diversity

MDPI

Article

Freshwater Landscape Reconstruction from the Bronze Age Site of Borsodivánka (North-Eastern Hungary)

Angel Blanco-Lapaz [1,2,*], Klára P. Fischl [3], Astrid Röpke [4], Tanja Zerl [4], Nadine Nolde [4], Michael Schmid [5] and Tobias L. Kienlin [4,*]

[1] Senckenberg Centre for Human Evolution and Paleoenvironment (SHEP), Hölderlinstrasse 12, D-72074 Tübingen, Germany
[2] Institute for Archaeological Sciences, University of Tübingen, Hölderlinstrasse 12, D-72074 Tübingen, Germany
[3] ELKH BTK Régészeti Intézet/ELRN RCH Archaeological Institute, HU-1097 Budapest, Hungary
[4] Institut für Ur-und Frühgeschichte, Universität zu Köln, Weyertal 125, D-50931 Köln, Germany
[5] ArchaeoConnect GmbH, August-Bebel-Str. 16, D-72072 Tübingen, Germany
* Correspondence: angel.blanco-lapaz@uni-tuebingen.de (A.B.-L.); tkienlin@uni-koeln.de (T.L.K.)

Abstract: This multiproxy work presents the archeozoological analysis of fish and microvertebrate remains from the Middle Bronze Age tell site of Borsodivánka (Borsod Plain, North-eastern Hungary). The fish faunal assemblage provides valuable data on the choice of exploited consumption patterns, taphonomy, and aquatic paleoenvironmental conditions at the site during the Bronze Age. Only freshwater taxa are present in the assemblage, for example, northern pike (*Esox lucius*); cyprinids: roach (*Rutilus rutilus*), common carp (*Cyprinus carpio*), common chub (*Squalius cephalus*) and common nase (*Chondrostoma nasus*); and percids: European perch (*Perca fluviatilis*) and pikeperch (*Sander lucioperca*). Herpetofaunal and micromammal remains are also part of this study, improving our knowledge of the site's freshwater ecosystem. The grass snake (*Natrix* cf. *natrix*) and the European pond terrapin (*Emys orbicularis*), typical of aquatic ecosystems, are associated with the Aesculapian ratsnake (*Zamenis longissimus*), more typical of forest, shrubland, and grassland. The presence of amphibians such as toads (*Bufo*/*Bufotes* sp.) and frogs (*Rana* sp.) complete the herpetofaunal list. The microvertebrates also support a mature fluvial system, as represented by taxa like the European water vole (*Arvicola amphibius*). Other micromammals are present, such as the wood mouse (*Apodemus sylvaticus*), the group of the common/field vole (*Microtus arvalis/agrestis*), the European mole (*Talpa europaea*), and the house mouse (*Mus musculus*). All of them are common in forests, shrubland, and grassland. However, the commensal house mouse is more commonly associated with anthropogenic areas. In conclusion, Borsodivánka is characterized by a diverse landscape mosaic, displayed by the coexistence of a well-developed forest and a freshwater inland ecosystem with agricultural land in the wider area. Finally, the Tisza River and its flood plain represented the main water source close to the site, distinguished by the dominance of fish species from deep and slow-flowing waters.

Keywords: Borsodivánka; settlement mound; Middle Bronze Age; freshwater ecosystem; fish; microvertebrates

Citation: Blanco-Lapaz, A.; Fischl, K.P.; Röpke, A.; Zerl, T.; Nolde, N.; Schmid, M.; Kienlin, T.L. Freshwater Landscape Reconstruction from the Bronze Age Site of Borsodivánka (North-Eastern Hungary). *Diversity* **2023**, *15*, 340. https://doi.org/10.3390/d15030340

Academic Editor: Pedro M. Anastácio

Received: 16 January 2023
Revised: 18 February 2023
Accepted: 21 February 2023
Published: 27 February 2023

1. Introduction

1.1. Borsod Region Bronze Age Settlement Project

The Borsod Region Bronze Age Settlement project (BORBAS) was established in 2012 in cooperation with the Universities of Miskolc (Hungary) and Cologne (Germany) and the Herman Ottó Museum at Miskolc. The project focuses on the multi-layer settlement mounds of the Bronze Age Hatvan and Füzesabony periods along the foothills of the Bükk mountains and the adjacent lowlands of the Borsod plainin northeastern Hungary (Figure 1). Instead of applying covering models to Bronze Age tell communities throughout the Carpathian Basin and subsuming variability under abstract notions of 'social evolution' or 'political economy', the BORBAS project seeks to contribute to a more nuanced understanding of tell-living and the different regional traditions of tell communities by returning to the primary evidence and allowing for variability in local manifestations and trajectories [1]. It seeks to explore the inner structure of these settlements, establish the location and layout of households, elucidate if there are settlement parts with specialized functions, and compare the architecture and activity patterns of the various parts of these sites. On a macro level, an attempt is made to define the factors that determine the choice of site location and to understand the spatial organization of the settlements in environmental, economic, and social terms.

