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Palaeoeconomy and Palaeoenvironment of Halmyris—A Roman Settlement in Southeast Romania: Archaeozoological and Phytolith Evidences

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Abstract: Halmyris (Murighiol, Tulcea County, Romania) is one of the most important Roman settlements located in the inferior sector of the Danube Delta, in the easternmost part of Scythia province during the Late Antiquity. Halmyris was the most easterly fort of the Danubian border in Roman times and probably served as a supply centre for the imperial fleet; Roman inscriptions inform on the existence of a 'mariner's village' named *vicus classicorum*. Given that the written information about this settlement is extremely incomplete, the study of animal and plant remains can answer important questions related to economic life (e.g., human use of biological resources) and the relationship between community and environment. This study contributes to understanding the process of Roman domination in the area (e.g., highlighting the improved type of cattle, brought and reproduced here by the Romans), as well as to the knowledge of environmental changes under anthropic pressure (e.g., animal extinction, such as aurochs). In 2014, extensive archaeological research took place in the extramural area of the fort. During research, a total area of 234 sqm was investigated through five trenches west–east oriented and perpendicular to vallum II but not intersecting with it. Phytolith samples were taken from the habitation levels dated to the 5th–6th centuries AD, and faunal remains were collected from four trenches dated to the 4th–6th centuries AD. Phytolith assemblages from the Halmyris site are composed mainly of grass phytoliths. We noticed important amounts of ELONGATE DENDRITIC forms and a high proportion of *silica skeletons*. Phytolith analysis resulting from the processing of 12 samples shows that cereals were a relevant part of the subsistence economy of the site, revealing an important signal of cereal processing. Flax fibers, which are the strongest natural fibers, were also identified in samples from Halmyris. The exploited animal resources are varied, including molluscs, fish, birds, and mammals. Most of the skeletal remains belong to the group of mammals. Animal husbandry represented an important occupation; the identified domestic mammals are cattle, sheep, goat, pig, horse, donkey, and dog. The predominant species were cattle and sheep/goat, both by the number of identified remains and by the minimal number of individuals. Hunting had small importance for the settlement under study, red deer and wild boar having the highest proportion of wild mammals.

Keywords: palaeoeconomy; phytoliths; palaeoenvironment; Halmyris; Roman settlement; Southeast Romania

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1. Introduction

The aim of the present study is to analyse the palaeoeconomy and palaeoenvironment of Halmyris by means of an integrated approach that includes detailed phytoliths and archaeozoological results, corelated with archaeological data. A research was carried out at Halmyris in order to provide information about subistence and daily activities as well as interactions with animals, plants, or the environment.

A defining characteristic of the evolution of the Roman Empire as a whole, continuous adaptation to socioeconomic and historical conditions, was noticed in all regions under imperial control. This fact is abundantly attested, through documentary and archaeological evidence, also in the West Pontic regions, important in the Roman economic structure and defensive military concept [1]. Thus, the broad study area of this article, the territory between the Danube River and the Black Sea, was gradually included in the imperial administrative structures, starting from the end of the 1st century BC, in the imperial administrative structures, and was militarily protected by the impressive Roman military defensive structure, generically known as the name *limes*. As a result of the war with the Dacians at the beginning of the 2nd century AD, the emperor Trajan rebuilt from the ground up the defence system of the Roman *limes* on the Lower Danube. He placed the V Macedonica legion at Troesmis (until 168), this form of the border resisting until the attacks of the Goths in the middle of the 3rd century [1]. Sometime between 286 and 293, as a result of Diocletian's administrative reforms, the territory would be part of the newly established Scythia Minor province (the dating is ensured by an inscription discovered in Tomis, present-day Constanța, Romania) [2]. Starting with Emperor Aurelian, there was *a fundamentis* reconstruction action of the fortifications in the new province, which lasted until the end of the reign of Constantine the Great, when both literary and epigraphic sources would record a military organization quite different from the previous one [3]. The Lower Danube frontier lasted until the middle of the 5th century, when a large part of the fortifications was destroyed by the attacks of the Huns. The last restoration began under Anastasius I (491–518 AD) and was continued under Justinian (527–565 AD). However, the *limes* of the Lower Danube was abandoned in the second decade of the 7th century by Emperor Heraclius, under the Slavic-Avar pressure and the strategic losses suffered by the Empire in the Orient [4].

The archaeological research undertaken in the current region of Dobrudja (ancient Scythia Minor) [5] sought to understand the evolution of the province's fortresses and settlements during the 4th–6th centuries AD. In response to the same historical conditions, similar developments could be observed, but also differences appear between structures with the same functions. The data resulting from the multidisciplinary research at Murighiol (Halmyris) must be interpreted in the broad context of the military and civil structures on the Lower Danube line. We mean the *castra* and fortresses of the province, contained in the Danube sector between Sacidava and the mouths of the Danube (the southernmost arm of the delta, Saint George–Peuce in antiquity). The Danube River, a based frontier permissive to human migration, was logistically difficult, if not impossible, to defend, and thus, from the beginning, needed constant supervision by military bases established by the Roman army and navy [6]. From the analysis of the historical general context of the province during the determined period, it can be seen that the fortifications of the 4th–6th centuries AD cannot be subjected to global comparisons regarding their general plane geometry and axial metric details. Constructively, the adaptation to the configuration of the banks is observed, an important number of fortifications of the *limes* being attached to the river bank, occupying platforms as high as possible to have the side facing the water naturally protected by often inaccessible slopes [7]. The fortress at Murighiol can be compared with similar fortifications in location and design, for example, the fortifications at Noviodunum, Troesmis "East", and Capidava in the province of Scythia and with Iatrus in Moesia Secunda [4,8].

The evolutionary similarities of the Halmyris fortress between the 4th and 6th centuries AD must also be seen in the narrow context of the defensive structure represented by the southern shore of the Dunavăț Peninsula, as inseparable parts of the Lower Danube Roman defensive system. At present, the known military installations on this river frontier segment are the chain of fortresses at Aegyssus (Tulcea), Nufăru, Salsovia (Mahmudia), and Halmyris/Salmorus/Thalamonium (Murighiol), as well as two auxiliary forts at Ilganii de Jos and Ad Stoma (Dunavăţu de Sus) and an recorded in *Notitia Dignitatum* naval base (*reliquatio*) at Platypegiae [5]. The Danube *limes* stretch between Ad Stoma and Aegyssus was established as an operative segment of the Lower Danube River frontier amidst a multifarious and resourceful environment in a key strategically position, at the contact between the Danube and the Black Sea [5]; a similar situation occurred in the Rhine–Meuse delta, Netherlands [9].

For the period of the 4th–6th centuries AD, archaeozoological (but also multidisciplinary) studies, of animal resources for food, husbandry strategies, or consumption practices, are limited for sites in the region of ancient Scythia Minor, comparative to other from South and West of Europe [10].

A little over a decade after the publication of the analysis of the faunal material collected from the *intramuros* area of the Halmyris fortress [11,12], the present study completes and expands the information on this archaeological site, through archaeozoological and phytolith analyses—a rich and original source of information. If the main purpose is to reconstruct the human–environment interactions in the Halmyris fortress area, the ways to achieve it are based on phytoliths for the palaeovegetation and animal skeletal remains for the paleofauna, being the first time that the research involves also archaeobotany, regarding this site, a well-specified archaeological context. The integration of archaeobotanical and archaeozoological data is not new for the archaeological sites of Romania, but most of this type of studies were carried out for the Neolithic and Chalcolithic sites [13].

The results obtained from this research are important because the existing information concerning the relationships between people and environment is incomplete for this period in the Lower Danube region.

Phytoliths are microscopic silica opal corpuscles that are produced in and between plant cells and that, after the decomposition of plants, are preserved quite well in various contexts [14], becoming true witnesses of the vegetation's composition in the past and therefore of the palaeoenvironment. Due to the fact that grasses produce a large amount of phytoliths, these bioindicators highlight aspects related to ancient agricultural practices, cereal processing, and also the meals of herbivorous animals [15–19], as well as the use of space [20]. The potential of phytolith analysis in more recently dated archaeological contexts is highlighted in the studies carried out in the Gallo-Roman sites in Belgium [21], the Roman and medieval ones in the Netherlands [22], the Roman ones in Spain [23], or Roman-Byzantine sites in Romania [13,24].

We mention the Roman-Byzantine site of (L)Ibida in Tulcea County, Romania, where integrative studies were carried out, presenting aspects of palaeoenvironment exploitation, plant cultivation for subsistence, animal husbandry, hunting, and fishing. Here, the analysis of organic remains contributed to evaluating the settlement area and the use of space within it, providing information about subsistence and daily activities, as well as the relationships with the natural environment [24,25]. Interdisciplinary analyses have also been published, for the period of the 4th–6th centuries AD, for different assemblages from Noviodunum [26]. This approach is useful to filter out certain regional idiosyncrasies, which are mainly due to the eco-geography and historical path of this region (i.e., *Scythia Minor*). For the first Christian millennium, for the Dobrudjan area, specific or extensive archaeozoological studies were also published [27,28].

For other archaeological sites in the area of the Lower Danube or on the Danube *limes*, mainly archaeozoological studies have been carried out. For Iatrus (present-day Krivina, Bulgaria), with a position and development similar to the fortress of Halmyris, archaeological and multidisciplinary research was carried out in the period 1992–2000 by a mixed German–Bulgarian team, an important contribution to the knowledge of the Danube *limes* during 4th–6th centuries AD, being brought by the archaeobotanical [29] and palynological [30] analyses. The analysis of the faunal material was also performed for the neighbouring area, the great legionary camp from *Novae* (Șviștov, Bulgaria) [31]; in Serbia, there are archaezoological analyses of animal remains from sites situated on the Danube line, which complement the archaeological research [32]. Thus, for the Lower Danube region, by the 4th–5th centuries, changes in dietary patterns were underway after a long period of stability in the early Empire [33].

2. Study Area and the Archaeological Context

2.1. Study Area

Halmyris is located in the Tulcea county (SE Romania), about 30 km eastward from the Tulcea city (the ancient Aegyssus) and 2.5 km east from the present-day Murighiol village (Figure 1). During antiquity, the Dunavăț Peninsula, where Halmyris lies, was named *extrema Scythiae minoris* and represented the last Roman bastion before the discharge into the sea of the Saint George arm (ancient Peuce) of the Danube [34]. The plateau on which it is located consists of a small rocky promontory (Figure 2), with an inclination from south to north, bordered to the south by the "Citadel Hill", which places Halmyris in a natural amphitheatre opening to the Danube [7,35–41].

Figure 1. Map of Scythia Minor indicating the location of Halmyris settlement (black dot).

The first phase of habitation has been dated to the 4th–1st centuries BC, although an Oriental Greco-bowl, a fishplate, and fragments of Mende and Chios amphorae together with handworked pottery would indicate an even earlier habitation. The second phase of habitation corresponds to early Roman settlement (1st–3rd centuries AD) when a *castrum* was built and the settlement was one of the main *statio* of the classis Flavia Moesica, the fleet of the Danube and the Pontus. In the first years of the 2nd century AD, the first Roman stone fortification was built at Halmyris. The shape of this fort was rectangular (181 × 120 m), and it housed an auxiliary unit and mariners of the Moesian fleet, next to a civilian settlement (*vicus classicorum*) [42]. In the late 3rd century, the Halmyris fortress was reshaped due to Gothic and Herulian destructions. The fortification at Halmyris was modified, the rectangular shape being replaced by a hexagonal one with the eastern and western sides converging towards the new North Gate, which has two massive U-shaped towers (Figure 3). The West Gate from the 2nd–3rd centuries AD was transformed into a gate with a round plan and two entrances flanked by two solid bastions on which the artillery was placed [43,44].

