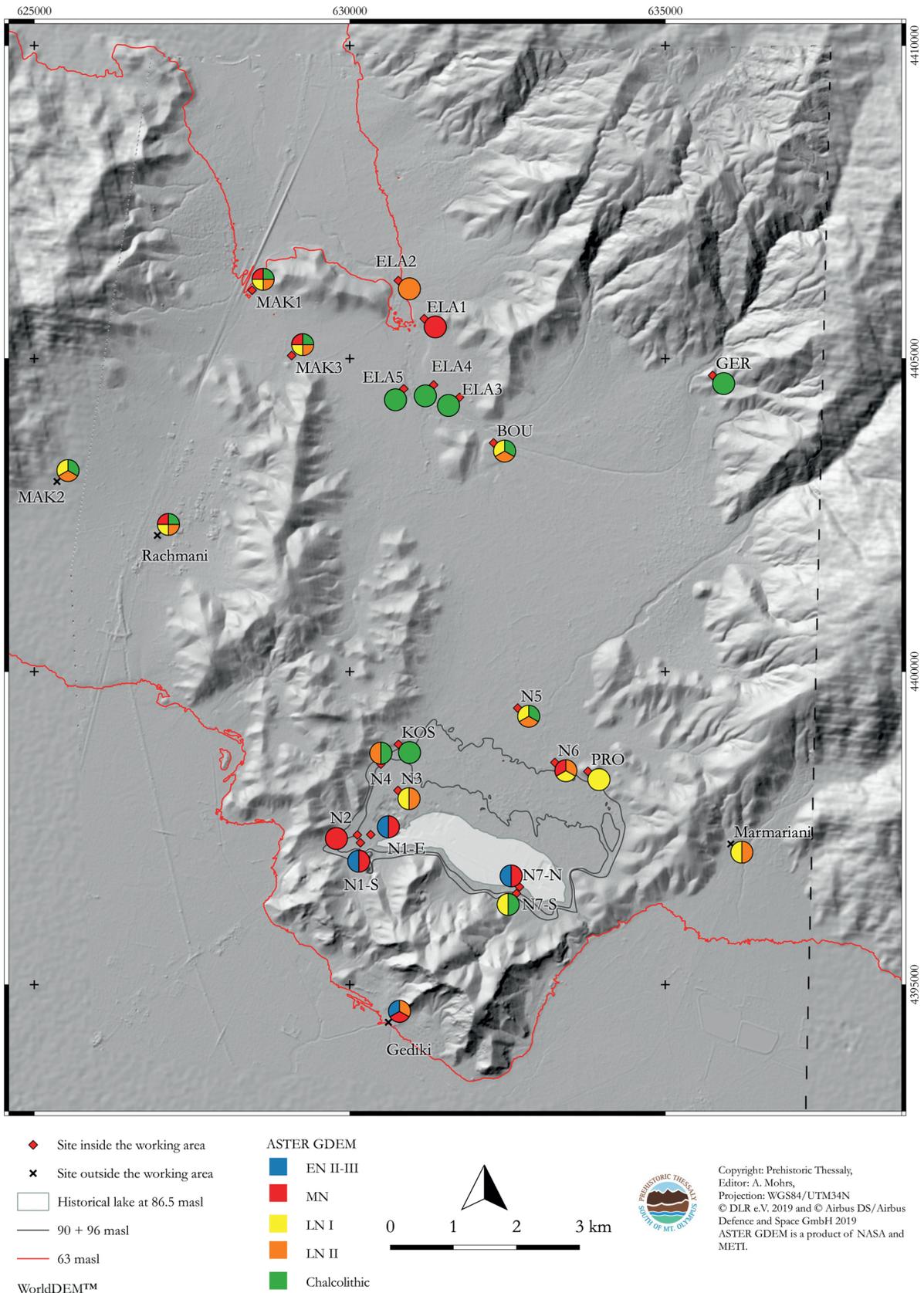


Fig. 12.4. The basins of Sykourio and Elateia with the investigated sites and their determined period of occupation (the location and chronology of the sites outside the basins were adapted from Gallis 1992).

Site	Height min (m)	Size (sqm)	Height of magoula / Inclination of flat site	Theocharis 1962	Gallis 1992 (ATAE-No)	Rel. chronology (Gallis 1992)	New appraisal (bold: ¹⁴ C dates).
Basin of Sykourio							
Nessonis 1-East	86.20	n.d.	- / n.d.	Mag. Nessonis I	286, Nesson 1	EN II-III; PS, PrS	EN I/II; 6400/6300 calBC EN/MN I (6000 BC);
Nessonis 7-North	86.70	2701	- / SW-NE: 1.1 m	-	24, Kalochori 3	-	EN II/III; 6200-6000 BC late LN I-LN II; 5200-4600 BC MN; post-6000 BC
Nessonis 1-South	86.90	14,400	- / S-N: 2,72 m	Mag. Nessonis III	25, Nesson 3	Tsangli, Larissa, Arapi, Ag. Sophia, cl. Dim.	LN I (5500-5000 BC); CH II (ca. 4000 BC)
Nessonis 3	87.50	11,700	2.91 m / -	Mag. Nessonis II	26, Nesson 2	EN, MN: PS, PrS, Sesklo	CH II; ca. 4000 BC
Nessonis 2	88.00	10,000	4.58 m / -	-	24, Kalochori 3	EN, LN, MBA	LN I (5500-5000 BC); CH II (ca. 4000 BC)
Nessonis 7-South	90.20; 91.30	2546	- / SW-NE: 3.1 m	Mag. Nessonis IV	287, Nesson 4	Rachmani	CH II; ca. 4000 BC
Nessonis 4	91.30	5547	- / NW-SE: 3.52 m	Mag. Nessonis VI	23, Kalochori 1	MN (Sesklo III)	MN III-LN II/CH I; ca. 5700-4400 BC
Nessonis 6	96.90	56,500	6.4 m / -	Mag. Nessonis V	288, Ossa 1	LN, BA	LN I-CH II; 5500-4000 BC
Nessonis 5	100.30	26,300	5.45 m / -	Mag. Bounarbasi	121, Pourmari 1	EN, MN, LN, BA, PG, Antiquity, Ottoman Per.	no new appraisal
Bounarbasi	103.20	11,9159	12 m / -	-	-	-	CH II/III
Agios Kosmas	114.40	n.d.	-	-	-	-	CH I
Profitis Ilias	128.30	n.d.	-	-	-	-	CH III
Germazi	259.70	n.d.	-	-	-	-	
Basin of Elateia							
Elateia 2	57.40	8900	- / W-O: 2 m	-	=	-	late LN I/ early LN II; 5100/5000 BC
Elateia 1	66.50	10,4925	- / C-N: 10 m; C-S: 9 m	-	119, Elateia	EN II-III, MN II, MBA, LBA	MN I; 6000-5800 calBC
Makrychori 3	77.00	22,500	2.3 m / -	-	134, Makrychori 3, Mag. Sigourotopi	EN II-III; LN (Arapi), BA	MN-CH I; 6000-4300 BC CH II/III; 3900/3700 BC
Elateia 4	79.30	4536	- / SE-NW: 2 m	-	=	-	CH II/III; 3900/3700 BC
Elateia 5	79.90	5602	- / SW-NE: 2 m	-	=	-	CH II/III; 3900/3700 BC
Elateia 3	85.30	16,335	- / SE-NW: 2 m	-	=	-	CH III; post-3700 BC

Tab. 12.1. Investigated sites arranged according to their heights within the respective basin; former designations and chronological assessments are also indicated (Abbreviations: PS=Protosesklo, PrS=Presesklo, PG=Protegeometric, BA=Bronze Age).

Nessonis 5, was not abandoned, even when it was possible to settle in the south again, and it was probably never directly threatened by flooding.

Throughout the late LN I until the end of the LN II and even long into the CH I, the climate and environmental conditions appear to have been stable with little or no fluctuations of the lake's water level. Settlements were continuously inhabited in the same spot, resulting in lower or higher settlement mounds (Nessonis 3, 5, 6). During the whole millennium between 5300/5200–4300/4200 BC, the establishment of new settlements or the temporary use of elevated locations was not observed. It was not until the Middle Chalcolithic (CH II, after 4300/4200 BC) that two new flat settlements, Nessonis 4 and Nessonis 7-South, were established. During this period (after 4200 BC), settling above 91 masl was necessary again, as Nessonis 3 with its highest point at 90.6 masl was abandoned and Nessonis 4 was newly founded at 91.30 masl and Nessonis 7-South was also resettled at 91.30 masl (Tab. 12.1).

It is striking that in the northern area of the Sykourio basin, in the sub-basin of Pournari, only two hilltop settlements from the LN and CH have been discovered so far: Bournabasi and Germazi. It is possible that prehistoric settlement sites on the fertile alluvial fans have been covered and/or destroyed by the modern development of present-day sites such as Sykourio, Pournari or Ossa, so that they could not be found in the survey. Or, if we take the settlement pattern from the Elateia basin as a basis, where settlements were mostly located at the confluence of two streams, then Bournabasi would indeed have been the only advantageous locations in the area.