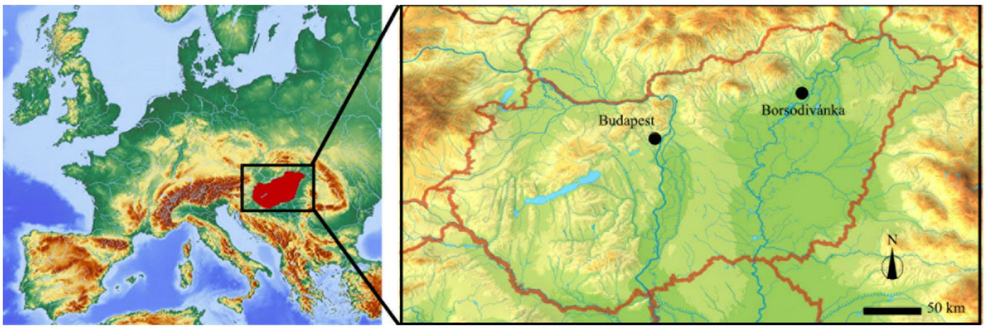

Figure 1. Borsodivánka location on the Borsod plain and the foothill zone of the Bükk mountains. Modified from www.pinterest.com (accessed on 2 February 2023).

In this context, zooarchaeological and archaeobotanical evidence is used to reconstruct, farming, animal husbandry, and hunting practices during the Bronze Age. For a comprehensive reconstruction of the landscape around the sites, it is also important to explore freshwater sources in the vicinity of settlements, such as ponds, streams, and rivers, and their role within the Borsod region.

In the Carpathians, previous palynological and isotopic studies analyzed several sites, such as Trió Cave and Ordacsehi-Bugaszeg, indicating that a mixture was present during the Bronze Age of different environments such as wooded steppe and floodplain. Those studies also indicated different periods of dry/warm and humid/cold conditions during the Middle-to-Late Holocene transition [2–5].

To this end, in the current paper, we present the results of an archeozoological analysis based on fish and microvertebrate remains from the Middle Bronze Age tell site of Borsodivánka. The fish faunal assemblage provides valuable data on the choice of exploited consumption patterns, taphonomy, and aquatic paleoenvironment conditions at the site during the Bronze Age.

Previous archeozoological studies [1,6] at six Bronze Age sites located in the Borsod region (North-eastern Hungary), such as Tard-Tatárdomb, Bogács-Pazsagpuszta, Mezőcsát-Laposhalom, Tiszabábolna-Fehérló-Tanya, Tiszakeszi-Bálinthát-Újtemető, and Tiszalúc-Dankadomb, identify 80% of animal finds as domesticates. Cattle and sheep/goats are the most frequently slaughtered species, followed by pigs. Horses and dogs are also present at all sites, albeit in much lower quantities [1,6].

The authors also identified hunted taxa at all sites, with red deer being the most common, followed by roe deer and wild boar. Aurochs and hares are also present but in lower quantities. The inhabitants of these sites also exploited wild game for their hides, namely brown bears (*Ursus arctos*; Tard-Tatárdomb), wolves (*Canis lupus*; Tard-Tatárdomb), and foxes (*Vulpes vulpes*; Tard-Tatárdomb and Bogács-Pazsagpuszta) [1,6]. Aquatic-related animals are present, for example, beaver (*Castor fiber*; Bogács-Pazsagpuszta and Mezőcsát-Laposhalom) and European pond terrapin (*Emys orbicularis*, present in all sites except Bogács-Pazsagpuszta). The presence of clams (*Unio* sp.) and snails indicates the exploitation and gathering of this resource. More than 80% of the finds recovered from Tiszalúc-Dankadomb and Tiszakeszi-Bálinthát-Újtemető, for example, are clams, indicating the importance of this aquatic resource at these sites [1,6]. Archaeologists also recovered fish remains from Tiszakeszi-Bálinthát-Újtemető (NISP = 1), Tiszalúc-Dankadomb (NISP = 1) [1,6].