Figure 2. Drone view, from southeast, of Halmyris site (by Valentin Ștefan, October 2022).

Figure 3. Drone view from east with the extramural area of Halmyris. Magenta arrow indicates the excavation area of 2014 (by Valentin Ștefan, October 2022).

Halmyris was probably affected by the military expeditions of the Goths at the end of the 4th century; it is certain that after this interval of decay of the buildings in the *intramuros* space, the settlement experienced a massive restoration at the beginning of the 5th century AD. In the 6th century AD, Emperor Justinian I rebuilt the city's defence system as mentioned by the ancient sources and mirrored by the results of archaeological research that revealed not only the restoration of the old monuments but also the construction of others of impressive quality, such as the baths, the northeast gate, or the fountain in the central area. The city became a bishopric in the middle of the 6th century according to the information in the *Notitia Episcopatuum*, and the *basilica episcopalis* was greatly expanded [45–47]. At the end of the 6th century AD, the settlement went into irreversible decline and was abandoned in the first decade of the 7th century AD.

2.2. Archaeological Context

In autumn of 2014, research in the extramural area of the fort started due to the necessity of building a new site museum and tourist information point.

The main archaeological feature is a building (Residence 1) composed of at least five rooms oriented generally NNE–SSW (Figure 4). The walls were made of stones bounded by adobe. Originally, the building consisted of two rooms and was built in the 4th century AD. Later, three more rooms were added in the second phase, at the beginning of the 5th century AD (Figure 5A,B). This was probably a residential complex located to the west of the fort, on the main road that connected the Danubian *limes* to the *extrema Scythiae minoris*. The lack of residential structures before the 4th century AD in this area may be due to a transgression of the Danube waters. The retreat of the waters to the north, corresponding to a period in the 4th century AD, probably at the beginning of it, resulted in the occupation of the space with a series of buildings whose usefulness is not certain.

Figure 4. Halmyris, Romania, 2014, extramuros area. Residence 1.

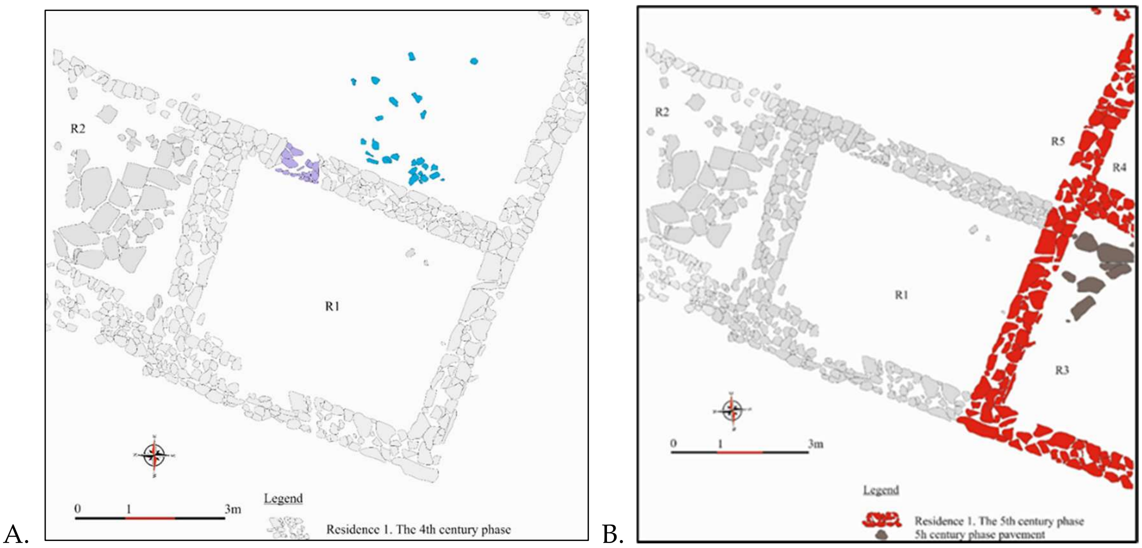

Figure 5. Halmyris, Romania, 2014, extramuros area (R1—room 1; R2—room 2; R3—room 3; R4—room 4; R5—room 5). Residence 1. (**A**) North wing (4th century). (**B**) South wing (5th century phase). Purple: entrance; blue: remains of a pavement; grey: 4th-century phase; red: 5th-century phase and associated pavement (brown).

From the stratigraphic point of view, the last level of habitation corresponds to a building made of mudbricks that functioned in the 6th century AD. The dating of the first phase of habitation in the 4th–5th centuries AD is provided by a large number of ceramic materials, metal implements, and dress accessories—mostly Zwiebelknopffibeln [48,49], coins, and glass fragments.

The particularly rich ceramic material and numismatic evidence indicate that this suburban edifice at Halmyris was built in the middle or in the second half of the 4th century AD and operated in the first phase until one of the Gothic invasions, probably until the year AD 378 or AD 395 when it was set on fire. Subsequently, the edifice was rebuilt at the beginning of the 5th century AD and operated for a short period in the first quarter of this century.

From the proximity of the residence outside Room 1, 23 bone and antler objects were found, among them 16 broken with cut-offs antler tines and tips (Figure 6A–C). This area was interpreted as a bone and antler workshop [50]. Moreover, a fragmentary *epistula comendaticia* attests the existence at Halmyris of a certain Valeria of Diocletianus, "the one who process the bone objects", at the end of the 3rd century or the beginning of the 4th century AD [51] (nos. 20, 44, 51, and 56), [52] (no. 36), [50]. Some clay loom weights discovered in the same area indicate that weaving was an activity practiced in an adjacent area.

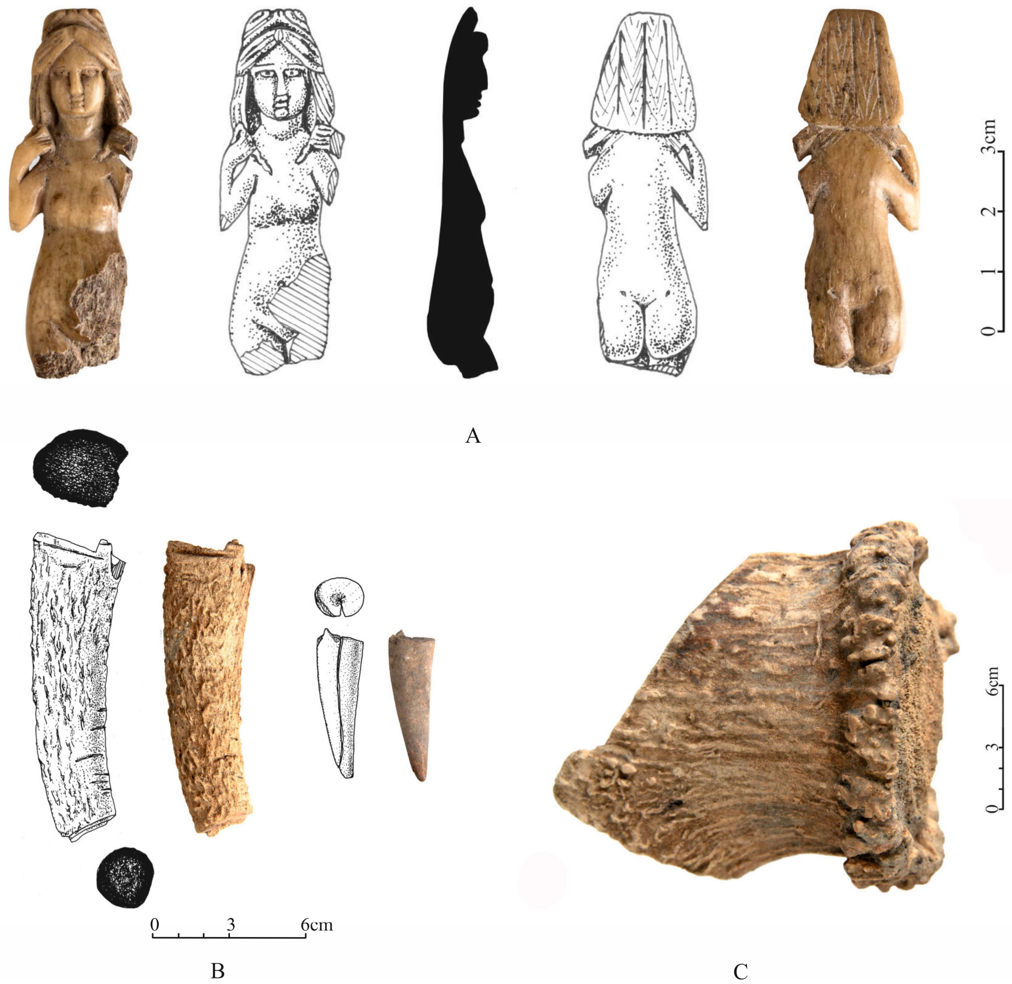

Figure 6. Red deer antler objects from Halmyris, Romania, 2014, extramuros area (4th–5th century AD). (**A**) Head of a distaff depicting Venus. (**B**) Sawn-off red deer antler tine and tip with saw marks. (**C**) Red deer antler with saw and knife marks on side surfaces.

After the end of this building, the space was not inhabited until the beginning of the 6th century AD when a modest mudbrick building was erected. The construction was performed on an earthen platform made over a levelling that removed the elevation of the stone residence that functioned in the 4th–5th centuries AD.

3. Materials and Methods

The animal and vegetal remains belong to an archaeological context dated to the late Roman and early Byzantine periods (4th–6th centuries AD). Regarding the faunal remains, it must be specified that the study will also make a comparison between the two samples, the *intramuros* one published in 2008 and 2011 [11,12] and the *extramuros* one analysed here.

3.1. Phytolith analysis

Phytoliths are suitable for the reconstruction of agricultural practices, cereal processing, and food because grasses produce a high amount of these plant microremains, and there is a specificity of the forms produced by Poaceae. Twelve sediment samples were taken from cultural layers, belonging to the 5th century (one set consisting of samples 1–9) and the 6th century (another set representing samples 10–12), in order to conduct phytolith analysis (Figure 7). Around 2 g of sediment, for each of the 12 samples, was subjected to a chemical protocol adapted after Lentfer, Boyd [53]. For the extraction of phytoliths, hydrochloric acid (35%), potassium hydroxide (10%), sodium polytungstate (density = 2.35), and hydrogen peroxide (30%) were used. For microscope observation, one drop of the final preparation obtained was mounted on one blade at a time. As an observation medium, immersion oil was used. The utilized nomenclature is that according to the International Code for Phytolith Nomenclature 2.0 [54]. All preparations were observed under a transmission optical microscope (x400). All Halmyris samples have preserved phytoliths very well, and it was possible to easily identify more than 300 phytoliths in each sample. The silica skeletons, diatoms, and sponge spicules were excluded from the total phytolith sum in order to avoid over-representation of these categories. There were no forms that we could not have categorized.