12.2.4. Results: From settlement to population dynamics in the Sykourio basin

In this interpretation, the foundation and abandonment of settlements with a shift to a higher-lying/drier spot occurred within a range of 10 m, between 86/87 and 96/97 masl, in accordance with the rising or falling lake level. In general, it seems that the older settlements were located at lower points, at ca. 86 m, the younger ones at 90 masl and above (Tab. 12.1).

During the warm and humid Atlantic period (between ca. 7000 and 3700 BC), flood events

may well have occurred. In addition, a polje, i.e. a basin without its own drainage, is very vulnerable to flooding.³² This would also apply to the Bara Toibasi area, as its flowing and standing waters are not connected to the Aegean Sea. It is even calculable that the levels of the lake rose at least twice; this is also indicated by the new founded settlements at higher altitudes and on hills. During the first rise, settlements moved from the southern to the western shore, and then on to the northern shore. It is therefore quite possible that in wet and rainy periods, the water levels may even have reached up to Nessonis 6 at ca. 97 masl for a few decades, but probably never up to the level of Nessonis 5 at 100 masl. This settlement was therefore probably not located directly on the lakeshore. It is also the only settlement with an unbroken pottery sequence from the later MN to the middle CH (ca. 5600 to 4000 BC) – presumably also because it was protected from flooding.

Even though not all of the settlement mounds may have been flooded, the scope of action of the farming communities specialized in plant cultivation would have been severely limited at a water level of around 100 masl³³, as there were no dry fields available near the settlements. However, it cannot be assumed that the lake level rose steadily, as there may also have been longer dry phases – otherwise the foundation of Nessonis 3 at the transition from LN I to LN II at 87.50 masl could not be explained (there is also an example from this phase in the Elateia basin: Elateia 2 – see below).

The new establishments after 4200 BC (Nessonis 4 and 7) were located above 90 masl: at this time the lower parts of the basin were no longer occupied. This observation is also supported by the evaluation of the pottery material as some of the sherds were secondarily transformed due to the effects of water (Tab. 12.2): worn and even rolled surfaces are most frequent in the immediate vicinity of Bara

³² Angelakis et al. 2020.

³³ How deep the valley cuttings (Turkish: Gedik) to the west and east of the Chassambali were in prehistoric times can only be surmised: On a map from 1926, the two eastern Gediks, named on Fig. 12.2 “Gedik Ortan” (leading to Ortaköy, today's Kalochori), and “Gedik Eski” (the “Old Cutting”) are at 120 masl. Yet, nowadays they are up to 20 m lower due to serpentinite mining and road widening. The lake water would therefore not have drained through the cuttings into the Thessalian Plain at below 120 masl in earlier times.

Toibasi Lake, in Nessonis 1-South and 2, meaning that these areas were covered by water for a longer time period of time. The flat settlements on the edge of the basin, near slopes (Nessonis 4 and Nessonis 7), were less at risk. Although the magoules Nessonis 3, 5 and 6 were spared from flooding or were abandoned in time, more burnt sherds were found in these settlements than at the other sites, demonstrating the danger of destructive fire in densely populated spaces.

This indicates a rather constant settlement density in the southern basin of Sykourio, around Bara Toibasi Lake: as soon as one settlement was abandoned, a new one was founded elsewhere, so that probably two to three settlement locations were always used simultaneously.

However, in the late LN I there seems to have been an increase in population, as new settlements were founded (Nessonis 3 and 5) and two others continued to be inhabited or were re-inhabited (Nessonis 6 and 7). For the LN II, we were able to document three tells in the area, two of which continued to be inhabited also in CH I (Nessonis 5 and 6). We do not have any evidence for flat sites from this period but only from the subsequent CH II and III, after the tells were abandoned.

Apart from the prosperous period in LN II, population numbers appear to have remained relatively constant, although estimates of population density are highly uncertain due to the lack in data. Generally, the number of people with which an individual can maintain meaningful relationships is calculated at 150.³⁴ Taking this figure as guiding value for the size of a Neolithic settlement, there would never have been more than 450 people living in the Sykourio basin at one time. Yet, this figure must be regarded as a very rough estimation.

At the end of the prehistoric period, the Bounarbasi settlement was established in the north of the basin, at the edge of the Elateia basin, at 103.20 masl, one of the highest located tells we have recorded.³⁵ Bounarbasi was mainly inhabited in the Mycenaean period – one of the few Late Bronze Age settlement known in the study area (e.g., Makrychori 1, the two

Site	Sherds (n)	Worn (n)	Worn (%)	Age
Basin	of	Sykourio		
<i>NES1-E</i>	-	-	-	<i>EN</i>
<i>NES7-N</i>	3	-	-	<i>EN/MN</i>
NES1-S	621	154	25	EN/MN–MN I
NES2	124	21	17	MN
NES4	150	9	6	CH I
NES7-S	261	12	4,6	LN I; CH I
NES6	100	4	4	MN–LN–CH I
NES5	163	4	2	LN–CH I
NES3	61	0	0	LN I–II
Sum	1483	204	14%	
Basin	of	Elateia		
<i>ELA5</i>	33	17	51	<i>CH II/III</i>
<i>ELA2</i>	31	12	39	<i>LN I</i>
ELA1	11396	3706	33	MN I
<i>ELA4</i>	40	9	23	<i>CH II/III</i>
ELA3	211	28	13	CH III
Sum	11711	3772	32%	
Basin	of	Makrychori		
MAK3	1740	66	4	EN/MN I–CH I

Tab. 12.2. Compilation of the analysed settlements and the identified worn sherd material, listed according to basins and degree of secondary change/wearing (in italics: inventories too small for reliable statements; bold: over 10% rolled; Abbreviations: ELA=Elateia; NES=Nessonis; MAK=Makrychori).

Mycenaean tholos tombs near Spilia in the hills, and the sites investigated by Maria Theochari in the Chassambali area³⁶). Floods must have posed a real threat throughout the 2nd mill. BC. The Mycenaeans countered this with great achievements in engineering, both in terms of dam construction and river redirection.³⁷ Its strategically advantageous location with a wide view of both the Elateia and Sykourio basins favoured its dominant position over several centuries. It deserves a separate study, but this is beyond the scope of our current possibilities.

³⁴ Sterelny and Watkins 2014, 681; Watkins 2020, 20, Fig. 1.

³⁵ This settlement mound, visible from afar, was topographically surveyed in 1966, but the envisaged excavation was never carried out (Kilian 1976).

³⁶ Gallis 1992, 179 with further bibliography; Theocharis 1962, 35–50.

³⁷ Angelakis et al. 2020. https://homersheimat.de/res/pdf/Exkursionsberichte-Griechenland-2019_II.pdf

12.3. Settlement dynamics in the Elateia and Makrychori basins: Elateia 1–5, Makrychori 1 and 3

12.3.1. *The landscape, the environment and the archaeological finds*

The Elateia basin is not hydrologically connected to the Sykourio basin (see Chapter 3). Its drainage transpires through the Pinios river, into which the Kalamitsa, the main river of the basin, flows. The basin of Elateia is thus linked to the Thessalian Plain and subject to its hydrological conditions. Coming from the plain, the Pinios crosses the basin at ca. 20 masl. At this lowest point, the next largest body of water, the Kalamitsa stream (now dried up), flows into it. This central area of the Elateia basin is characterized by a depression both south and north of the Pinios up to ca. 40 masl. After that, the terrain rises more steeply. Some of the streambeds, especially those that flow into the Kalamitsa from the east and drain the water from the 1978 m high Ossa massif into the basin, end in this deep depression.³⁸ Their courses are therefore very clearly marked on historical maps (Fig. 12.5). Other smaller ones, mainly in the west, end at higher altitudes, at around 60 masl: they have therefore not dug as deep into the slopes as the eastern ones. While the eastern watercourses could swell into torrential waters, especially during snowmelt, in rainy years, and during heavy rainfall,³⁹ this danger did not exist in the west.

In contrast to the Sykourio basin, flowing waters may have posed more of a potential threat in the Elateia basin than standing bodies of water. However, the western settlement area, the sub-basin of Makrychori, seems to have been less vulnerable to flooding due to its smaller bodies of water. It may therefore be no coincidence that the two long-lived tells Makrychori 1 and 3 were built here, while in

the east there are only shallow settlements from isolated periods (cf. Tab. 6.30).

Despite an intensive search, no agglomerations that could be described as a prehistoric settlement were found in the eastern part, west of the present-day village of Elateia. However, a number of heavily worn sherds, as if rolled by water, were found in survey fields F300 to F320. The amount of material is limited in most cases (less than 1 kg of sherds), and only slightly more numerous in F307, F313 and F314 (over 2 kg of sherds). In addition, the sherds are very heavily rolled and therefore of little significance. However, two aspects stand out:

- with only one exception, the vessel fragments above the 63 m line are 100% rolled (Fig. 2.11). They are handmade and despite the limited inventory, various handles were included. They could be prehistoric, most likely dating to the Chalcolithic (fields F305-F307 and F311-F318).
- the finds from the fields below the 63 m line are often wheel-thrown and have a green or light glaze (F301-303, 309-310) and therefore date to historical times.