Studies in Hungary based on Bronze Age fish are still scarce [7]. In Százhalombatta-Földvár (Middle Bronze Age, levels 2–12), researchers indicated the presence (NISP = number of identified specimens) of the great sturgeon (*Huso huso*; NISP = 2), sterlet (*Acipenser ruthenus*; NISP = 3), Danube salmon (*Hucho hucho*; NISP = 1), northern pike (*Esox lucius*; NISP = 10), roach (*Rutilus rutilus*; NISP = 4), orfe (*Leuciscus idus*, NISP = 2), barbel (*Barbus barbus*; NISP = 7), bleak (*Alburnus alburnus*, NISP = 3), bream (*Abramis brama*; NISP = 15), vimba (*Vimba vimba*; NISP = 1), common carp (*Cyprinus carpio*; NISP = 125), catfish (*Silurus glanis*; NISP = 5), and pikeperch (*Stizostedion lucioperca* = *Sander lucioperca*, NISP = 4). Most fish remains were located outside houses, while fish remains within structures were rare and located near walls where they were less likely to be destroyed or removed during cleaning [8].

1.2. Borsodivánka and Its Archaeological Context

The BORBAS team has excavated the tell of Borsodivánka-Marhajárás-Nagyhalom since 2015 [1,9,10]. The Early-to-Middle Bronze Age (3665 +/− 35 BP to 3359 +/− 27 BP according to the C14 dates obtained so far) settlement is situated on the northern edge of a flood-free island surrounded by the Rima, Kánya, and Eger streams. It comprises a central tell enclosed by a ditch and a horizontal outer settlement. The ditch around the multi-layer central mound is connected to ancient streams (Figure 2).

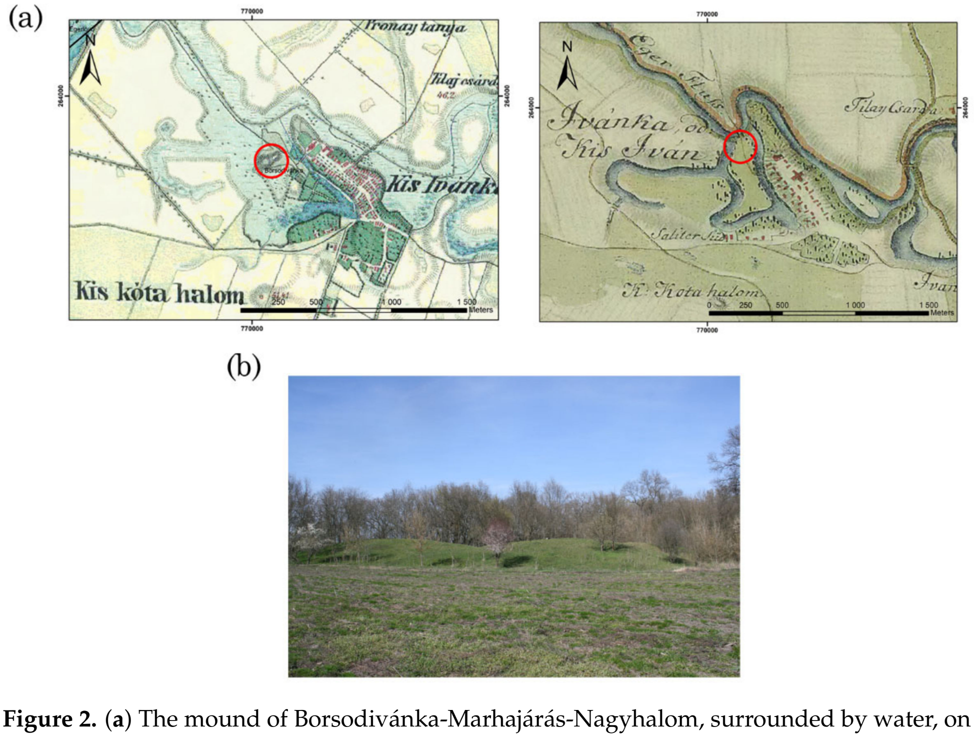

Figure 2. (**a**) The mound of Borsodivánka-Marhajárás-Nagyhalom, surrounded by water, on the old Austrian–Hungarian maps of the First and Second Military Surveys (1806–1869). (**b**) Borsodivánka-Marhajárás. The tell part of the site seen from the south-east with surface survey in progress on the surrounding outer settlement [1]. The red cicle indicate the location of the site of Borsodivánka.