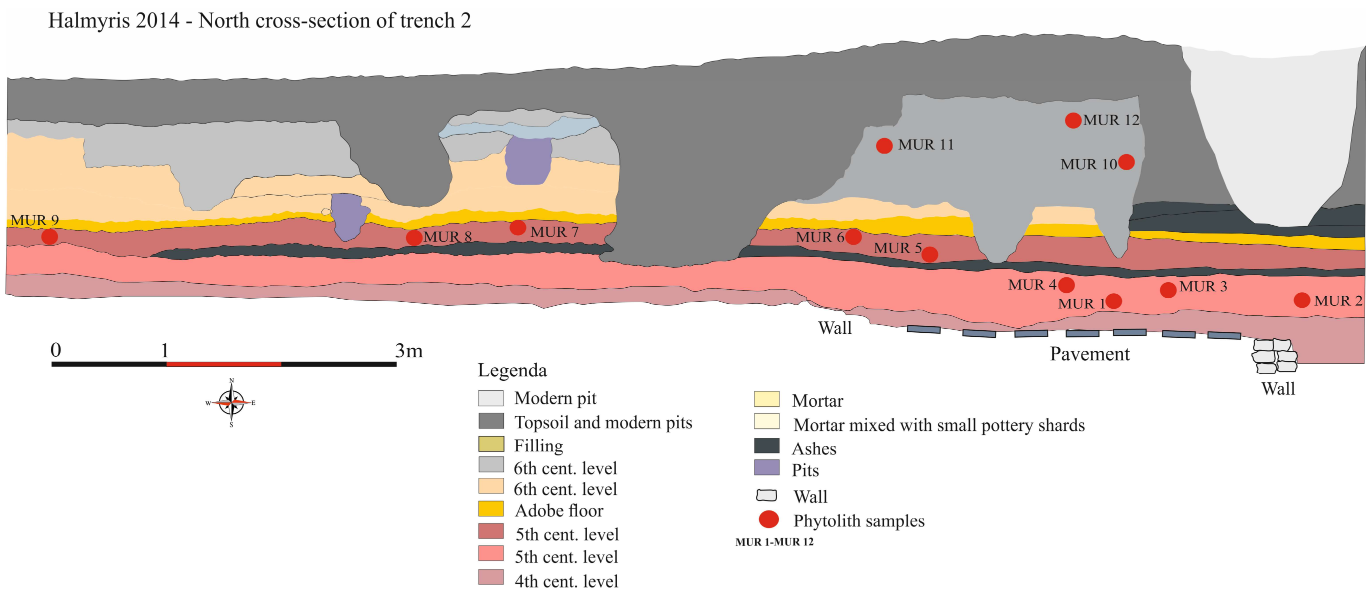

Figure 7. Halmyris, Romania, 2014, extramuros area. The location of phytolith samples in the north cross section of trench 2.

3.2. Archaeozoology

The archaeozoological sample consists of 2207 hand-retrieved faunal remains (without the sediment sieving), collected during the archaeological excavation carried out outside the fortress in 2014. A total area of 234 sqm was investigated through five trenches west–east oriented and perpendicular to vallum II but not intersecting with it. Thus, 808 remains were recovered from excavated section 1 (S1), 644 from section 2 (S2), 463 from section 3 (S3), and 292 from section 4 (S4). Their relative dating, for the 4th–6th centuries, was made in accordance with the archaeological artefacts discovered in the respective contexts.

To clarify the origin of the animal remains recovered from the site, a taphonomic evaluation was carried out. The anatomical and taxonomic identifications, quantification as number of remains (NR) and minimum number of individuals (MNI), estimation of ages at slaughter, and sex allowed for evaluating the animal resources used by the community (What species of animals were consumed? What was the preference for them following the frequency of remains or estimated individuals?), and also some characteristics of their management (e.g., selection of animals by age and sex) [55,56]. All animal remains were anatomically and taxonomically identified using the osteological reference collection of the Faculty of Biology in Alexandru Ioan Cuza University of Iași, followed by the data recording and analysing using Microsoft Excel. The bone measurements were performed according to the A. von den Driesch guide [57], and the osteometric data were used to separate domestic species from their wild ancestors (i.e., *Sus domesticus*/*Sus scrofa*, *Bos taurus*/*Bos primigenius*) to estimate the sex in *Bos taurus* and the withers height in different mammal species (i.e., *Bos taurus*, *Ovis aries*, *Capra hircus*, *Sus domesticus*, *Sus scrofa*, and *Canis familiaris*). The estimation of sex in cattle is based on the metric data of metapodial bones. To calculate the withers height in cattle, different coefficients are applied that depend on the sex and bone (i.e., metacarpal or metatarsal). To estimate the withers height, specific coefficients were used as follows: the coefficients of Fock [58] for *Bos taurus*, the coefficients of Teichert [59] for *Ovis aries*, the coefficients of Schramm [60] for *Capra hircus*, the coefficients of Teichert [61,62] for *Sus domesticus* and *Sus scrofa*, and the coefficients of Harcourt [63] for *Canis familiaris*. The withers height is an indicator frequently used in archaeozoology to assess the animal's body size, which can depend on different factors, such as sex, geographical range, and nutrition. In the case of domestic species, the body size can indicate the growth conditions of the livestock, as well as possible selections to produce forms/breeds.

4. Results and Discussion

4.1. Phytolith Analysis

In the 12 samples taken from cultural layers, several phytolith morphotypes were identified: RONDEL, BILOBATE, CROSS, SADDLE, CRENATE, POLYLOBATE, BULLIFORM FLABELLATE, ELONGATE ENTIRE, ELONGATE DENDRITIC, ACUTE BULBOSUS, BLOCKY, CYPERACEAE type, SPHEROID, and TRACHEARY (Table 1, Figure 8). *Silica skeletons* were also identified. A few diatoms and sponge spicules were recorded in some samples. The phytoliths observed in the samples of Halmyris (Figure 8) belong mainly to the Poaceae family, the identified morphotypes revealing the existence of several of its subfamilies.

Table 1. Phytolith data from Halmyris.

Sample Code	**Rondel**	**Bulliform flabellate**	**Spheroid**	**Acute bulbosus**	**Elongate entire**	**Elongate dendritic**	**Crenate**	**Polylobate**	**Bilobate**	**Cross**	**Saddle**	**Blocky**	**Cyperaceae type**	**Tracheary**	**Diatoms**	**Sponge Spicules**	***Silica Skeleton***	**Phytolith Sum**
MUR 12	223	12	29	7	29	22	3	1	0	1	0	2	2	0	3	0	80	331
MUR 11	218	1	19	11	36	20	4	1	3	4	0	1	0	0	0	0	47	318
MUR 10	248	8	11	6	27	23	4	0	1	0	0	4	1	0	0	0	38	333
MUR 9	248	2	10	10	50	51	8	2	1	0	2	1	1	0	0	0	12	386
MUR 8	295	5	8	11	29	45	3	0	0	0	0	3	0	0	0	1	19	399
MUR 7	281	4	11	7	12	46	7	1	1	1	2	4	0	0	2	0	78	377
MUR 6	207	4	24	9	35	20	5	5	3	1	0	3	1	1	1	2	74	318
MUR 5	225	1	21	6	14	23	7	0	1	1	1	2	0	1	0	0	109	303
MUR 4	242	4	13	15	36	58	5	0	2	0	1	8	3	1	0	2	115	388
MUR 3	264	2	22	4	28	66	5	0	0	1	1	7	0	0	0	0	46	400
MUR 2	262	5	13	13	41	77	7	0	2	2	2	1	1	1	0	0	38	427
MUR 1	325	6	25	8	36	90	7	0	4	1	2	3	0	1	0	1	34	508

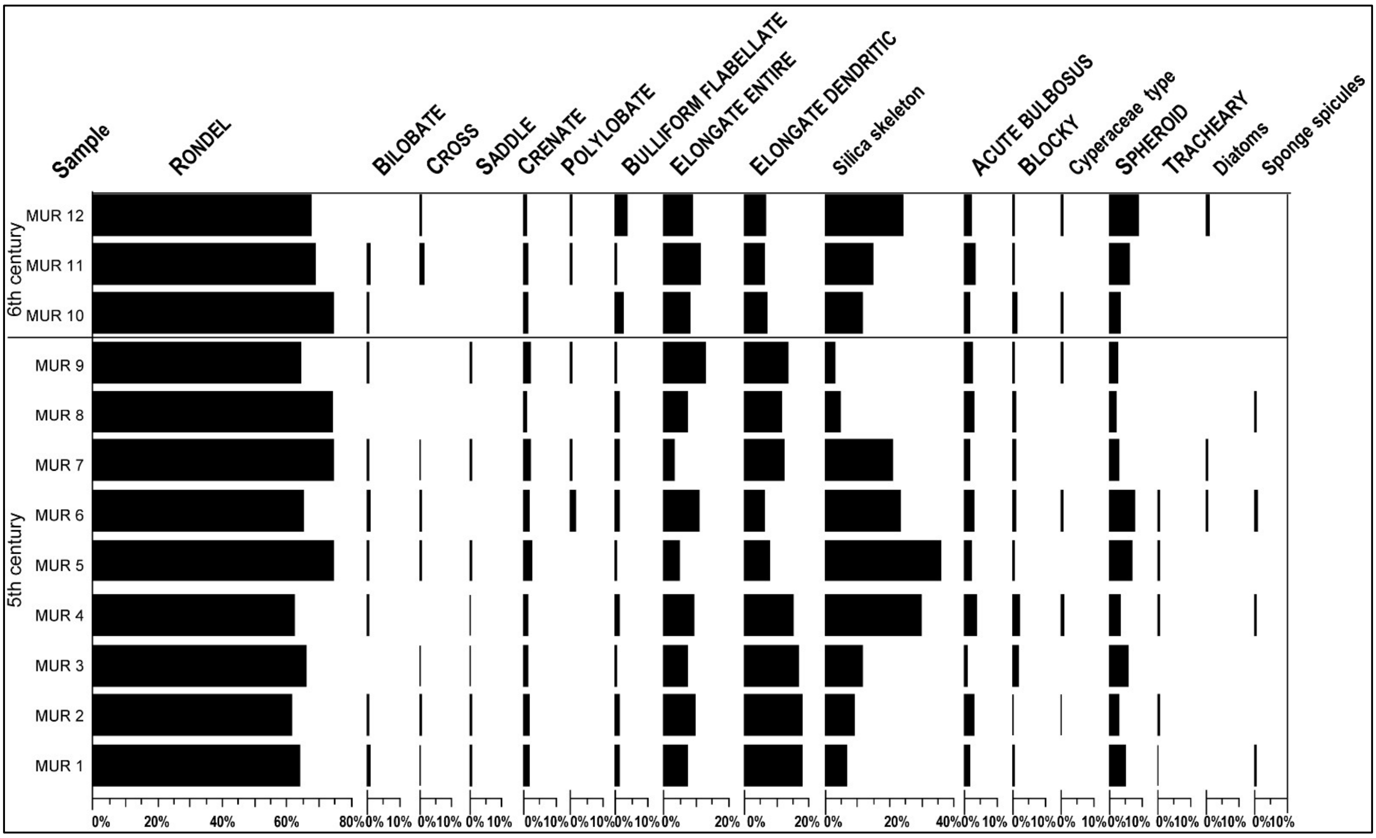

Figure 8. Phytolith diagram from Halmyris settlement, extramuros area.