There is one exception to both these rules: F310 contained 94% rolled material and the sherds from F304 were not from a historical period.⁴⁰ Nevertheless, we assume that the prehistoric inventories represent the remains of short-term stays above the 63 m line; lower levels were probably only visited in historic times.

All long-term prehistoric sites known to us were found to the east and west of Mt Sklyrotopos (known also as Mt Douramani) or farther south. They are located either at the confluence of several streams (Elateia 1, 2, 5 and Makrychori 1) or at some distance (Makrychori 3, Elateia 3 and 4). The northern area was probably not attractive for prehistoric settlers, and we assume that an extended wetland covered this part of the basin.

The oldest known prehistoric settlements in the Elateia and Makrychori basins, Elateia 1, Makrychori 1 and 3, were founded at altitudes between 66 and 77 masl. In the area of the flat settlement of Elateia 1, settlement activity shifted towards higher grounds over the course of the

³⁸ These formerly water-rich streams still carried water in their lower courses until a few decades ago. Today, the little water from the upper reaches is diverted to irrigate the almond groves, on which the private economy has been based since the 1980s.

³⁹ Such events were familiar during the last century, which is why the bed of the Xerias stream, for example, had to be widened and the banks additionally reinforced with stone packs every 20–30 years.

⁴⁰ A flint fragment was found there that could be from prehistoric time as well.

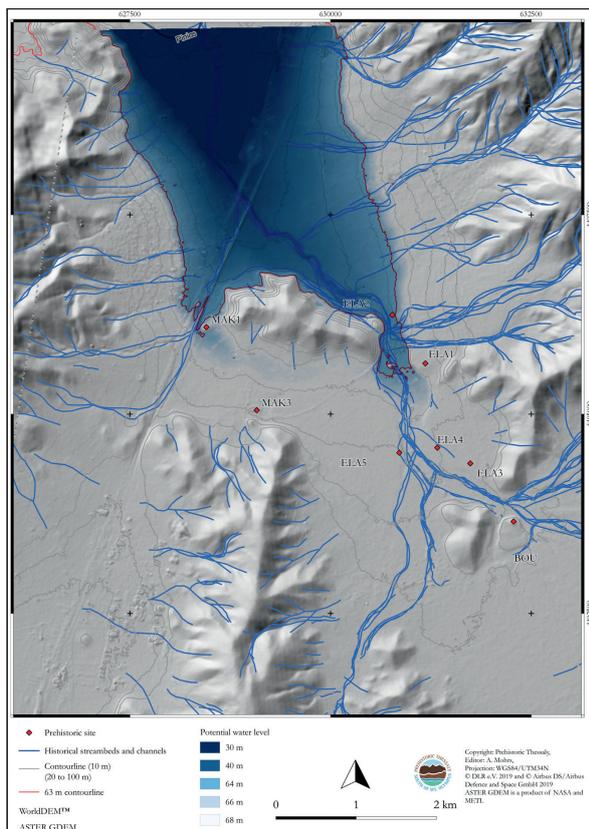


Fig. 12.5. Map of the flowing waters and depressions in the Elateia and Makrychori basins based on information from historical maps (streams and river courses) and a modern DEM and, in relation to this, the location of prehistoric settlements. Note the red contour line at 63 masl (cf. Fig. 12.6) that may surround a wet or marshy surface.

ca. 200 years of settlement, from ca. 66/72 to 76/79 masl (cf. Fig. 6.43). We attribute this to flooding by the Tsantarli stream, against the ingress of which a ditch was dug around the northern and eastern parts of the settlement (cf. Chapter 9.3). Nevertheless, Elateia 1 had to be abandoned after 5800 calBC.

Makrychori 1 was also demonstrably surrounded by ditches, the oldest of which dates from the EN/MN. This settlement seems to have been less endangered by water, as the continued habitation has formed a magoula in subsequent periods, meaning that the site was not abandoned. This may also be due to the fact that the much smaller and shorter streams from Mt Erimon, which is only 500 m high, poured into the basin with less force than those from the almost 2000 m high Ossa massif. Also at the EN/MN transition, Makrychori 3 was

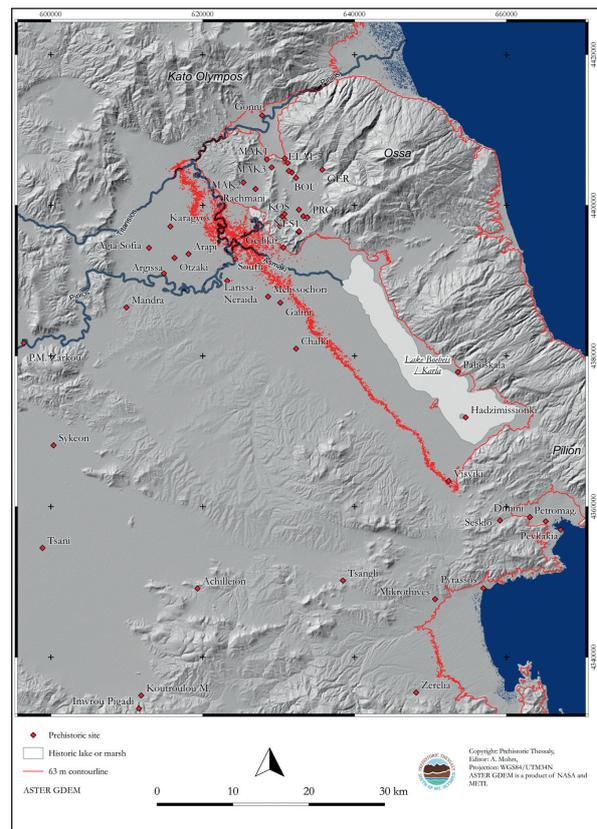


Fig. 12.6. The 'Grundmann line' (contour line at 63 masl), around potential prehistoric standing bodies of water in eastern Thessaly.

founded at a much higher altitude, at 77 masl, and mainly used in the LN (see Chapter 7).

A very limited inventory from Elateia 2 has survived from the LN, a linear scattering, possibly in a secondary position at a record depth of 57.4 masl. Similar to the situation in the Sykourio basin with the foundation of Nessonis 3 at a low point, there appears to have been a brief decline in water levels in the Elateia basin as well. Elateia 4–5 from the CH II (after 4200 BC) and Elateia 3 from CH III (after 3700 BC) lie even higher, at just under 80 m and at 85.30 masl, respectively.

As in the Sykourio basin, the Elateia basin shows a tendency for the oldest settlements to have been founded at lower altitudes and to have moved to higher areas over the centuries: At the transition from EN to MN, the flat settlement of Elateia 1 was established around 6000 calBC, and at the same time or shortly afterwards Makrychori 1 and 3 were founded. In the MN and LN, settlement locations were consistent, so that metres high tells developed (Makrychori 1 and 3). Afterwards, during

the Chalcolithic (Elateia 3–4), the settlements were again relatively short-lived and in the highest locations, as in the area of Bara Toibasi. In this area, only two or at most three settlements existed at the same time, too. Accordingly, a somewhat smaller population must be expected here (around or less than 300–400 inhabitants).

With the exception of Elateia 2, no settlement lies lower than 63 masl. This contour line taken from a modern DEM would largely correspond to the important line that was identified by Kimon Grundmann as a potential lakeshore line for Lake Karla in the Thessalian Plain at 60 masl (Fig. 12.6). He did not find any Middle or Late Neolithic sites at lower altitudes when mapping the settlements known to him on a 1:75,000 Greek Ordnance Survey map.⁴¹ His emphasis is specifically on the Middle Neolithic, since the “*Träger der Thessalischen A-Kultur*”, the “*representatives of the Thessalian A-culture*” who founded the sites⁴² can be equated with the Sesklo culture of the MN. He concluded from this that the water level of Lake Karla was much higher in the Neolithic than it was in the early 20th century (60 m compared to 44 masl⁴³).

The extent of the lake has been discussed by various scholars,⁴⁴ as both Neolithic and Bronze Age settlements, not known in Grundmann’s time, were found in the area of the lake.⁴⁵ They support the view of a more restricted lake area, at least during specific periods in prehistoric and historic times. In line, though, with Grundmann’s observations, a maximum extension of a water body or a swamp at the 63 m contour line could also be assumed in

the basins of Elateia and Makrychori. In wet periods, with a significant rise in the groundwater level or floods up to 70 masl, the depression south of the mountain would also have been uninhabitable (cf. Chapter 4, Mohrs’ contribution). In fact, in the fields F361 to F375 between Makrychori 1 and 3, only 1–5 sherds were collected, if at all; only F368 at 68.5–69.5 masl was somewhat richer with 11 sherds – these sherds are all very heavily rolled (cf. Fig. 2.12, TRA8). It is possible that the depression between the three sites Elateia 1, Makrychori 1 and 3 was at least temporarily covered with water or a swamp.

There is a large amount of heavily worn sherds (Tab. 12.2), at some sites up to 50% of the inventory is impacted. Unfortunately, the sites with the highest values are those with very limited inventories (Elateia 2, 5), so these figures cannot be of great significance. However, it can be stated that there is an important difference between the two basins: whereas in the basin of Sykourio, only the older settlements (Nessonis 1-South and Nessonis 2) contained many worn sherds, in the Elateia basin not a single site shows less than 10% of worn sherds (in sum 32% as opposed to 14%). In addition, sintering was also noted at least in the material from Elateia 1 and Makrychori 3 (see Chapters 6.3.1 and 7). It is therefore probable that after the abandonment of these two settlements, some areas were heavily affected by environmental changes (the keyword here is post-deposition process), which could be due to their proximity to a body of water with regular overflow. Sites could have been covered by standing water or at least a swamp.