Once composed into the English landscape garden of the Orczy-Prónay castle, the tell served as a calvary in early modern times. The narrow footpath providing it with its current double-hill form was carved into the small mound at that time. Additionally, in the 1970s or 1980s, a shooting range was cut into the eastern part of the mound (Figure 3). The goal of the initial 2015 and 2016 campaigns at Borsodivánka was to straighten the oblique profile wall of the former shooting range, document the settlement's profile, and obtain samples for radiocarbon dating. During this work, we could distinguish several major occupation phases; one comprised five phytolith layers with three backfill layers consisting mainly of waste in between. To investigate this interesting situation in greater detail, our current 6 × 6 m excavation was opened in 2017.

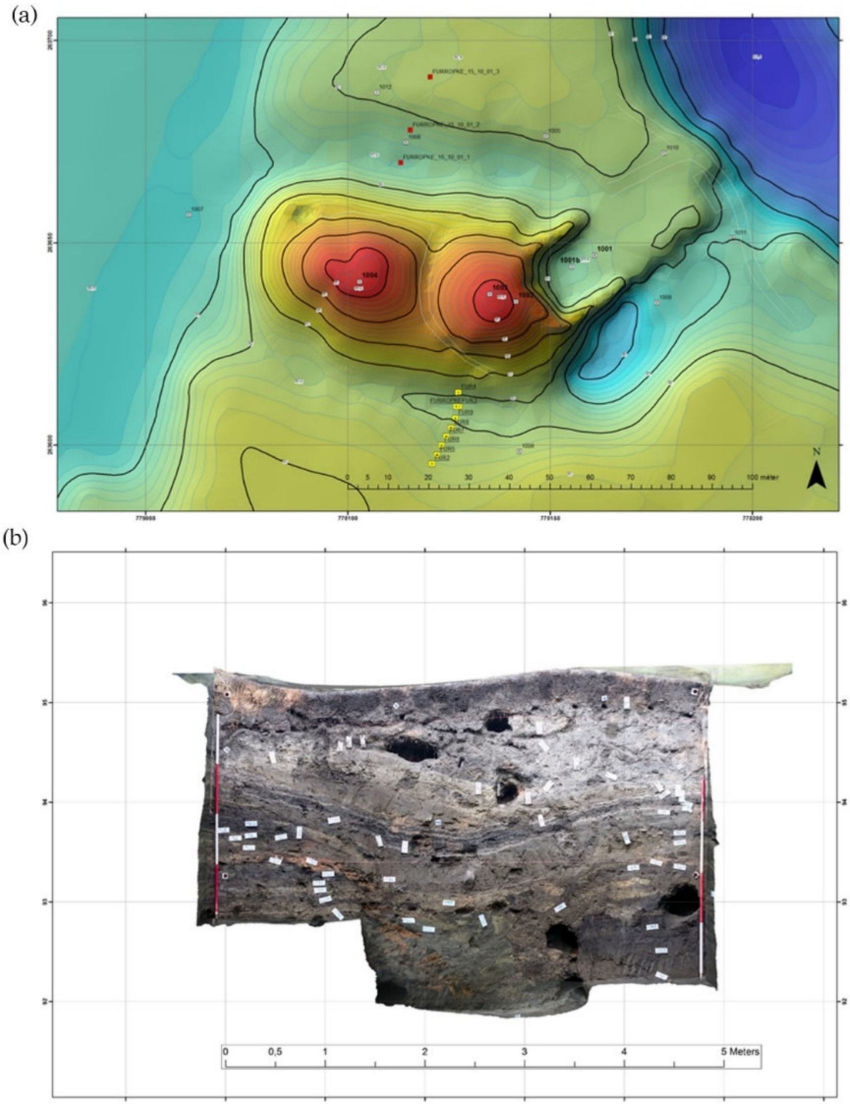

Figure 3. (**a**) Geodetic survey map of Borsodivánka-Marhajárás-Nagyhalom. Both tops belong to the tell, and it was only disturbed and divided into two in early modern times. (**b**) Profile with the layer sequence of the tell set.