RONDEL-type phytoliths clearly dominate in all samples (exceeding even 74% in both 5th- and 6th-century samples). In a temperate context such as this one, this morphotype can be considered as coming mainly from the subfamily Pooideae [18,64]. Additionally, in this subfamily, we can fit the CRENATE-type phytoliths. It is noted that modest percentages are recorded (maximum of 2.07% for the 5th century and maximum of 1.25% for the 6th century), but they are present in all the 12 samples.

Produced mainly by Panicoideae, BILOBATE-type phytoliths are a fairly constant presence in Halmyris, even if the percentages recorded are very small (maximum of 0.94% in both the 5th- and 6th-century samples). Only three samples did not preserve this morphotype.

The presence of the subfamily Panicoideae in Halmyris is also attested by the CROSS morphotype (maximum of 0.47% for the 5th century and maximum of 1.26% for the 6th century). Additionally, POLYLOBATE phytoliths confirm the presence of panicoids in the studied site (maximum 1.58%).

SADDLE-type phytoliths are a good indicator of the Chloridoideae subfamily, but they can also be produced by species of other subfamilies of grasses [54]. The punctual presence can be observed in most samples.

ELONGATE ENTIRE and ACUTE BULBOSUS are morphotypes produced in the vegetative parts of grasses. These phytoliths are constant presences in Halmyris samples. ELONGATE ENTIRE is better represented than ACUTE BULBOSUS, recording maximum percentages of 12.95% for the 5th century and 11.32% for the 6th century.

The diagram reveals a significant presence of ELONGATE DENDRITIC–type phytoliths. These are forms that come from the inflorescences of grasses [65] and that, in archaeological research, are used as indicators for the presence of cereals [66]. Studies indicate that their important share in the archaeological context is an indication of the accumulation of these plants [66].

Extremely well represented are the articulated phytoliths—*silica skeletons*, representing almost 36% in a sample of the 5th century. Important increases of the values are observed in the samples of both the 5th and 6th century.

Besides the grasses, the Cyperaceae family is also a good producer of phytoliths [67]. In the analysed samples, we also identified phytoliths specific to CYPERACEAE type, but the percentages were extremely low (maximum of 0.77% for the 5th century samples and 0.60% for the 6th century).

BLOCKY-type phytoliths can be produced by both monocotyledonous and dicotyledonous plants, as well as conifers [54,68]. Some studies [69] indicate that in the marshy areas, an abundance of BLOCKY and ELONGATE ENTIRE phytoliths can be recorded, suggesting an abundant presence of species from the Cyperaceae family. At Halmyris, only ELONGATE ENTIRE phytoliths are better represented, the BLOCKY morphotype being a constant presence, but extremely low.

BULLIFORM FLABELLATE are phytoliths originating from epidermal cells, disposed longitudinally in leaves of the Poaceae and Cyperaceae species [54,70]. The percentages recorded by them are not at all high, but this type is present in all samples analysed.

Phytoliths that are most often associated with dicotyledonous plants were identified in all samples. The SPHEROID morphotype, whose provenance is attributed mainly to this group of plants [71–73], completes the phytolith spectra from Halmyris. Considering the low production of phytoliths in the case of dicots, we consider as important values those recorded in the observed samples. The percentages of the SPHEROID morphotype reach up to 7.55% in the 5th-century samples and up to 8.76% in the 6th-century samples.

The analysis of phytoliths has brought to light particularly interesting results for this site. A homogeneity of the spectra recorded in the 12 samples is noted. However, there are also variations in certain identified morphotypes, variations that highlight agricultural concerns of Halmyris communities, intensified especially towards the middle of the 5th century. Percentages made by ELONGATE DENDRITIC phytoliths and by *silica skeletons* represent evidence not only of cereal presence, but also of their processing at the site during the 5th century. An intense activity of cereal processing is also observed in the 6th century, when the percentages of *silica skeletons* exceed 24%. The presence of phytoliths from dicotyledon plants, registering a curve with relatively the same tendency as that made by *silica skeletons*, suggests that there was no selection of the material. Additionally, the significant percentage of phytoliths coming from the leaves and stems, correlated with the percentage of *silica skeletons* coming from the same parts of the cereals, proves that whole plants (with straw) have been brought to the site. The flax fibres found in the analysed samples confirm that there was no rigorous selection, among the cereals being other plants, such as *Linum.* In other Romano-Byzantine sites in Dobrogea (e.g., the Ibida site), the analysis of the phytoliths also highlighted the dominance of Poaceae [13,24] and the presence of cereals in the fortress [13], but still there was no signal of grain processing in situ. A situation similar to the one in Halmyris was registered for another site in Dobrogea. Such high percentages of ELONGATE DENDRITIC phytoliths, as well as of *silica skeletons* (over 25%), characterize the spectrum of phytoliths obtained for the prehistoric site Taraschina [17,74].

4.2. Archaeozoology

The analysed sample from the extramuros area counts 2207 faunal remains. It consists of hand-retrieved faunal remains, collected in 2014 (a total of 234 sqm, five sections): 808 remains were recovered from section 1 (S1), 644 from section 2 (S2), 463 from section 3 (S3), and 292 from section 4 (S4). Their relative dating, for the 4th–6th centuries, was made in accordance with the archaeological contexts. Their taphonomic evaluation indicates that most of them are of domestic origin, being household waste mainly from food of animal origin. As can be seen from Table 2, about 38% of the total remains show traces of butchery, burn, and gnawing by other animals, most often dogs. We also mention that the degree of bone fragmentation is relatively high, so that for this reason, of the total number of mammal remains, about 15% could not be identified by species. A very small number of remains (i.e., bones and antlers), representing about 0.5% of the sample, showed signs of processing.

Table 2. Halmyris, Romania, 2014, extramuros area (4th–6th centuries AD). Distribution of remains with taphonomy evidence (NR = number of remains).

Taphonomy Evidence	NR	%
Remains with butchering traces	574	26.00
Remains with burn traces	74	3.35
Remains with animal teeth marks	187	8.47
Manufactured bones and antlers	12	0.54
Total sample	2207	100

The data for extramuros assemblage were compared with the intramuros assemblage [11,12]. The intramuros assemblage was collected during 2004–2007 archaeological excavations from the following areas: military barrack's block inhabited by the garrison soldiers, the assumed Episcopal Palace, a structure closely related to the activities in the northern gate and towers, the bathhouse, tower no. 2, a storage one with an apparent waterproof basin on its bottom for keeping fresh fish/meat products, and tower no. 12. The intramuros sample consists of 3553 faunal remains, of which 3457 originate in mammals, 87 in birds, and 9 in molluscs (Table 3). Fish remains, extremely numerous, were not identified and included in the analysis [11,12].

Table 3. Halmyris, Romania (4th–6th centuries AD). Distribution of animal remains by taxonomic groups (NR = number of remains).

Taxonomic Group	Species	Extramuros Sample		Intramuros Sample [11,12]	
		NR	%	NR	%
Molluscs	*Unio* sp. (freshwater mussel)	11	0.50	-	-
	Mytilus sp. (mussel)	1	0.04	-	-
	Unidentified molluscs	-	-	9	0.25
	Total molluscs	12	0.54	9	0.25
Fish	*Cyprinus carpio* (common carp)	43	1.95	-	-
	Silurus glanis (wels catfish)	77	3.49	-	-
	Esox lucius (northern pike)	4	0.18	-	-
	Acipenser sp. (sturgeons)	8	0.36	-	-
	Unidentified Teleostei	37	1.68	-	-
	Total fish	169	7.66	*	-
Reptiles	*Testudo* sp. (tortoise)	3	0.14	0	-
Birds	*Gallus domesticus* (chicken)	4	0.18	50	1.41
	Anser domesticus (goose)	-	-	5	0.14
	Anas plathyrinchos (duck)	-	-	4	0.11
	Unidentified bird	5	0.23	28	0.79
	Total birds	9	0.41	87	2.45
Mammals	Total mammals	2014	91.26	3457	97.30
Total sample		2207	100	3553	100

*—Although the number of fish remains was extremely high in the intramuros sample, they were not quantified.

The taxonomic identification indicates that several groups of animals were exploited as follows: molluscs (0.54%), fish (7.66%), reptiles (0.14%), birds (0.41%), and mammals (91.26%). Most of the remains belong to the group of mammals (91.26%) (Table 3). The same resources were also identified inside the fortress, except for reptiles (Table 3).

Identified molluscs in the extramuros sample are represented by freshwater and marine mussels (i.e., *Unio* sp.—11 remains and *Mytilus* sp.—one). Fish species identified in the same sample are presented in Table 3, summing a total of 169 remains; their high frequency also mentioned in the extramuros sample reinforces their importance for the community. Reptiles are represented by three dermal plaques of turtle (*Testudo* sp.) identified only in the extramuros sample. As regards bird species, *Gallus domesticus* was identified in both extra- and intramuros samples, and *Anser domesticus* and *Anas plathyrinchos* only in the intramuros sample.

The hunting was less important for the settlement under study, being indicated by the frequency of wild mammal remains identified in the extra- and intramuros samples (about 12% and 21%, respectively). The list of common wild mammal species identified in extra- and intramuros includes *Cervus elaphus*, *Sus scrofa*, *Capreolus capreolus*, *Bos primigenius*, *Lepus europaeus*, *Meles meles*, *Vulpes vulpes*, and *Castor fiber*. In addition to these, *Canis lupus* (extramuros) and *Lutra lutra* and *Martes martes* (intramuros) were also identified. *Cervus elaphus* and *Sus scrofa* have the highest proportions among wild mammals in both samples (Table 4).

Table 4. Halmyris, Romania (4th–6th centuries AD). Quantification of mammal remains by NR and MNI (NR = number of remains; MNI = minimum number of individuals).