Whether a lake also formed in the Elateia basin, in the catchment area of the Pinios river, must be clarified by drillings. Assuming from the situation in the plain, the water level could have theoretically reached a maximum level of 63 m (corresponding to the ‘Grundmann-line’, set by him at 60 m), at least in extreme cases and particularly water-abundant years. Measured by the sherd material, the Elateia basin was the most vulnerable to high water levels/flooding and therefore probably not suitable for permanent settlements: all inventories show more than 10% worn and rolled material. The degree of rolling tends to decrease with increasing altitude (except in Elateia 5). This is also obvious in the Sykourio basin – with the exception of Nessonis 3. In the Elateia basin above 79 masl

⁴¹ Grundmann 1937, 59–60 and Map 37. At 60 masl he recognised a «strongly blurred ground wave» („eine stark verwischte Bodenwelle“), the western course of which corresponded with the isohypse of those Neolithic mounds located at its edge. In the centre of the suggested outline of the lake, some isolated sites in elevated, island-like locations appeared. His assumption was confirmed shortly afterwards during the topographical survey of the Visviki Magoula in 1941. The first dwellings may have been founded at the EN/MN transition near the lakeshore at ca. 67 masl: the maximum water level of Lake Karla was assumed to be at 65.79 m (Alram-Stern and Dousougli-Zachos 2015, Plates 2–5 and 11).

⁴² Grundmann 1937, 58.

⁴³ Grundmann 1937, 59.

⁴⁴ Gallis 1992, 24–25; Toufexis 2016, 361–362 (with further bibliography).

⁴⁵ E.g., Stephanovikeio 2 (former Magoula Karamourlar) and Amygdali 1 (Gallis 1992, 97, 180), or Palioskala – the latter founded on the eastern shore of the lake at 46/47 masl. (Toufexis 2016, 361).

and in the Sykourio basin above 91.30 masl the fewest sherds were rolled by the water.

As noted in Chapter 2.4, despite these good results, there are still large gaps in the knowledge regarding settlement and/or population dynamics in the basins we investigated. In the future, the question of Early and Middle Bronze Age settlements should also be investigated more closely – these periods are only sparsely represented, as the chronologically closest finds date from the Mycenaean period, and then from antiquity.

12.3.2. Ditches and structures in Elateia 1: Model of a settlement

Zooming in from the landscape to the level of the individual settlements, we succeeded to survey two flat settlements intensively and to also examine them geophysically. The magnetogram from Nessonis 1-South is difficult to interpret due to the challenging substrate with its numerous serpentinite boulders, which leave anomalies in the magnetogram (Fig. 9.1.5). On the other hand, Elateia 1 (pleasantly) surprised us because of the good concordance between the archaeological and geophysical prospections. At ten hectares, this settlement is not only the most extensive, but also the most complex flat site of the MN I known to us. Its internal organisation is visible in the magnetogram (Fig. 9.3.4), in the form of linear, angular and circular anomalies.

If one agrees with our interpretation (cf. Chapter 9.3), then the sites' area is surrounded by a ditch to the north and east (L1 on Fig. 9.3.3) and also internally structured by further ditches: a narrower ditch (L2) running approximately parallel NW–SE and a straight ditch section in W–E direction, which appears to connect the two previous ones. This transverse structure (L3) divides the eastern area into a northern and a southern part. While most of the anomalies, which we interpret as remnants of former surface structures, were located in the west of the settlement and also in the south-east, the northern and central-eastern areas contain comparatively few thermoremanent structures.

This picture can be supplemented using so-called heat maps, created from the three-dimensionally measured finds. In this analysis, the decorated pottery is considered significant in the context of the social organisation of the settlement: its

appearance is seen in connection with areas of social contact and where social interaction was practised – whether at settlement level or in local/regional exchange. These could have been residential buildings or, more generally, well-defined spaces. It is probably no coincidence that all the observed 'hotspots' are located in the west, protected by the inner ditch (L2), and in the south, the densest settlement area (Fig. 9.3.6).

Even if we are not yet able to assess what these 'protected areas' may have looked like in Elateia 1, the pottery concentrations together with the geomagnetic signals are an important indication for potential locations of buildings with a distinct social or economic function. The standard MN house at Sesklo, for example, was approximately 4 x 6 m in size and contained a hearth. Some potential candidates for residential buildings can be identified in the magnetogram of Elateia, which are also emphasised by the hotspots calculated statistically in the GIS (cf. Fig. 9.3.4 and 9.3.6–9).

However, they are so far apart that it is not possible to speak of a specific settlement centre. As not all of the dwellings are likely to be visible in the magnetogram, it is not clear whether they appeared alone or in small groups. A very conspicuous structure in the central area, measuring ca. 19 x 14 m, was probably not a residential building, but rather an open space with pottery kilns, unroofed but surrounded by firewalls.⁴⁶

The division of the survey area into fields (the basic walking units) was defined before the geophysical investigations started. The subsequent analysis of the finds from these units has led to the delimitation of eight areas: four western (NW, CNW, CSW and SW) and four eastern ones (NE, CNE, CSE and SE). Their boundaries correspond well with the geomagnetic signals and this mutual confirmation between two such different survey methods encourages us to interpret Elateia 1 as a settlement with scattered buildings. It contained both residential buildings and economically important structures (kiln areas) as well as open spaces between them and/or at the fringes of the settlement (Fig. 9.3.10). The latter can be subdivided by the linear structures, with L3 in particular separating

⁴⁶ Comparable with the kilns from Imvrou Pigadi (Kyparissi-Apostolika 2012, Fig. 8–11).

an area almost devoid of finds (NE) from an area richer in finds (area CNE), and L2 separating a residential area from an open area.

We assume that the entire settlement area enclosed by the outer ditch was in use at the same time, at least for a certain period. Based on the pottery analysis, a shift (a horizontal stratigraphy) can be demonstrated, according to which some areas came into use earlier and others later (cf. Chapter 6.3.1.7.4).⁴⁷ The basic structure of the settlement is therefore that of a hamlet-like scattered settlement.

12.3.3. *The domestication of water*

Special attention should be paid to the ditches, which were built collectively and benefited the community. In the last years, especially with the new results obtained from geophysical investigations, ditches seem to be an integral part of almost all Neolithic settlements in Thessaly and elsewhere.⁴⁸ As they not only delimited the boundaries of the settlements but also segregated parts of their inner space, it is generally recognized that ditches served various purposes. Therefore, apart from acquiring importance at a symbolic, ideological and social level, they are not to be interpreted merely as defensive enclosures.⁴⁹ Lately, among their various practical uses, the drainage of settlement areas and the protection from flooding has been emphasized. This is the case for a number of sites located in the south-eastern part of the Thessalian Plain around Lake Karla.⁵⁰

Water management was certainly of great importance, and we would like to add to this also the irrigation of gardens.⁵¹ The outer ditch in Elateia 1 does not surround the areas identified as residential, but rather the relatively empty spaces in the northeast, south of a streambed. Assuming that the gardens and fields were located there, the ditches may not have been used solely for drainage but also for irrigation. No ditches were needed on the

more elevated areas or on the other, southern side, probably because there were no open spaces there that could have served as gardens and needed to be irrigated.

In both cases, drainage and/or irrigation, ditch systems might have been the solution to the problem, as the required amounts of water could be kept available in a controlled manner or, to the contrary, excess water could be drained away, as the ditch follows the slope of the terrain from the highest point at 79 masl to the lowest part of the settlement, where it ends near the steep scarp at c. 68 m. As the “domestication of water” (or at least its control in the course of sedentism) was considered very early on by archaeologists,⁵² apart from the ditches, also wells should be considered as a stabilizing factor.⁵³ Drilling of wells is a practice known in Thessaly at least from the LN onwards.⁵⁴

12.4. Tells and flat settlements: Neolithic and Chalcolithic settlement patterns

12.4.1. *Thessalian tells*

Thessaly is best known for its tell settlements (magoules) – and these have been explored for over 100 years (with interruptions). They were the only type of settlement acknowledged by archaeologists of the 20th c., which is why the few known flat settlements were considered to be destroyed tells (cf. Chapter 1.3.1 and Table 12.1).⁵⁵ Yet, there seems to have been almost no destruction of particularly the higher tells, above 4–5 m height, as they are rarely built over or used for intensive agriculture. Due to their investigation, we possess a wealth of information and publications on MN and LN materials that help us to classify surface finds within these clearly defined and stratigraphically contextualised inventories.

Within our study area, it is evident that from the beginning of the MN to the end of CH I (i.e. be-

⁴⁷ Reingruber et al. 2021.

⁴⁸ Toufexis 2017.

⁴⁹ Toufexis 2017, 323–327 (with further bibliography).

⁵⁰ Sarris et al. 2015.

⁵¹ For a discussion on the use and interpretation of ditches see Toufexis 2017 (with further bibliography).