Based on our current state of knowledge, before the completion of the excavation expected in 2023, the site contains a complex sequence of occupation phases on the margin of the tell, separated by the use of the plot in question as a midden (Figure 4, Table 1).

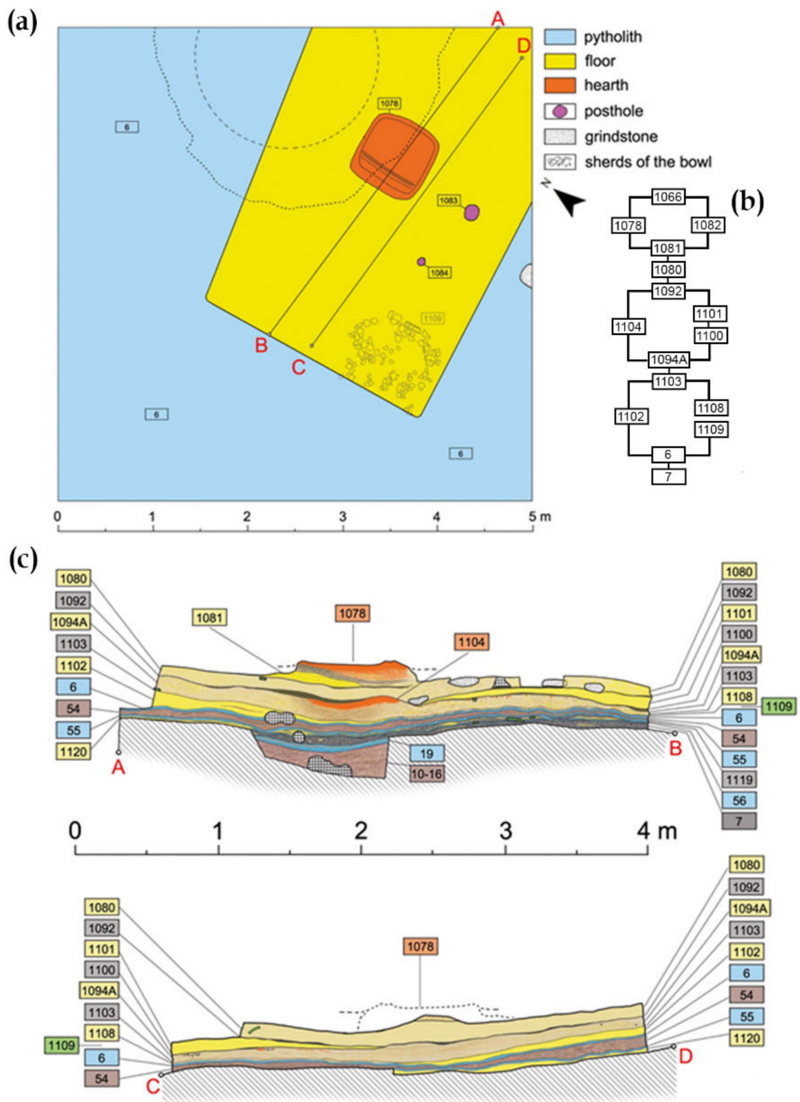

Figure 4. (**a**) Reconstructed layout of house A with the marks of the profiles. (**b**) Harris matrix of the house A layer sequence. (**c**). Profile of house A with two main occupation periods. From North (A,B) and South (C,D). Modified from Fischl et al. 2022 [11].

Calcareous sediments and several phytolith layers sealed the midden, mainly composed of common reed (*Phragmites australis*) [12]. This kind of regularly deposited refuse points to some degree of waste management while the plot was abandoned. Judging by the diversity of waste encountered and the concomitant subsistence strategies deduced, more than just one adjacent household 'contributed' to the accumulation of waste during this phase. Interestingly, corresponding distinctions are also evident in the architecture.

There is evidence of prior and subsequent house structures in the same location, determined from the floor sequence, with distinct features—e.g., well-prepared calcareous floors with a vegetal temper (below) and less well-prepared earthen floors with no intentional tempering and reed matting (above) [13].

The evidence already available from excavation points to the presence of households with different traditions, indicating variability in household practices and their relative 'success' and longevity. At some stage, some plots may have been abandoned and later re-occupied by a family or household of a different 'origin', be it from the tell, the outer settlement at Borsodivánka itself, or its surroundings.