Species	Extramuros Sample				Intramuros Sample [11,12]	
	NR	%	NR	%	NR	%
Bos taurus (cattle)	929	54.11	25	30.49	685	24.04
Ovis aries/Capra hircus (sheep/goat)	268	15.61	11	13.41	642	22.53
Sus domesticus (pig)	190	11.07	16	19.51	708	24.85
Equus caballus (horse)	63	3.67	4	4.88	127	4.46
Canis familiaris (dog)	46	2.68	4	4.88	58	2.04
Equus asinus (donkey)	10	0.58	2	2.44	16	0.56
Felis domesticus (cat)	-	-	-	-	8	0.28
Total domestic mammals	1506	87.71	62	75.61	2244	78.76
Cervus elaphus (red deer)	100	5.82	6	7.32	209	7.33
Sus scrofa (wild boar)	84	4.89	5	6.10	330	11.58
Capreolus capreolus (roe deer)	9	0.52	2	2.44	16	0.56
Lepus europaeus (hare)	2	0.12	1	1.22	10	0.35
Canis lupus (wolf)	4	0.23	1	1.22	-	-
Bos primigenius (auroch)	1	0.06	1	1.22	1	0.04
Castor fiber (beaver)	2	0.12	1	1.22	5	0.18
Meles meles (badger)	8	0.47	2	2.44	5	0.18
Lutra lutra (Eurasian otter)	-	-	-	-	10	0.35
Martes martes (pine marten)	-	-	-	-	8	0.28
Vulpes vulpes (fox)	1	0.06	1	1.22	11	0.39
Total wild mammals	211	12.29	20	24.39	605	21.24
Total identified mammals	1717	100.00	82	100.00	2849	100
Unidentified mammals	297				608	
Total mammals	2014				3457	

Considering the ecological affinities of the wild mammal species identified outside the fort, they were grouped into forest species (i.e., *Cervus elaphus*, *Sus scrofa*), forest edge/open space species (i.e., *Capreolus capreolus*, *Bos primigenius*, *Lepus europaeus*), semiaquatic species (i.e., *Castor fiber*), and eurytopic species (i.e., *Meles meles*, *Vulpes vulpes, Canis lupus*). The frequencies of these groups, as the number of remains, indicate the prevalence of forest species (Figure 9), meaning that not far from the settlement, there was a large forest, in which game such as red deer and wild boar could easily be found.

Domestic mammals represent the most important meat source in the settlement (within 4th–6th centuries AD), so in the two samples, about 87% and 78% remains, respectively, belong to these species (Table 4). The domestic mammal species identified in both samples are *Bos taurus*, *Ovis aries/Capra hircus*, *Sus domesticus*, *Equus caballus*, *Equus asinus*, and *Canis familiaris*; *Felis domesticus* was identified only in the intramuros sample. In the extramuros sample, cattle is predominant, followed by sheep/goat and pig by both the number of identified remains (NR) and the minimal number of individuals (Table 4). In intramuros, the pig has the highest frequency but only as NR, MNI not being estimated in the previous study.

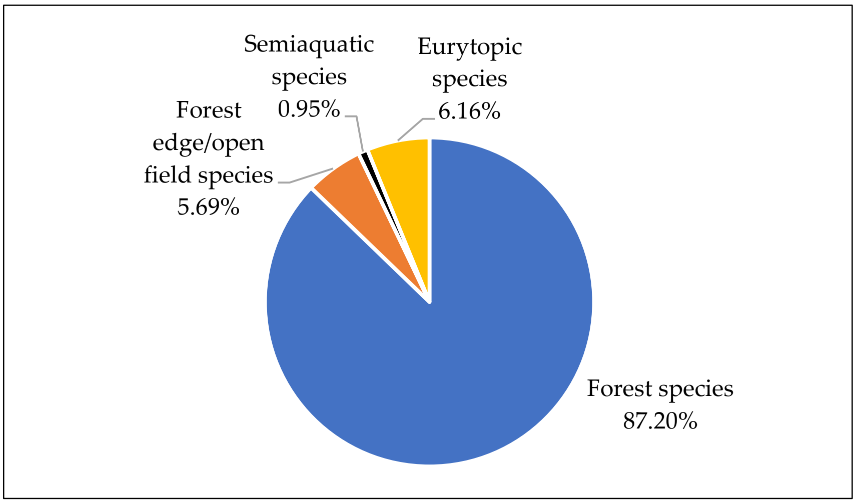

Figure 9. Halmyris, Romania, 2014, extramuros area (4th–6th centuries AD). Proportions of wild mammal species by ecological groups.

Following within the extramuros sample the distribution of the remains by skeletal regions in the mammal species with the highest frequencies, it is found that all body parts are represented (Figure 10). This indicates that the butchery of animals, both domestic and wild, was performed within the settlement.

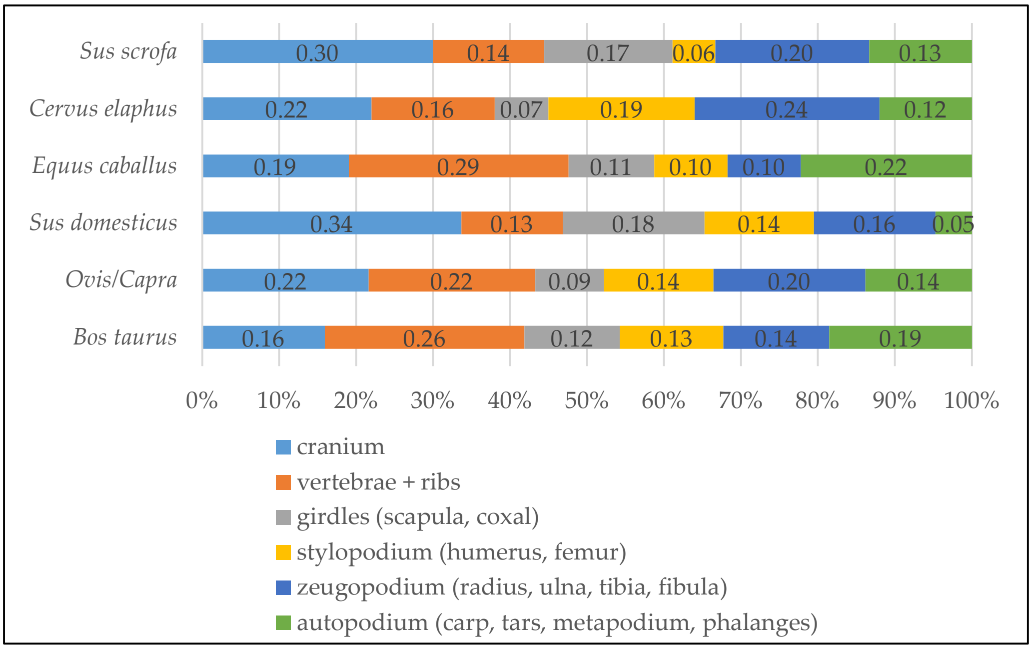

Figure 10. Halmyris, Romania, 2014, extramuros area (4th–6th centuries AD). Skeletal frequency in mammal species from extramuros sample.

The estimated slaughter ages indicate different exploitation strategies for domestic animals, depending on the species. Thus, within the extramuros sample, in domestic cattle and sheep/goats, slaughtered mature individuals appear predominantly, which means that they were kept for secondary products (e.g., milk, wool, traction force, breeding stock). The ratio between slaughtered adults and immatures appears higher in cattle than in sheep/goats (Figure 11; Table 5). In the case of pigs, this ratio is the opposite, with more individuals slaughtered at young ages to obtain meat and other products (e.g., fat, skin).

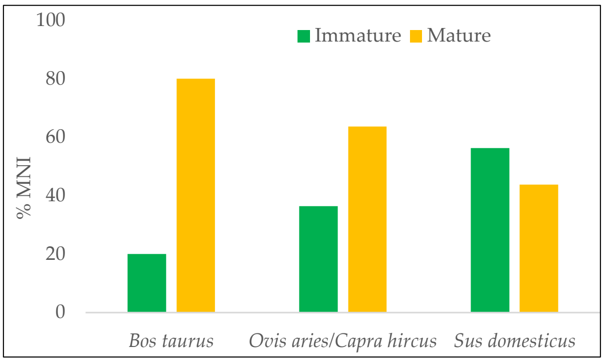

Figure 11. Halmyris, Romania, 2014, extramuros area (4th–6th centuries AD). Proportions between immature and mature estimated individuals of *Bos taurus* (cattle), *Ovis aries/Capra hircus* (sheep/goat), and *Sus domesticus* (pig) in extramuros sample.

Table 5. Halmyris, Romania, 2014, extramuros area (4th–6th centuries AD). Dental age of slaughter for estimated individuals of *Bos taurus*, *Ovis aries/Capra hircus*, and *Sus domesticus* in extramuros sample (MNI—minimal number of individuals).

Species	Category Immature/Mature	MNI	Age
Bos taurus (cattle)	Immature (under 2.5 years old)	1	4–6 months
		2	6–12 months
		1	12–18 months
		1	2–2.5 years
	Total	5	
	Mature MNI (over 2.5 years old)	1	2.5 years
		6	2.5–4 years
		13	Over 4 years
	Total	20	
Ovis aries/Capra hircus (sheep/goat)	Immature (under 2 years old)	1	3–6 months
		1	1–1.5 years
		2	1.5–2 years
	Total	4	
	Mature (over 2 years old)	1	2 years
		2	2–3 years
		4	Over 3 years
	Total	7	
Sus domesticus (pig)	Immature (under 2 years old)	3	4–6 months
		3	6–9 months
		3	13–18 months
	Total	9	
	Mature MNI (over 2 years old)	1	2 years
		3	2–3 years
		3	Over 3 years
	Total	7	

The sex ration in cattle is of 15 castrated males: 13 females: 4 males (Table 6). Therefore, in this case, the management of cattle stock was aimed at ensuring traction force, securing milk production and a breeding stock, based on keeping most castrated males and females at adult ages, and only a small number of males.

Table 6. Halmyris, Romania, 2014, extramuros area (4th–6th centuries AD). Estimations of withers height and sex based on osteometric data (used coefficients as follows: Fock [58] for *Bos taurus*, Teichert [59] for *Ovis aries*, Schramm [60] for *Capra hircus*, Teichert [61,62] for *Sus domesticus* and *Sus scrofa*, and Harcourt [63] for *Canis familiaris*).

Species	Anatomical Element	Bone Length (mm)	Sex Estimation	Withers Height (cm)
Bos taurus	metacarpus	218	castrated	133.41
Bos taurus	metacarpus	205	castrated	125.46
Bos taurus	metacarpus	204	castrated	124.84
Bos taurus	metacarpus	190	castrated	116.28
Bos taurus	metacarpus	192	female	115.20
Bos taurus	metacarpus	205	female	123.00
Bos taurus	metacarpus	186	female	111.60
Bos taurus	metacarpus	204	female	122.40
Bos taurus	metacarpus	201	female	120.60
Bos taurus	metacarpus	195	female	117.00
Bos taurus	metacarpus	195	male	121.87
Bos taurus	metacarpus	199	castrated	121.78
Bos taurus	metacarpus	202	castrated	123.62
Bos taurus	metacarpus	203	castrated	124.23
Bos taurus	metacarpus	183.5	castrated	112.30
Bos taurus	metacarpus	192	castrated	117.50
Bos taurus	metacarpus	181	female	108.60
Bos taurus	metacarpus	182	female	109.20
Bos taurus	metacarpus	215	male	134.37
Bos taurus	metatarsus	217	castrated	118.26
Bos taurus	metatarsus	248	castrated	135.16
Bos taurus	metatarsus	234	castrated	127.53
Bos taurus	metatarsus	244	castrated	132.98
Bos taurus	metatarsus	225	female	120.37
Bos taurus	metatarsus	218	female	116.63
Bos taurus	metatarsus	220	female	117.70
Bos taurus	metatarsus	232	male	128.76
Bos taurus	metatarsus	208	male	115.44
Bos taurus	metatarsus	227	female	121.44
Bos taurus	metatarsus	218	female	116.63
Bos taurus	metatarsus	230	castrated	125.35
Bos taurus	metatarsus	237	castrated	129.16