⁵² Mithen 2010.

⁵³ Peltenburg 2003, 31.

⁵⁴ Toufexis 2017, 210–214, 291–295.

⁵⁵ Gallis 1992, 120 described also Elateia 1 as a circular magoula with a diameter of 150 m and a height of 1 m. Unlike us, he dated the Neolithic material to the EN (Protosesklo and Presesklo) and to the MN II.

tween 6000 and 4200 BC), there were comparatively stable and spatially constant settlement patterns that were favourable to the development of tells. Although there are indications for settlement interruptions, these elevated and widely visible structures were inhabited again and again – at least until the end of CH I.

Unlike the tall and compact tells from Anatolia, the Thessalian tells are flatter and broader. According to our knowledge, tells were barely formed before the MN and this would speak in favour of a somewhat more dispersed settlement pattern despite the stability of locations: and indeed, to date no agglutinative structures have been found in Greece.⁵⁶ This means that the concept of the tell and that of the ‘village’, which was allegedly imported by migrants from Anatolia or the eastern Mediterranean region into Thessaly before 6000 BC, must be reconsidered.

So far, only tells have been geophysically prospected in Thessaly,⁵⁷ i.e. only the upper 1–2 metres have been recorded. Therefore, magnetograms are images of only the most recent occupation phase and cannot be generally assigned to a specific phase without adding a detailed chronological analysis of the pottery. In order to provide solid and verifiable chronological frameworks for the two magnetograms obtained by G. Tsokas and his team, we have statistically evaluated the find material and created heat maps with the help of QGIS (see above).

12.4.2. Flat sites in the working area

Flat sites are not only endangered by human intervention (e.g., civil engineering and agriculture with heavy machinery), but have also been subject to the forces of nature over the millennia. Erosion or accumulations in the form of colluvium and alluvium have removed them from our view. The deterioration in visibility goes hand in hand with their inadequate exploration: flat settlements are not easy to recognise in the terrain. Without systematic investigations, they can be identified only by chance or luck, and therefore, they played no role in the re-

search of the Neolithic in Thessaly until now. During our intensive and systematic surveys, we were able to identify ten flat settlements dating either to the beginning of the Neolithic or to the end of the Chalcolithic (cf. Fig. 2.3). Three other sites inhabited only for a short phase were located on hilltops.

12.4.2.1. Flat sites from the earlier stages of the Neolithic

In the Sykourio basin, we were able to identify three EN flat settlements: Nessonis 1-East and 1-South, and Nessonis 7-North. The oldest settlement in the Elateia basin is also a flat settlement (Elateia 1 from the MN I). Their sizes are considerable with areas of up to 10 ha in Elateia 1. We have only been able to gain glimpses of the Nessonis 1 flat settlement, as the area of Nessonis 1-East together with the area up to Nessonis 1-South is heavily impaired and can no longer be visualised in context (cf. Fig. 6.3). The whole habitation area may have covered 5 to 6 ha, of which only Nessonis 1-South with 1.4 ha is preserved.

Two flat sites (Elateia 1 and Nessonis 1-South) were prospected not only archaeologically but also geomagnetically. At these sites, it is also apparent that individual households shifted their position, so that not all of the structures recognisable in the magnetogram interpreted as houses must have existed at the same time. Neighbouring households may have formed loosely scattered primeval hamlets (German: *Urweiler*) in the EN as well as in the early MN (i.e. between 6400/6300 and 5800 BC). In general, we were therefore not able to identify any organized village-like settlement patterns in our study area before 5800 BC.

The identification of more flat settlements from this early period is crucial for a better understanding of the Neolithisation process in the circum-Aegean and even south-eastern Europe in general.

12.4.2.2. Flat sites from the later stages of the Chalcolithic

Contrary to the earlier stages of the Neolithic, the later stages of the Chalcolithic are not well researched yet. It proved a challenge to classify the materials from the flat settlements of the CH II–III. Due to a lack of published comparative finds, these pottery styles could only be provisionally assigned

⁵⁶ Toufexis 2017, 340–343.

⁵⁷ Sarris et al. 2015; 2017.

to a specific period within this epoch. Nevertheless, we possess of a large amount of find material from the survey itself and were able to identify specific combinations of traits belonging to the 4th mill. BC (cf. Chapter 6.3).

The situation in Nessonis 7 presents a challenge. This site is an example of a settlement with single phases but episodic re-usage: three flat settlements could be recognised there, which are only slightly apart spatially but very distant from each other temporally. The older one originates from the EN/MN (Nessonis 7-North) and lies at the same altitude as Nessonis 1; however, the younger ones originated in the LN I (Nessonis 7-South), and then again in the CH II at ca. 91 masl. Their inhabited areas are comparatively small; a longer settlement period is unlikely as no tell formed.

In the later CH, new settlements were founded and inhabited only briefly (cf. Tab. 6.30): five in the basin of Sykourio (Nessonis 4 and 7-South from the CH II, as well as the three hilltop settlements of Pr. Ilias, Germazi and Agios Kosmas) and three in the basin of Elateia (Elateia 3–5).⁵⁸ It is therefore by no means warranted to assume a thousand-year gap in settlement in the Chalcolithic: although the tells were abandoned around 4300/4200 BC, the region was not. However, as flat settlements are more difficult to find than tells, this false impression of an abandoned region emerged, which we would now like to rectify: Site stability was abandoned in favour of an episodic and mobile settlement pattern that left no thick deposits.

Therefore, instead of a gap in the settlement, after ca. 4200 BC we are faced with a gap in research. In this respect, the underlying problem is that of visibility. The question of visibility is also an important issue in regions where tells did not form, such as in Central and Eastern Europe.⁵⁹ In those parts of Europe where no sufficient systematic and intensive surveys have been carried out, one should be cautious of acknowledging the abandonment of entire areas of land.⁶⁰

12.4.2.3. What flat sites can tell⁶¹

From the period before 6000 BC and, again, after 4200 BC, the number of well-excavated and dated sites is low. Consequently, the information for the EN (6500 to 6000 BC) and the later CH (after 4200 BC) is comparatively limited. Especially after tells were abandoned around 4200 BC (Nessonis 5 and 6), it appears that the whole region was deserted. But ‘abandonment’ and ‘desertion’ should not be used interchangeably. In the Sykourio basin, the abandonment of the tell, a form of settlement that had become obsolete for various reasons⁶², was accompanied by a shift towards a new (or rather: old) pattern – the flat settlement. The habitation of the region thus did not end, but settlement behaviour changed, shifting towards an episodic (no longer continuous) use of a site. Additionally, there may even have been some kind of interaction between sites in the basin with those on the hills (Pr. Ilias, Agios Kosmas and Germazi).

Flat sites have taught us that people founded settlements at different altitudes in different periods and that these shifted according to the environmental conditions. However, in the case of flat settlements, some differences can be identified, which may also be chronologically relevant: horizontal shifts within the habitation area can be demonstrated at the early sites of Nessonis 1 and Elateia 1. The commitment to a specific location is recognizable here: in Nessonis, the habitation area moved from Nessonis 1-East to Nessonis 1-South, before Nessonis 2 was built on a neighbouring, slightly elevated site, all within an area of 5 to 6 ha, before the territory was abandoned. In Elateia 1, the settlement area was as large as 10 ha⁶³. Here, the parts of the terrain positioned at lower altitudes were also used before more elevated locations were inhabited, before an eventual abandonment of the site.

It appears that the EN and MN I flat settlements were much larger than the Chalcolithic ones. Apart from Elateia 3, all these sites are smaller than 1 ha in size. We conclude that the settlement mobility

⁵⁸ A potential flat settlement from late LN I is Elateia 2, a site that must be explored in more detail.

⁵⁹ E.g., Koch et al. 2017, 86–87; Reingruber and Rassamakin 2016, Fig. 40.

⁶⁰ In this sense argues also Tsirtsoni 2016.

⁶¹ Alluding to the title of an important contribution by Kotsakis 1999.

⁶² Link 2006.

⁶³ For comparison: Nessonis 5 with 2.6 ha and Nessonis 6 with 5.7 ha are the largest magoules in the study area.

was much higher in the CH II–III than in the EN/MN, and that there may have been an interplay between the sites in the basin and those on the hill-tops.

12.4.2.4. The concept of the village

At the beginning of the Neolithic, dense building development is not yet to be expected in our study area: the individual buildings (as in Nessonis 1-South and Elateia 1) were set far apart and the deposits resulting from them are only thin, less than a meter thick (cf. Chapter 10.1.2). Hitting these is either a stroke of luck or the result of a systematic search (in our case both). According to our observations, no village complexes with parallel aligned houses forming alleys were established at least in NE Thessaly in the EN II and in the MN I. Rather, isolated households were scattered over a larger settlement area, separated from each other by open spaces.⁶⁴ The most prominent example is that of Elateia 1 (Fig. 9.3.4). Whether this is an exception or not can only be ascertained once more extensive and intensive surveys have been carried out. Only when this settlement pattern is better known, it will be possible to propose reliable models for the development of villages in the Aegean. In our study area, a concentration of the settlement activity in a planned village structure located in a selected area is only recognisable from the MN onwards (e.g., Magoula Nessonis 2).