Table 6. *Cont.*

Species	Anatomical Element	Bone Length (mm)	Sex Estimation	Withers Height (cm)
Capra hircus	metacarpus	137	-	78.77
Capra hircus	metacarpus	126.5	-	72.73
Capra hircus	metatarsus	126	-	67.28
Ovis aries	metatarsus	148.5	-	67.42
Ovis aries	metatarsus	141	-	64.01
Ovis aries	metatarsus	150	-	68.10
Ovis aries	metatarsus	147	-	66.73
Sus domesticus	metacarpus 4	77.5	-	78.66
Sus scrofa	calcaneus	106	-	101.60
Sus scrofa	metatarsus 3	108	-	101.43
Sus scrofa	metatarsus 3	108.5	-	101.89
Sus scrofa	radius	210	-	109.16
Sus scrofa	astragalus	53	-	97.17
Sus scrofa	astragalus	56	-	102.5
Canis familiaris	tibia	193	-	57.29
Canis familiaris	femur	141	-	42.97
Canis familiaris	humerus	170	-	55.65
Canis familiaris	femur	217	-	66.84
Canis familiaris	tibia	196	-	58.17
Canis familiaris	femur	195.5	-	60.09

The osteometric analysis of the extramuros remains shows a dimensional variability among domestic species, especially in the case of cattle. Most heights at the withers were calculated for cattle, varying between 108 and 135 cm (Table 6). The existence of tall individuals (4 heights at the withers in the range of 131–136 cm) is noted, but also of much smaller waists (6 heights at the withers in the range of 186–116 cm). The appearance of very large cattle, sheep, and goats throughout Roman provinces that is evidenced by biometric analyses of animal remains is also testified by other many archaeological sites. In Romania, this phenomenon was highlighted for the first time by Alexandra Bolomey, who hypothesized the existence at Histria of both improved animals brought by the Romans and nonimproved native [75]. Later, Haimovici [76] confirmed this hypothesis by analysing samples from Teliţa Amza (2nd–4th centuries), Dinogetia (4th–6th centuries), Histria (6th century).

In the case of other domestic animals (i.e., sheep, goat pig, and dog), the withers heights were calculated in a smaller number and the differences between them can rather be attributed to individual variability (Table 6). However, these data are important for knowing the body size of the animals in the livestock, being also useful for future studies of regional synthesis.

The appearance of very large cattle, sheep, and goats throughout Roman provinces that is evidenced by biometric analyses of animal remains is also testified by Roman sites in Serbia. During the late Iron Age, cattle withers heights reached the lowermost point (106–109 cm) [32] in the region, while at Roman sites, withers heights ranged from 100 to 140 cm, which suggest the presence of small "local" breeds and also of improved breeds of cattle [32]. "The increase of cattle size is linked to the Roman acquisition and has been evidenced throughout Europe. It is usually explained by the import of large breeds from other provinces (mainly Italy), and their crossbreeding with local breeds, but also by import of new foodstuffs and selection of specific local breeds. However, improved breeds of cattle enabled a wide range of new advantages, such as an increased quantity of meat which was a necessity due to the growth of the cities and the population in them, but also greater strength of traction animals" [32].

The tendency to increase the cattle withers heights from the Roman provinces, compared with those raised in the previous period, is known and considered as a response to the new economic situation in the empire's provinces. In the Roman West, we see the development of taller and more robust domestic animals than during the Iron Age. This has been observed for sites in the northwestern third of France, Belgium, and the Netherlands; most individuals are over 1.30 m [77]. The same trend was observed for the north of Italy [78]; the roman cattle withers heights are 125 to 150 cm, while the native cattle withers heights reach an average of 110 cm [79].

To contextualize the faunal remains, the data for the settlements of Histria, Ibida, and Dinogetia were used for comparison in the frequencies of taxa (Table 7).

Table 7. Distribution of animal remains by taxonomic groups in faunal comparative samples (NR = number of remains).

Sample	Taxonomic Group	Mollusca (Molluscs)	Pisces (Fish)	Reptilia (Reptiles)	Aves (Birds)	Mammalia (Mammals)	Total
Halmyris (extramuros)	NR	12	169	3	9	2013	2207
	%	0.54	7.66	0.14	0.41	91.26	100
Halmyris (intramuros) [11]	NR	9	0	0	87	3457	3553
	%	0.25	0	0	2.45	97.3	100
Histria (6th century AD) [80]	NR	0	0	0	0	570	570
	%	0	0	0	0	100	100
Ibida [13]	NR	0	33	0	0	923	956
	%	0	3.45	0	0	96.55	100
Ibida [24]	NR	31	9131	0	186	8045	17393
	%	0.18	52.50	0	1.07	46.25	100
Dinogetia (4th–6th centuries AD) [81]	NR	16	28	0	7	129	180
	%	8.89	15.55	0	3.89	71.67	100

The fish remains in the samples are represented by bones and scales, mostly from teleosts and, only a few scales, from sturgeons. The largest share of fish remains is in the sample from Ibida, which also has the greatest diversity of identified species. At Dinogetia [81], three species of teleostean fish (*Cyprinus carpio, Silurus glanis*, and *Esox lucius*) were identified, as in Halmyris. At Ibida, besides the *Acipenser* sp., 12 teleostean fish species were identified: *Esox lucius, Abramis brama, Aspius aspius, Blicca bjoerkna, Cyprinus carpio, Pelecus cultratus, Rutilus rutilus, Scardinius erythrophthalmus, Tinca tinca, Silurus glanis, Perca fluviatilis,* and *Stizostedion lucioperca* [82].

In all settlements, domestic mammals have the highest share: 78.7% Halmyris [11,12], 87.7% Halmyris (current study), 90.6% Dinogetia [81], 97.2% Histria [80], and Ibida—92%, respectively, 94%–96% [13,24]. Eight species were identified for domestic mammals (*Bos taurus, Ovis aries, Capra hircus, Sus domesticus, Equus caballus, Equus asinus, Canis familiaris*, and *Felis domesticus*); the cat is missing only at Dinogetia and Halmyris (current study). However, there are differences regarding the proportion of the main domestic species in these samples. The situation with the highest proportion for domestic cattle, followed by sheep/goat and pigs, is found at Ibida, Histria, and Halmyris (current study). At Dinogetia, there is a change in the sense that on the second position is the pig, followed by sheep/goat.

In Halmyris intramuros [11], the highest share is for the pig, followed by the cattle and then sheep/goat.

The number of identified wild mammal species differs from one sample to another. At Dinogetia, only 3 species were identified (*Cervus elaphus, Sus scrofa*, and *Castor fiber*) [81]; at Histria, 5 species (*Cervus elaphus, Sus scrofa, Capreolus capreolus*, and *Phocena relicta*) [80]; at Ibida, 10 species (*Cervus elaphus, Sus scrofa, Capreolus capreolus, Bos primigenius, Canis lupus, Lepus europaeus, Meles meles, Vulpes vulpes, Ursus arctos,* and *Delphinus* sp.) [13,24]; and at Halmyris, 11 species (*Cervus elaphus, Sus scrofa, Capreolus capreolus, Bos primigenius, Canis lupus, Lepus europaeus, Meles meles, Vulpes vulpes, Castor fiber, Lutra lutra,* and *Martes martes*). Red deer and wild boar occur in all the studied samples and have the highest share among wild mammals. The beaver occurs only in Dinogetia and Halmyris. The auroch was identified at Histria, Halmyris, and Ibida. The beaver and the auroch are extinct species in the nowadays fauna of Romania. Red deer and bear are species that have narrowed their distribution area to the Carpathian area, and are no longer found in the area under study.

5. Conclusions

Halmyris is one of the most important Roman settlements located in the easternmost part of Scythia, province during the Late Antiquity. The fortress played an important defensive role in the terminal segment of the Danube limes, being part of the military system built on the southern shore of the Danube peninsula (extrema Scythiae minoris)—a chain of seven (known) fortresses, auxiliary forts, and a naval base (reliquatio). From its history of more than five centuries of Romanity, the present study focuses on the period of the 4th–6th centuries. Archaeological research confirms the existence of an intense elaborate economic life (certified, among many other evidences, by the existence of a bone and antler workshop).

The multidisciplinary analyses carried out on the samples taken during the archaeological survey in 2014 complement the archaeological information, bringing new data on the diet of the military and civilians, the current occupations, the existing supply chains during this period of the 4th–6th centuries AD.

Biological proxies highlight the fact that the subsistence economy of the Halmyris inhabitants was based mainly on plant cultivation and animal husbandry.

Agriculture and cereal processing is clearly attested. The phytolith analysis reveals the dominant presence of grasses and demonstrates that cereals were a particularly important source for the palaeoeconomy of Halmyris communities of the 5th and 6th centuries. Phytoliths pointing to abundant chaff residues and grain processing residues were identified in all samples. It turns out that the cereals, but also the chaff, were mixed with leaves of dicotyledonous plants, which means that there was no special selection of plants (cereals) subjected to processing, during both the 5th and 6th centuries. The cereals, which were probably processed in the extramuros, were intended to feed the human inhabitants rather than their animals.

The exploited animal resources are varied, including molluscs, fish, birds, and mammals. Most of the remains belong to the group of mammals. Animal husbandry represented an important occupation, and the identified domestic mammals are cattle, sheep, goat, pig, horse, donkey, and dog. The predominant domestic species are cattle, sheep/goat, and pig by both the number of identified remains and the minimal number of individuals. The osteometric analysis shows a dimensional variability among domestic species, especially in the case of cattle. Cattle of large size were identified, belonging to a supposed breed improved by the Romans. The estimated slaughter ages indicate different exploitation strategies for domestic animals, depending on the species. The ruminants (cattle, sheep/goats) were slaughtered predominantly at mature ages, which means that they were kept mainly for secondary products. In pig appear more individuals slaughtered at young ages to obtain meat and other primary products (e.g., fat, skin).

Hunting has a relatively small importance for the settlement under study. However, the diversity of identified wild species (e.g., red deer, wild boar, roe deer, aurochs, hare, wolf, badger, beaver, and fox) reflects a variety of exploited environments—forest, open field, aquatic. The frequencies of these groups, as the number of remains, indicate the prevalence of forest species, meaning that not far from the settlement, there was a large forest, in which game could easily be found. Among these, forest species such as red deer and wild boar have the highest proportion as wild mammals, being hunted mainly as a supplemental source of food.

Archaeozoological and phytolith results as a whole indicate that the Halmyris settlement was in an open space, dominated by grasses. This hypothesis is supported by phytolith data, e.g., the dominance of grasses, but also by the archaeozoological analysis, e.g., dominance of cattle and sheep/goat. Remains of plant and animal are important sources of evidence regarding environment, production of food, and other purposes in the ancient communities. Future research on carpological remains, if discovered, as well as pollen analyses, could complete the information obtained in this study; also, the animal remains could be subjected to stable isotope analyses, providing valuable additional information.

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References

1. Teodor, E.S. The Border area between Moesia Secunda and Scythia Minor in a topographical approach. In *Identităţi Culturale, Locale Şi Regionale în Context European. Studii de Arheologie şi Antropologie Istorică. In Memoriam Alexandri V. Matei*; Matei, A.V., Pop, H., Bejinariu, I., Băcueţ-Crişan, S., Băcueţ-Crişan, C., Eds.; Mega: Cluj-Napoca, Romania, 2010; pp. 421–438.
2. Zahariade, M. *Moesia Secunda, Scythia și Notitia Dignitatum*; Biblioteca de arheologie, Editura Academiei: București, Romania, 1988.
3. Zahariade, M. *The Scythian Section of Notitia Dignitatum: A Structural and Chronological Analysis. Ad Fines Imperii Romani. Studia Thaddaeo Sarnowski Septuagenario ab Amicis, Collegis Discipulisque Dedicata*; Institute of Archaeology, University of Warsaw: Warsaw, Poland, 2015; pp. 151–172.
4. Țentea, O.; Opriș, I.C.; Popescu, F.-M.; Rațiu, A.; Băjenaru, C.; Călina, V. Frontiera romană din Dobrogea. O trecere în revistă și o actualizare. *Cercet. Arheol.* **2019**, *26*, 9–82. [CrossRef]
5. Zahariade, M.; Lungu, V.; Covacef, Z. *Scythia Minor. A History of a Later Roman Province (284-681)*; Pontic Provinces of the Later Roman Empire I; Adolf M. Hakkert: Amsterdam, The Netherlands, 2006.
6. Ellis, L.; Places, E. A Chorological Approach to Identity and Territory in Scythia Minor (Second-Seventh Centuries). In *Romans, Barbarians, and the Transformation of the Roman World*; Ralph, W.M., Danuta, S., Eds.; Ashgate: Surrey, UK, 2011; pp. 241–251.
7. Ştefan Al., S. Cetatea romană târzie de la Murighiol. *Studiu aerofotografic. Peuce* **1984**, *9*, 663–674.
8. Dintchev, V. Sur la caracteristique d'Iatrus (deuxieme moitie du Ive—debut du Ve s.) in Vorträge der Internationalen Konferenz Svištov, Bulgarien (1–5 September 1998). In *Der Limes an der Unteren Donau von Diokletian bis Heraklios*; Herausgegeben von Gerda von Bülow und Alexandra Milčeva: Sofia, Bulgaria, 1999; pp. 165–174.
9. Van Lanen, R.; de Kleijn, M.; Gouw-Bouman, M.; Pierik, H. Exploring Roman and early-medieval habitation of the Rhine–Meuse delta: Modelling large-scale demographic changes and corresponding land-use impact. *Neth. J. Geosci.* **2018**, *97*, 45–68. [CrossRef]
10. King, A. The Romanization of diet in the western empire: Comparative archaeozoological studies. In *Italy and the West, Comparative Issues in Romanization*; Keay, S., Terrenato, N., Eds.; Oxbow Books: Oxford, UK, 2001; pp. 210–223.

11. El Susi, G. Data about hunting practices by Halmiris (Murighiol, Tulcea County) inhabitants in 4th–7th centuries AD. *Cult. și civ. la Dunărea de Jos* **2008**, *24*, 201–210.
12. El Susi, G. Animal breedind in late Roman settlements from Dobrudja, in the light of research at Murighiol (Halmyris, Tulcea county). *Cult. și civ. la Dunărea de Jos* **2011**, *28*, 170–189.
13. Stanc, S.; Danu, M.; Paraschiv, D.; Bejenaru, L. Bioarcheological Indicators Related to Human–Environmental Interactions in a Roman–Byzantine Settlement in Southeast Romania: Ibida Fortress. *SAGE Open* **2020**, *10*, 2158244020969664. [CrossRef]
14. Kibblewhite, M.; Tóth, G.; Hermann, T. Predicting the preservation of cultural artefacts and buried material in soil. *Sci. Total Environ.* **2015**, *529*, 249–263. [CrossRef] [PubMed]
15. Dal Corso, M.; Out, W.A.; Ohlrau, R.; Hofmann, R.; Dreibrodt, S.; Videiko, M.; Müller, J.; Kirleis, W. Where are the cereals? Contribution of phytolith analysis to the study of subsistence economy at the Trypillia site Maidanetske (ca. 3900-3650 BCE), central Ukraine. *J. Arid Environ.* **2018**, *157*, 137–148. [CrossRef]
16. Danu, M.; Diaconu, V.; Bejenaru, L. Chalcolithic agropastoralism traces in the site of Răucești (Neamț county, Romania): Phytoliths and animal remains. *Int. J. Conserv. Sci.* **2016**, *7*, 1071–1080.
17. Danu, M.; Messager, E.; Carozza, J.M.; Carozza, L.; Bouby, L.; Philibert, S.; Anderson, P.; Burens, A.; Micu, C. Phytolith evidence of cereal processing in the Danube Delta during the Chalcolithic period. *Quat. Int.* **2019**, *504*, 128–138. [CrossRef]
18. Delhon, C.; Binder, D.; Verdin, P.; Mazuy, A. Phytoliths as a seasonality indicator? *The example of the Neolithic site of Pendimoun, south-eastern France. Veget. Hist. Archaeobotany* **2020**, *29*, 229–240.
19. Malaxa, D.I.; Stanc, M.S.; Bărbat, I.A.; Gâza, O.; Păceşilă, D.; Bejenaru, L.; Danu, M. Farming Beginning in Southwestern Transylvania (Romania). Subsistence Strategies in Mureş Valley during the Early Neolithic. *Diversity* **2022**, *14*, 894. [CrossRef]
20. Pető, Á.; Kenéz, Á.; Prunner, A.C.; Lisztes-Szabó, Z. Activity area analysis of a Roman period semi-subterranean building by means of integrated archaeobotanical and geoarchaeological data. *Veg. Hist. Archaeobotany* **2015**, *24*, 101–120. [CrossRef]
21. Wouters, B.; Devos, Y.; Vrydaghs, L.; Ball, T.; De Winter, N.; Reygel, P. An integrated micromorphological and phytolith study of urban soils and sediments from the Gallo-Roman town Atuatuca Tungrorum, Belgium. *Geoarchaeology* **2019**, *34*, 448–466. [CrossRef]
22. Druzhinina, O.; van den Berghe, K.; Golyeva, A. Application of the microbiomorphic (phytolith) analysis in the geoarchaeological study of the land-use at the Voorthuizen-Wikselaarseweg archaeological site (Netherlands). In Proceedings of the EGU General Assembly 2021, online, 19–30 April 2021. EGU21-9043. [CrossRef]
23. Kirchner, A.; Herrmann, N.; Matras, P.; Müller, I.; Meister, J.; Schattner, T.G. A pedo-geomorphological view on land use and its potential in the surroundings of the ancient Hispano-Roman city Munigua (Seville, SW Spain). *EG Quat. Sci. J.* **2022**, *71*, 123–143. [CrossRef]
24. Pîrnău, R.-G.; Stanc, S.M.; Roșca, B.; Bejenaru, L.; Danu, M. A Multidisciplinary Approach to Human–Environmental Interactions at the Roman-Byzantine Ibida Fortress (Dobrogea, South-Eastern Romania). *Environ. Archaeol.* **2022**. [CrossRef]
25. Pîrnău, R.G.; Patriche, C.-V.; Roşca, B.; Vasiliniuc, I.; Vornicu, N.; Stanc, S. Soil spatial patterns analysis at the ancient city of Ibida (Dobrogea, SE Romania), via portable X-ray fluorescence spectrometry and multivariate statistical methods. *Catena* **2020**, *189*, 104506. [CrossRef]
26. Stanc, S.; Stănică, A.D.; Bejenaru, L.; Danu, M. Archaeological animal remains from Noviodunum fortress. *Int. J. Conserv. Sci.* **2021**, *12*, 195–204.
27. Stanc, S. *Arheozoologia Primului Mileniu d.Hr. Pentru Teritoriul Cuprins între Dunăre şi Marea Neagră*; Editura Universităţii Alexandru Ioan Cuza Iaşi: Iaşi, Romania, 2009.
28. Stanc, S.; Bejenaru, L. Animal resources exploited in settlements of the 2nd–7th centuries in the area between Danube and Black Sea: Archaeozoological data. *Istros* **2013**, *19*, 389–409.
29. Neef, R. Archäobotanische Untersuchungen im spätantiken Iatrus/Krivina (Grabungskampagnen 1992–2000), in Gerda von Büllow, Burkhard Böttger, Sven Conrad, Bernhard Döhle, Gudrun Gomolka-Fuchs, Edith Schönert-Geiss, Dimităr Stančev und Klaus Wachtel. In *Iatrus-Krivina. Spätantike Befestigung und frühmittelalterliche Siedlung an der Unteren Donau. Band VI: Ergebnisse der Ausgrabungen 1992–2000*; Römisch-Germanische Kommission des Deutschen Archaölogischen Instituts, Frankfurt a.M., Verlag Philipp von Zabern, Mainz am Rhein: Frankfurt, Germany, 2007; pp. 415–446.
30. Lazarova, M. Pollenanalytische Untersuchungen an Material aus den archäologischen Ausgrabungen im Kastell Iatrus, in Gerda von Büllow, Burkhard Böttger, Sven Conrad, Bernhard Döhle, Gudrun Gomolka-Fuchs, Edith Schönert-Geiss, Dimităr Stančev und Klaus Wachtel. In *Iatrus-Krivina. Spätantike Befestigung und Frühmittelalterliche Siedlung an der Unteren Donau. Band VI: Ergebnisse der Ausgrabungen 1992–2000*; Römisch-Germanische Kommission des Deutschen Archaölogischen Instituts, Frankfurt a.M., Verlag Philipp von Zabern, Mainz am Rhein: Frankfurt, Germany, 2007; pp. 447–456.
31. Niemczak, K. Archaeozoological analysis of animal remains from the Roman fortress camp in Novae. *Novensia* **2016**, *27*, 55–82.
32. Vuković-Bogdanović, S. Roman archaeozoology in Serbia: State of the discipline and preliminary results. In *Archaeology and Science*; Institute of Archaeology: Belgrade, Serbia, 2016; Volume 13, pp. 99–113.
33. King, A. Diet in the Roman world: A regional inter-site comparison of the mammal bones. *J. Rom. Archaeol.* **1999**, *12*, 168–202. [CrossRef]