12.5. Climate curves and population dynamics

Climate curves are developed on the basis of temperature and oxygen curves which are obtained from ice cores. In order to achieve a better regional resolution, these are compared with existent sections in vegetation history. Results from terrestrial or marine cores and palynological studies are also incorporated.⁶⁵ Together, they show a coherent picture that should be compared with the cultural events in the respective working area.⁶⁶

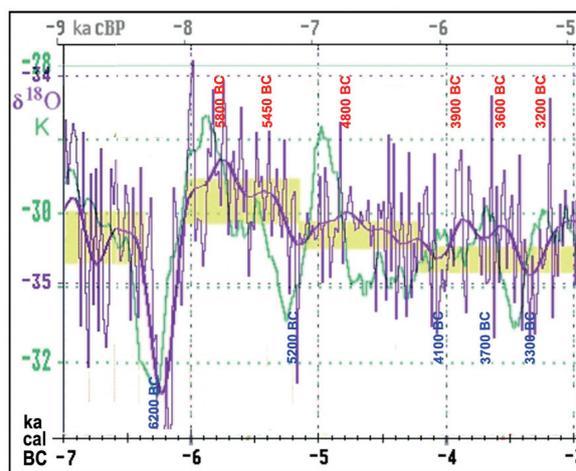


Fig. 12.7. Excerpt from the climate curve first plotted by H. J. Holm (2011, Fig. 3) based on oxygen isotopes from two Greenland ice cores. Four major temperature declines (around 6200, 5200, 4100 and 3300 calBC) are suggestive of a cooler and drier climate, while elevated temperatures indicate warmer and wetter periods (courtesy of H. Holm 2022, key and descriptions in Holm 2024).

The climate is a dominant factor to which humans can adapt – specifically when changes in environmental conditions and vegetation cover occur slowly, over decades. It may be rewarding to countercheck these with the prehistoric dynamics in the basin area. The question is whether there is any connection between climate changes, i.e. oscillations between colder/drier and warmer/wetter phases, and settlement shifts. Were there periods of relative stability (when tells developed) as opposed to instability (and increased mobility)?

The climate curves established for the northern hemisphere show a climate improvement in the Early Atlantic (cf. Tab. 2.1, from ca. 7200 BC), a warm period that lasted until ca. 1000 BC, the end of the Subboreal. There were two particularly conspicuous events, a peak and a drop, in the period we are interested in (Fig. 12.7): the negative one, the 8.2 ka event, with very cold and dry weather, and the positive one around 5800 BC, with very warm and humid periods. In just 400 years, humans were exposed to two extremes that were never equalled again. After a further unstable course of the curve

⁶⁴ Reingruber 2024.

⁶⁵ Kotthoff et al. 2008.

⁶⁶ Cf. also Reingruber 2021.

⁶⁷ Ideal climate conditions are high precipitations and warm temperatures (Schneider and Lohmann 2003, 46), as they prevailed in the Holocene Climatic Optimum of the 6th and 5th mill. BC (AT3 on Tab. 2.1).

a climatic optimum⁶⁷ (a relatively flat area on the curve), was only reached again between 5000 and 4200 BC, but between ca. 4200 and 3200 BC the fluctuations are strong again, with a very cool phase around 3300 BC.

In the Aegean, the transition from the Mesolithic to the Neolithic took place around 6600/6500 BC, in the early phase of the Atlantic period. Around 6400/6300 BC, there were signs of a particularly severe drop in temperature, and shortly afterwards the first settlement known to us was established in the working area: Nessonis 1. The rapid warming after 6200 BC may have led to a rise in levels of Bara Toibasi Lake and to the first floods. The continuous rise in temperature even after 6000 BC was accompanied by a warmer/humid climate and a slow but steady rise of the lake levels. At least the early settlements were abandoned around 6000 BC and higher-lying locations were sought.

The new foundations of Nessonis 2 and Elateia 1 show two very different types of settlement (a magoula and a flat settlement), both of which were in use for 200–300 years. When the absolute temperature peak was reached around 5800 BC, the flat settlement was given up, and not much later the whole area around the small tell Nessonis 2 was also abandoned. This stable but comparatively short period of the later MN was followed by several centuries of instability (throughout the LN I). Around 5200 BC, another low point of the climate curve was reached, accompanied by a colder and drier weather – it allowed for lower places to be inhabited again for a comparatively short time (e.g., Elateia 2 and Nessonis 3).

Temperatures rose again until around 4200 BC without any recognisable major fluctuations: this is the time of the LN II and CH I, the time of the tell settlements Nessonis 5 and 6, Makrychori 1 and 3, a demographic obviously stable period in the basin. But around 4200 BC it became distinctly cooler again, and a period with numerous fluctuations followed until the Subboreal. During this unstable period, hilltop settlements were founded (Agios Kosmas, Germazi and Pr. Ilias). For the period before and after 3700 BC, a longer period of drought was documented in the Aegean region⁶⁸, during which it would again have been possible to establish set-

tlements both in the basin of Sykourio (Nessonis 4, 7-South) and in the basin of Elateia (Elateia 4–5), even if these were at higher altitudes than those of the Neolithic. At the end of the Chalcolithic and after a dramatic drop in temperature, the youngest of the settlements, Elateia 3, was abandoned around 3300 BC.

A question to be addressed by future investigations would be how much arable land was actually available to the few settlements that existed simultaneously, even in extremely wet periods, and how many people could be fed from it. What was the carrying capacity of the two basin areas if there really were extensive wetlands? It must also be left to future studies to obtain information from contextualized material that can also be verified in the laboratory (e.g. isotope and pollen analyses) to gather information on mobility and vegetation. Our estimates are very simple and based solely on the number and size of settlements. In the Sykourio basin, we estimate that around 450 people may have lived at the same time (there may have been more in the LN). Since there were only two or at most three settlements in the Elateia basin at the same time, a somewhat smaller population must be assumed here (300–400 people). However, these figures can only be regarded as rough population numbers.

12.6. Conclusions and outlook

Thanks to the two main pillars of our research: (1) the long-durée approach with the two epochs of the Neolithic and Chalcolithic (2) in a well-defined, self-contained working area, we can now make statements about land use and adaptations, and their respective conditions. Through the detailed chronological evaluation of the already known and newly collected Neolithic and Chalcolithic finds, we have highlighted both transitions and breaks between individual epochs and worked out settlement and population dynamics. For the archaeological investigations it was essential to identify the natural area as a basin landscape with two different surface water systems: this self-contained settlement chamber not far from the coast, benefitting from fertile alluvial fans, and numerous flowing and standing waters offered an advantageous habitat for both mobile and sedentary communities.

⁶⁸ Kotthoff et al. 2008, 1030.

Through systematic surface exploration a total of eight flat settlements were recognised in addition to the already known tells, including single phased (Nessonis 4) and episodic reoccupied flat settlements (Nessonis 7). Likewise, horizontal shifts (stratigraphies) were observed in Nessonis 1 and Elateia 1. By linking distribution maps based on statistical analyses (e.g. heat maps) with the magnetograms of the geophysical prospection in QGIS, we have succeeded in reconstructing the settlement patterns at these two selected sites.

In times when settlements were frequently replaced, no further deposits were formed on the initial layer, so that we encounter them as flat settlements. However, in a diachronic comparison it was possible to analyse when and where long-lived tells were formed and what caused this stability of location. The decision in favour of or against a settlement location was certainly a very complex one that cannot be satisfactorily explained by only using our current approach. Nevertheless, a few basic factors should be recognisable and applicable. These include the favourable proximity to clean water, rock formations and biological and mineral resources in general. But also, the safe distance to threats such as flooding and inundation, desiccation and bush fires were certainly part of the considerations. What we observed in our study area was the combination of optimal proximity to water resources coupled with a safe distance from them – even though the latter did not always work well (e.g. in Elateia 1).

A sudden cooling and extreme reduction in temperatures by 4–5°C may have led to an economical re-orientation of peoples living in the basins to more safety with more readily available proteins, carbohydrates and fats obtained from domesticated animals and plants. But just after 6100 calBC an even more drastic warming started that reached around 5800 calBC its climax. These warmer and more moist conditions may have affected the choice of settlement locations farther away from raising water levels and torrents. In both basins, the oldest settlement sites were also the lowest. The probable slow rise in lake levels may have forced the inhabitants to seek out new locations. In the EN and early MN (between 6500/6300 and 6000/5800 BC), people only moved a few metres further away at a time, only as much as was necessary (a maximum of 100–200 m away and only one

metre in altitude). After that, no further displacement can be determined for the middle and later MN – and there are also no flat settlements from this period. From this it can be concluded that the continuity of location indicates a uniform and predictable water level of the lake, as relocations were obviously not necessary anymore. This stability began to falter in the second half or at the end of the 5th millennium BC (from the CH II onwards), as new locations were now sought that were higher up and did not remain in use for long.