34. Zahariade, M. The Aegyssus/Ad Stoma-Roman Frontier Sector in Extrema Scythiae Minoris: Understanding a Defensive System in a River Delta Environment. In *Kontaktzone Balkan. Contributions to the International Colloquium "The Danube-Balkan Region as a Contact Zone between East-West and North-South" from 16–18 May 2012 in Frankfurt a. M.*; von Bülow, G., Ed.; Rdolf Habelt Verlag: Bonn, Germany, 2015; pp. 219–235.
35. Suceveanu, A.; Zahariade, M. Du nom antique de la cité romaine tardive d'lndependenta (dep. de Tulcea). *Dacia N.S.* **1987**, *31*, 87–96.
36. Zahariade, M.; Suceveanu, A.; Opaiț, A.; Opaiț, C.; Topoleanu, F. Early and Late Roman Fortification at lndependența, Tulcea County. *Dacia N.S.* **1987**, *31*, 97–106.
37. Zahariade, M. An Early and Late Roman Fort on the Lower Danube Limes: Halmyris (Independența, Tulcea County, Romania). In *Roman Frontier Studies 1989, Proceedings of the XVth International Congress of Roman Frontier Studies, University of Canterbury, UK, 2-10 September 1989*; Maxfield, V.A., Dobson, M.J., Eds.; University of Exeter Press: Exeter, UK, 1991; pp. 311–317.
38. Suceveanu, A.; Zahariade, M.; Topoleanu, F.; Poenaru Bordea, G. Halmyris. In *Halmyris I. Monografie Arheologică*; Editura Neremia Napocae: Cluj-Napoca, Romania, 2003.
39. Zahariade, M. From dava to civitas: Halmyris, a Getic, Early and Late Roman Settlement on the Lower Danube. In *The Bosporus: Gateway between the Ancient West and East (1st Millennium BC-5th Century AD), Proceedings of the Fourth International Congress on Black Sea Antiquities Istanbul, 14th–18th September 2009*; Tsetskhladze, G., Atasoy, S., Avram, A., Dönmez, S., Hargrave, J., Eds.; BAR International Series 2517: Oxford, UK, 2013; pp. 207–212.
40. Romanescu, G.; Mihu-Pintilie, A.; Carboni, D. *The City-Port of Halmyris: An Integrated Geoarchaeological and Environmental Approach to the Last Roman Bastion on the Eastern Flank of the Danubian Limes*; PESD, Alexandru Ioan Cuza University Publishing House: Iași, Romania, 2018; Volume 2, pp. 25–46.
41. Giaime, M.; Magne, G.; Bivolaru, A.; Grandouin, E.; Marriner, N.; Morhange, C. Halmyris: Geoarchaeology of a fluvial harbour on the Danube Delta (Dobrogea, Romania). *Holocene* **2019**, *29*, 313–327. [CrossRef]
42. Suceveanu, A.; Zahariade, M. A New Vicus on the Territory of Roman Dobrudja. *Dacia N.S.* **1986**, *30*, 109–120.
43. Zahariade, M. The Northern and Western Gates of the Halmyris Fort. In *Limes XX. XXth International Congress of Roman Frontier Studies (LIMES XX Gladius, Anejos 13)*; Morillo, A., Hanel, N., Martin, E., Eds.; Consejo Superior de Investigaciones Cientificas: Madrid, Spain, 2009; pp. 77–88.
44. Mărgineanu Cârstoiu, A.; Apostol, V. La fortification d'Halmyris: Étude architecturale des Portes Ouest et Nord. *Caiete ARA* **2015**, *6*, 37–78. [CrossRef]
45. Zahariade, M. The Halmyris Episcopal Basilica and the Martyrs' Crypt. *Il Mar Nero* **2001–2003**, *5*, 143–168.
46. Zahariade, M. The Episcopal Basilica from Halmyris and the Crypt of Epictetus and Astion. *Thraco-Dacica S.N.* **2009**, *1*, 131–150.
47. Miriţoiu, N.; Soficaru, A.D. Anthropological study of the human bones found in the crypt from Halmyris. *Thraco-Dacica S.N.* **2009**, *1*, 151–181.
48. Nuțu, G. Le "Zwiebelknopffibeln" da Halmyris (Provincia Scythia). *Quad. Friulani Di Archeol.* **2010**, *20*, 99–108.
49. Nuțu, G. Belt buckles, strap-ends and appliqués from Halmyris (Moesia Inferior/Scythia). *Novensia* **2011**, *22*, 171–199.
50. Rafailă-Stan, S.; Nuţu, G. Worked bone and antler from Halmyris: An insight on everyday life of a frontier post of scythia. *Quat. Int.* **2018**, *472*, 142–148. [CrossRef]
51. Zahariade, M. Personal Names at Halmyris. *Thraco-Dacica S.N.* **2012–2013**, *4–5*, 159–182.
52. Zahariade, M.; Alexandrescu, C.G. *Greek and Latin Inscriptions from Halmyris. Inscriptions on Stone, Signa, and Instruments Found between 1981 and 2010*; BAR IS: Oxford, UK, 2011.
53. Lentfer, C.J.; Boyd, W.E. A comparison of three methods for the extraction of phytoliths from sediments. *J. Archaeol. Sci.* **1998**, *25*, 1159–1183. [CrossRef]
54. International Committee on Phytolith Taxonomy (ICPT). International code for phytolith nomenclature (ICPN) 2.0. *Ann. Bot.* **2019**, *124*, 189–199. [CrossRef]
55. Udrescu, M.; Bejenaru, L.; Hriscu, C. *Introducere în Arheozoologie*; Editura Corson: Iași, Romania, 1999.
56. Reitz, E.J.; Wing, E.S. *Zooarchaeology (Cambridge Manuals in Archaeology)*, 2nd ed.; Cambridge University Press: Cambridge, UK, 2008.
57. von den Driesch, A. A guide to the measurement of animal bones from archaeological sites. In *Peabody Museum Bulletin 1*; Harvard University Press: Cambridge, MA, USA, 1976; pp. 1–137.
58. Fock, J. *Metrische Untersuchungen an Metapodien Einiger Europäischer Rinderrassen. Diss.Med. vet., LMU-München*; Ludwig-Maximilians-Universität München: München, Germany, 1966.
59. Teichert, M. Osteometrische Untersuchungen zur Berechnung der Widerristhohe bei Schafen. In *Archaeozoological Studies*; Clason, A.T., Ed.; North-Holland Publishing Company: Amsterdam, The Netherlands, 1975; pp. 51–69.
60. Schramm, Z. Różnice morfologiczne niektórych kości kozy i owcy/Morphological differences of some goat and sheep bones. *Roczniki Wyższej Szkoły Rolniczej w Poznaniu. Wydział Zootech.* **1967**, *10*, 107–133.
61. Teichert, M. Osteometrische untersuchungen zur berechnung der wide, risthöhe bei vor- und frühgeschichtlichen schweinen. *Kühn-Archiv* **1969**, *83*, 237–292.
62. Teichert, M. Withers height calculations for pigs—Remarks and experience. In Proceedings of the Handout distributed at the 6th ICAZ Conference, Washington, DC, USA, 21–25 May 1990.
63. Harcourt, R.A. The dog in prehistoric and early historic Britain. *J. Archaeol. Sci.* **1974**, *1*, 151–175. [CrossRef]

64. Piperno, D.R.; Pearsall, D.M. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithson. Contrib. Bot.* **1998**, *85*, 1–22. [CrossRef]
65. Ball, T.B.; Gardner, J.S.; Anderson, N. An approach to identifying inflorescence phytoliths from selected species of wheat and barley. In *Phytoliths: Applications in Earth Sciences and Human History*; Meunier, J.D., Colin, F., Eds.; A. A. Balkema: Abingdon, UK, 2001; pp. 289–302.
66. Novello, A.; Barboni, D. Grass inflorescence phytoliths of useful species and wild cereals from sub-Saharan Africa. *J. Archaeol. Sci.* **2015**, *59*, 10–22. [CrossRef]
67. Fernandez-Honaine, M.; Zucol, A.; Osterrieth, M. Phytolith analysis of Cyperaceae from the Pampean region, Argentina. *Aust. J. Bot.* **2009**, *57*, 512–523. [CrossRef]
68. Strömberg, C.A.E. The Origin and Spread of Grass-Dominated Ecosystems during the Tertiary of North America and How It Relates to the Evolution of Hypsodonty in Equids. Ph.D. Thesis, University of California, Berkeley, CA, USA, 2003.
69. Novello, A.; Barboni, D.; Berti-Equille, L.; Mazur, J.-C.; Poilecot, P.; Vignaud, P. Phytolith signal of aquatic plants and soils in Chad, Central Africa. *Rev. Palaeobot. Palynol.* **2012**, *178*, 43–58. [CrossRef]
70. Esau, K. *Plant Anatomy*, 2nd ed.; Wiley: New York, USA, 1965.
71. Albert, R.M.; Lavi, O.; Estroff, L.; Weiner, S.; Tsatskin, A.; Ronen, A.; Lev-Yadun, S. Mode of occupation of Tabun Cave, Mt Carmel, Israel during the Mousterian period: A study of the sediments and phytoliths. *J. Archaeol. Sci.* **1999**, *26*, 1249–1260. [CrossRef]
72. Delhon, C.; Alexandre, A.; Berger, J.F.; Thiébault, S.; Brochier, J.L.; Meunier, J.D. Phytolith assemblages as a promising tool for reconstructing Mediterranean Holocene vegetation. *Quat. Res.* **2003**, *59*, 48–60. [CrossRef]
73. Runge, F. The opal phytolith inventory of soils in Central Africa. Quantities, shapes, classification and spectra. *Rev. Palaeobot. Palynol.* **1999**, *107*, 23–53. [CrossRef]
74. Danu, M.; Carozza, J.-M.; Messager, E. Les sédiments comme révélateurs des activités anthropiques dans le delta du Danube—phytolithes. In *Au-Delà de la Nature : Le Bas Danube et Son Delta Durant les Huit Derniers Millénaires*; Carozza, L., Micu, C., Eds.; Editura Mega: Cluj, România, 2022.
75. Bolomey, A. Materiale paleofaunistice de la Histria. *Stud. Si Cercet. Antropol.* **1965**, *2*, 179–189.
76. Haimovici, S. Ameliorarea rasiala a animalelor domestice evaluata prin specia taurine (Bos taurus), facuta de catre romani, dupa venirea lor in Antichitate, in actuala Dobroge. *Pontica* **2006**, *39*, 349–353.
77. Duval, C.; Lepetz, S.; Horard-Herbin, M.-P. *Diversité des cheptels et diversification des morphotypes bovins dans le tiers nord-ouest des Gaules entre la fin de l'âge du Fer et la période romaine*; Gallia—Archéologie de la France Antique, CNRS Éditions: Paris, France, 2012; Volume 69, pp. 79–114.
78. Audoin-Rouzeau, F. La taille du boeuf domestique en Europe de l'antiquite aux tepms modernes. In *Fiches D'osteologie Pour L'archeologie, Serie B: Mammiferes, 2, APDCA*; Juan-les-Pines: Paris, France, 1991; pp. 3–40.
79. Audoin-Rouzeau, F. Compter et mesurer les os animaux. Pour une histoire de l'élevage et de l'alimentation en Europe de l'Antiquité aux Temps Modernes. *Hist. Mes.* **1995**, *10*, 277–312. [CrossRef]
80. Haimovici, S. Studiul arheozoologic al unor resturi faunistice descoperite în nivelul aparţinând sec. al VI-lea p.Chr. al cetăţii Histria. *Pontica* **2007**, *XL*, 541–558.
81. Haimovici, S. Studiul arheozoologic al resturilor de la Dinogetia (Garvăn), aparţinând epocii romane târzii. *Peuce* **1991**, *10*, 355–360.
82. Stanc, S.; Radu, V.; Bejenaru, L. Analyse archeozoologique des restes de poissons provenant du site de Slava Rusă (Roumanie). In *Archéologie du Poisson. 30 ans d'Archeo-Ichtyologie au CNRS. XXVIIIe Rencontres Internationales D'archéologie et D'histoire D'antibes*; Bearez, P., Grouard, S., Clavel, B., Eds.; Éditions APDCA: Antibes, France, 2008; pp. 257–279.