We know of two settlements in the Elateia basin that constructed irrigation and/or drainage ditches or protective walls(?) (Elateia 1 and Makrychori 1). In our view, ditches were used for water management and targeted plant cultivation. Once these ditches became ineffective in Elateia 1 the inhabitants moved to a higher-lying location. The raised tells may have been protected from flooding, but the fields and the catchment areas necessary for subsistence were not. At the end of CH I, around 4200 BC, the tell settlements also were abandoned, but the areas were by no means deserted, let alone depopulated. At the end of the prehistoric period, however, more elevated terrains were sought out. The presumed lack of finds in CH II–III thus turns out to be rather a research problem than a settlement gap.

The choice of a settlement location depends on numerous factors, one of which is certainly the proximity to a body of water – not least to wells, especially in the floodplains. However, not only the construction, but also the abandonment of a site may go hand in hand with this. We were able to show that the two settlement types in the basins of Sykourio, Elateia and Makrychori (tells and flat sites) were not only determined by socio-cultural factors, but also depended on environmental influences, climate and lake level fluctuations. Some sites were continuously inhabited over a longer period, resulting in tells (e.g. Makrychori 1 and 3, Nessonis 3, 5 and 6). Some of these tells were inhabited from the later MN until the end of CH I (cf. Tab. 6.30 and Tab. 12.1). Yet, a different picture emerges both at the beginning of the Neolithic (EN–MN I) and at the end of the Chalcolithic (in CH II–III): only flat settlements have been documented from this period in the Sykourio basin.

With our investigations, we have developed a methodologically viable approach that allows us

to discuss other issues than what is possible in the case of mostly small-scale excavations. This includes the comparison of settlement mounds and their place-commitment with the flat, mobile settlements from the same settlement area. Our models and concepts of (regional) mobility are based on their juxtaposition. It is noticeable that in some periods in our working area no mounds were formed, but in others they have. By comparing this with climate curves, it could be surmised that settlements were abandoned or founded more frequently during periods of greater warming and humidity (e.g. EN II–MN I, 6200–5800 BC). The climatic fluctuations in the 4th mill. BC probably also led to a more mobile way of life during the later Chalcolithic. In contrast, the largest and highest tells were created during the Holocene climatic optimum of the 5th mill. BC.

By integrating archaeological, geophysical, archaeometric, topographical, hydrogeological and mineralogical evaluations into a Geographical Information System, we were able to investigate in a multi-disciplinary project a hitherto undervalued landscape in NE Thessaly: the basins of Elateia and Sykourio. Future investigations will be needed in order to explore not only on but also under the today's surface.

Bibliography

Alram-Stern 1996: E. Alram-Stern, *Die ägäische Frühzeit*, 1. Band: *Das Neolithikum in Griechenland* (Wien 1996).

Alram-Stern and Dousougli-Zachos 2015: E. Alram-Stern und A. Dousougli-Zachos, C.II. *Das Spätneolithikum und Chalkolithikum*. In: *Die deutschen Ausgrabungen 1941 auf der Visviki-Magula/Velestino – Die neolithischen Befunde und Funde*. *Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer Kulturraumes* 36 (Bonn 2015) 125–219.

Angelakis et al. 2020: A. N. Angelakis, G. Antoniou, K. Voudouris, N. Kazakis, N. Dalezios, and N. Dercas, *History of floods in Greece: causes and measures for protection*. *Natural Hazards* 101, 833–852, 2020. <https://doi.org/10.1007/s11069-020-03898-w>

Combourieu-Nebout et al. 2013: N. Combourieu-Nebout, O. Peyron, V. Bout-Roumazielles, S. Goring, I. Dormoy, S. Joannin, L. Sadori, G. Siani, and M. Magny, *Holocene vegetation and climate changes in the central Mediterranean inferred from a high-resolution marine pollen record (Adriatic Sea)*. *Clim. Past*, 9, 2013, 2023–2042. www.clim-past.net/9/2023/2013/ doi:10.5194/cp-9-2023-2013

Gallis 1992: K. Γαλλής. *Άτλας προϊστορικών οικισμών της ανατολικής Θεσσαλικής πεδιάδας*. Λάρισα: Εταιρεία Ιστορικών Ερευνών Θεσσαλίας (Λάρισα 1992).

Grundmann 1937: K. Grundmann, *Magula Hadzimisiotiki*. Eine steinzeitliche Siedlung im Karla-See. *Mitteilungen des Deutschen Archäologischen Instituts, Athenische Abteilung* 62, 1937, 56–62.

Hauptmann 1969: H. Hauptmann, *Die Funde der frühen Dimini-Zeit aus der Arapi-Magula, Thessalien*. In: H. Hauptmann und V. Milojević, *Die Funde der frühen Dimini-Zeit aus der Arapi-Magula, Thessalien*. *Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer-Kulturraumes* 9 (Bonn 1969) 7–134.

Hauptmann 1981: H. Hauptmann, *Die deutschen Ausgrabungen auf der Otzaki-Magula in Thessalien III. Das späte Neolithikum und das Chalkolithikum*. *Beiträge zur ur- u. frühgeschichtlichen Archäologie des Mittelmeer-Kulturraumes* 21 (Bonn 1981).

Holm 2011: H. J. Holm, *Archäoklimatologie des Holozäns: Ein durchgreifender Vergleich der „Wuchshomogenität“ mit der Sonnenaktivität und anderen Klimaanzeigern („Proxies“)*. *Archäologisches Korrespondenzblatt* 41(1), 2011, 119–132. DOI: <https://doi.org/10.11588/ak.2011.1.34544>.

Holm 2024, H. J. J. G. Holm, *North-western European Holocene Climate Proxies and Culture Stages*. In: *Wikimedia Commons*, Licence CC BY-SA 4.0. Last update: Mon, 27 May 2024 19:33:36 GMT. <https://dewiki.de/b/24888c> (last accessed 31 July 2024).

Kilian 1976: K. Kilian, *Der Siedlungshügel Bunar-Baschi bei Sikourion*. In: V. Milojević, A. von den Driesch, K. Enderle, J. Milojević-v.Zumbusch und K. Kilian, *Die deutschen Aus-*

- grabungen auf Magulen um Larisa in Thessalien 1966: Agia Sofia-Magula, Karagyös-Magula und Bunar Baschi. Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeer-Kulturraumes 15 (Bonn 1976), 65–71.
- Koch et al. 2017: I. Koch, S. Scharl, and D. Schyle, Das 4. Jahrtausend in der Niederrheinischen Bucht – erste Schritte auf dem Weg zur Kenntnis einer kaum fassbaren Epoche. In: J. Pyzel (ed.), Das 4. Jahrtausend. Fokus Jungsteinzeit. Berichte der AG Neolithikum Band 6. Welt und Erde (Kerpen-Loogh 2017) 77–91.
- Kotthoff et al. 2008: U. Kotthoff, U. C. Müller, J. Pross, G. Schmiedl, I. T. Lawson, B. van de Schootbrugge, and H. Schulz, *Lateglacial and Holocene vegetation dynamics in the Aegean region: an integrated view based on pollen data from marine and terrestrial archives*. *The Holocene* 18(7), 2008, 1019–1032. DOI: 10.1177/0959683608095573
- Kotsakis 1999: K. Kotsakis, What Tells can Tell: Social Space and Settlement in the Greek Neolithic. In: P. Halstead (ed.), *Neolithic Society in Greece* (Sheffield 1999) 66–76.
- Link 2006: T. Link, Das Ende der spätneolithischen *Tellsiedlungen* im Karpatenbecken – Kulturwandel oder Kulturbruch? (Bonn 2006).
- Marks 1987: A. Marks, Umweltgeschichtliche Aspekte des Neolithikums in Thessalien. *Archäologische Informationen* 10(1), 1987, 97–99.
- Milojčić 1976: V. Milojčić, Die Stratigraphie der frühen und beginnenden mittleren Bronzezeit auf der Argissa-Magula. In: E. Hanschmann und Vladimir Milojčić, Die deutschen Ausgrabungen auf der Argissa-Magula in Thessalien III: Die frühe und beginnende mittlere Bronzezeit. Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeerraums 13–14 (Bonn 1976) 7–19.
- Mithen 2010: S. Mithen, The domestication of water: water management in the ancient world and its prehistoric origins in the Jordan Valley. *Philosophical Transactions of the Royal Society A, Mathematical, Physical and Engineering Sciences* 368(1931), 2010, 5249–5274. doi: 10.1098/rsta.2010.0191. PMID: 20956370
- Morgenschweis 2011: G. Morgenschweis, *Hydrometrie: Theorie und Praxis der Durchflussmessung in offenen Gerinnen*. VDI-Buch. Springer-Verlag (Berlin u.a. 2010). https://doi.org/10.1007/978-3-642-05390-0_2
- Peltenburg 2003: E.J. Peltenburg, Identifying Settlement of the 10th–9th Millennium BP in Cyprus from the Contents of Kissonerga-Mylothkia Wells. In: J. Guilaine and A. Le Brun (eds.), *Le Néolithique de Chypre, Actes du Colloque International Organisé par le Département des Antiquités de Chypre et l'École Française d'Athènes, Nicosie 17–19 Mai 2001*. *Bulletin de Correspondance Hellénique, Supplement* 43, 2003, 15–34.
- Reingruber 2008: A. Reingruber, Die Argissa-Magula. Das frühe und das beginnende Neolithikum im Lichte transägäischer Beziehungen. Die deutschen Ausgrabungen auf der Argissa-Magula II. Beiträge zur ur- und frühgeschichtlichen Archäologie des Mittelmeerraums 35 (Bonn 2008).
- Reingruber 2021: A. Reingruber, Sesshaft – und wie geht es weiter? Ortswechsel und Ortskonstanz im Becken von Sykourio, Thessalien. *Mitteilungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte* 42, 2021, 89–98.
- Reingruber 2022: A. Reingruber, Panta Rhei: die Argissa Magula am Ufer des Flusses Pinios zwischen 6500 und 400 v. Chr. In: E. Kaiser, M. Meyer, S. Scharl und St. Suhrbier (eds.), *Wissenschichten: Festschrift für Wolfram Schier zu seinem 65. Geburtstag*. *Internationale Archäologie, Studia honoraria* 41 (Rahden/Westf. 2022) 105–123.
- Reingruber 2023: A. Reingruber, Spoons from Spondylus: A New Interpretation of Aegean Neolithic Artefacts based on finds from Elateia and Nessonis in Northeast Thessaly. In: V. Şahoğlu, İ. Tuğcu, O. Kouka, Ü. Gündoğan, Ü. Çayır, R. Tuncel, and A. Erkanal-Öktü (ed.), *HAYAT: Arkeolojiye adanmış bir yaşam – HAYAT: A Life Dedicated to Archaeology*. *Studies in Mediterranean Archaeology in Memory of Hayat Erkanal* (Ankara 2023) 353–364.
- Reingruber 2024: A. Reingruber, The Oikos, the Orygma and the Open Spaces: Aegean Neolithic Settlement Patterns in Perspective. In: T. Kienlin (ed.), *Household Practices and Houses – Current Approaches from Archaeology and the Sciences*. *Universitätsforschungen zur prähistorischen Archäologie* 399 (Bonn 2024) 79–104.
- Reingruber and Rassamakin 2016: A. Reingruber, J. Rassamakin, Zwischen Donau und Kuban: Das nordpontische Steppegebiet im 5. Jt. v. Chr. In: V. Nikolov und W. Schier (ed.), *Der Schwarzmeerraum vom Neolithikum bis in die Früheisenzeit (6000–600 v. Chr.)*. *Kulturelle Interferenzen in der Zirkumpontischen Zone und Kontakte mit ihren Nachbargebieten*. *Prähistorische Archäologie in Südosteuropa* 30 (Rahden/Westf. 2016) 273–310.
- Reingruber and Thissen 2017: A. Reingruber and L. Thissen, The 14SEA Project: A 14C database for Southeast Europe and Anatolia (10,000–3000 calBC). www.14sea.org
- Reingruber et al. 2021: A. Reingruber, G. Toufexis, and Y. Maniatis, Elateia 1 in northeastern Thessaly 8000 years ago: Relative and absolute chronology of a flat extended settlement. *Documenta Praehistorica* 48, 2021, 184–201. DOI: <https://doi.org/10.4312/dp.48.22>
- Reingruber et al. 2024: A. Reingruber, G. Toufexis, S. Valkaniotis, and A. Manakos, The basins of Sykourio and Elateia in northeastern Thessaly: an attempt at reconstructing the (pre) historic landscape. In: AETHSE, *Archaologiko Ergo Thessalias kai Sterea Elladas* 6, Volos 2018 (Athens 2024) 59–70.
- Sarris et al. 2015: A. Sarris, C. C. Garcia, T. Kalayci, F.-X. Simon, G. Cantoro, J. Donati, M. Manataki, K. Vouzaxakis, V. Rondiri, P. Arachoviti, K. Almatzi, D. Efstratiou, and E. Stamelou, Magoula Visviki from a Geophysical Prospection Perspective. In: E. Alram-Stern and A. Dousougli-Zachos, *Visviki-Magula / Velestino. Die neolithischen Befunde und Funde. Die Deutschen Ausgrabungen 1941*. Beiträge zur ur-

- und frühgeschichtlichen Archäologie des Mittelmeer-Kulturräumens 36 (Bonn 2015) 573–579.
- Sarris et al. 2017: A. Sarris, T. Kalayci, F.-X. Simon, J. Donati, C. Cuenca García, M. Manataki, G. Cantoro, I. Moffat, E. Kalogiropoulou, G. Karampatsou, K. Armstrong, N. Argyriou, S. Dederix, C. Manzetti, N. Nikas, K. Vouzaxakis, V. Rondiri, P. Arachoviti, K. Almatzi, D. Efstathiou, and E. Stamelou, Opening a New Frontier in the Study of Neolithic Settlement Patterns of Eastern Thessaly, Greece. In: A. Sarris, E. Kalogiropoulou, T. Kalayci and L. Karimali (eds.), *Communities, Landscapes and Interaction in Neolithic Greece*. International Conference, Rethymno 29–30 May 2014. International Monographs in Prehistory, Archaeological Series 20. Ann Arbor (Michigan 2017) 27–48.
- Schneider and Lohmann 2003: R. Schneider and G. Lohmann, Das Klima der letzten 11.000 Jahre. DWD: Klimastatusbericht 2003, 35–54. https://www.dwd.de/DE/leistungen/klimastatusbericht/publikationen/ksb2003_pdf/03_2003.pdf;jsessionid=BD90BB84DF3EED5AF84ECE9FFF6FA69.live11052?__blob=publicationFile&v=1 (aufgerufen am 25.3.2021)
- Sterelny and Watkins 2014: K. Sterelny and T. Watkins, Neolithization in Southwest Asia in a Context of Niche Construction Theory. *Cambridge Archaeological Journal* 25(3), 2014, 673–705. doi:10.1017/S0959774314000675
- Theocharis 1962: Δ.Π. Θεοχάρης, Από τη νεολιθική Θεσσαλία. *Θεσσαλικά Δ'*, 1962, 63–83.
- Theocharis 1973: D. R. Theocharis (ed.), *Neolithic Greece* (Athens 1973) 17–128.
- Toufexis 2016: G. Toufexis, Palioskala. A Late Neolithic, Final Neolithic and Early Bronze Age settlement in the Eastern Thessalian plain (Central Greece). In: Z. Tsirtsoni (ed.), *The Human Face of Radiocarbon. Reassessing Chronology in Prehistoric Greece and Bulgaria, 5000-3000 cal BC*. Publications de la Maison de l'Orient et de la Méditerranée: Travaux de la Maison de l'Orient et de la Méditerranée- Série Recherches archéologiques 69 (Lyon 2016) 361–380.
- Toufexis 2017: G. Toufexis, *Oikistiki drastiriotita kai organosi tou horou stous oikismous tis Neoteris Neolithikis sti Thessalia: Paradeigmata apo tous oikismous ston Profiti Iliia Mandras, Makrychori, Galene and Rachmani*. PhD thesis, University of Thessaly (2017). <http://hdl.handle.net/10442/hedi/41426>
- Toufexis and Reingruber 2021: G. Toufexis and A. Reingruber, Proistoriki katikisi kai palaioperivallon stis Lekanes tou Sykouriou kai Elateias. *Praktika 10ou Synedriou Larisaikon Spoudon*, 2021, 7–24. (griech.: Γ. Τουφεξής και Α. Reingruber, Προϊστορική κατοίκηση και παλαιοπεριβάλλον στις Λεκάνες του Συκουρίου και Ελάτειας. Πρακτικά 10ου Συνεδρίου Λαρισσαϊκών Σπουδών, 2021, 7–24). (The prehistoric habitation and the palaeo-environment in the basins of Sykourio and Elateia. In: *Proceedings of the 10th Conference of Larissa Studies*, 2021, 7–24.)
- Tsirtsoni 2016: Z. Tsirtsoni, *The Human Face of Radiocarbon. Reassessing Chronology in Prehistoric Greece and Bulgaria, 5000-3000 cal BC*. Publications de la Maison de l'Orient et de la Méditerranée: Travaux de la Maison de l'Orient et de la Méditerranée- Série Recherches archéologiques 69 (Lyon 2016).
- Watkins 2020: T. Watkins, Setting the Neolithic of Southwest Asia in Its Evolutionary Context. In: H. Khalaily, A. Re'em, J. Vardi, and I. Milevski (eds.), *The Mega Project at Motza (Moza): The Neolithic and Later Occupations up to the 20th Century* (Jerusalem 2020) 19–36. <https://doi.org/10.2307/j.ctv1b9f5bh.4>
- Weninger et al. 2005: B. Weninger, E. Alram-Stern, E. Bauer, L. Clare, U. Danzeglocke, O. Jöris, C. Kubatzki, G. Rollefson, and H. Todorova, Die Neolithisierung von Südosteuropa als Folge des abrupten Klimawandels um 8200 cal BP. In: D. Gronenborn (ed.), *Klimaveränderung und Kulturwandel in neolithischen Gesellschaften Mitteleuropas, 6700–2200 v. Chr. Römisch-German. Zentralmuseum Tagungen 1* (Mainz 2005) 75–117.
- Wijnen 1981: M.H.J.M.N. Wijnen, *The Early Neolithic Settlement at Sesklo; an Early Farming Community in Thessaly, Greece*. *Analecta Praehistorica Leidensia* 14, 1981, 1–146.