Table 1. Characteristics of Borsodivánka layers.

Structure	Layers	Characteristics
House A	S1066	Uppermost destruction layer
	S1081	Gray-yellow sand layer
	S1100	Black activity remains on the floor S1094A
	S1101	Yellow floor renovation (western part)
	S1102	First floor. Over the uppermost phytolith layer S6
	S1103	Black activity remains on the first floor
	S1105	Local phytolith layer, laying on the black activity remains of S1092
Around Hose A	S1072	Gray-yellow porous layer outside the house A
	S1089	Ashy phytolith layer
	S1097	Brown layer over S1072 outside the house A
Garbage layers (A-C)	S1119	The garbage layer of the layer group consists of phytolith and garbage layers
	S54	The garbage layer of the layer group consists of phytolith and garbage layers
	S55	The garbage layer of the layer group consists of phytolith and garbage layers
	S56	The garbage layer of the layer group consists of phytolith and garbage layers
	S6	Phytolith layer, part of the layer group consists of phytolith and garbage layers
	S7	The bottom, thick garbage layer of the layer group consists of phytolith and garbage layers
House D	S1091	Red, burnt layer. The uppermost, heavily damaged house remain

Since 2015, the excavations in Borsodivánka have been accompanied by archaeobotanical analyses. In a preliminary study based on 1600 macro-remains from samples taken during the 2015 excavation [12–14], crop residues (44%) were predominant, followed by weeds (29%), ruderals (12%), grassland taxa (10%), and gathered plants (5%). In the case of crops, the majority of the remains are from cereals (84.4%), including spelt (*Triticum spelta*), einkorn (*T. monococcum*), emmer (*T. dicoccum*), and hulled barley (*Hordeum vulgare* ssp. *vulgare*). Pulses and oil plants are represented by lentils (*Lens culinaris*) and gold of pleasure (cf. *Camelina sativa*). Zerl et al. (2016) [14] also point out that over 80% of the archaeobotanical material comes from layer 7 (S7).

Zooarchaeological studies are still ongoing in Borsodivánka, but preliminary results identify dogs, horses, pigs, sheep/goats, and cattle. However, compared with the other BORBAS project sites, in Borsodivánka, cattle remains are less frequent than other domestic animals. Wild animals include reed deer, hare, and wild boar [6]. Prior researchers have not conducted a detailed study of the fish remains at Borsodivánka, instead only describing the general presence of small carp species and pikes [6]. In addition to the plant remains, archaeologists recovered numerous fish scales (>1000) from layer 7 (S7), which is why it can be interpreted as a "waste layer" containing charred residues from crop processing and food preparation [14].

2. Material and Methods

A total of 5542 fish and 74 microvertebrate remains (are present in the Borsodivánka assemblage. These remains were collected by floatation of archaeobotanical samples from the House A layers (S1066, S1081, S1100–1103, 1105), layers of the area around House A (S1072, S1089, and S1097), layers from House D (above House A; S1091), and the garbage layers between House A and House C (S1119, S54–56, S6, and S7) during the 2020 campaign (Figures 3 and 4, Table 1). While analyzing this material, we used a binocular EXACTA OPTECH model LFZ s/n 201,030 20W and a Dino-Lite Edge Digital Microscope.

2.1. Taxonomy

We determined the microvertebrate and fish remains taxonomically and anatomically using the modern reference collection at the University of Tübingen and several osteological atlases [15–18]. We used the taxonomic nomenclature for fish from Cannon (1987) [19] and Wheeler and Jones (2009) [20]. This study refers to the number of identified specimens (NISP) as a standard measure of abundance [20]. Still, we considered the indeterminate fish fragments belonging to Teleostei *sensu stricto*. For this work, when osteometric models to estimate fish size were not available, we estimated the size through direct comparison with specimens of known length from the modern comparative collection (University of Tübingen).

2.2. Quantification

This study used the typical quantification values initially developed for studying terrestrial vertebrates, such as the number of identified specimens (NISP). Here, determining the minimum number of individuals (MNI) is more problematic since vertebrae, spines, and ribs commonly dominate fish assemblages. MNI is based on counting the minimum number of elements of the most frequent single skeletal part [21]. To calculate this value, the bones must show laterality, but vertebrae, spines, and scales do not follow this rule. Cranial elements are helpful for this calculation. However, vertebral fish remains cannot be attributed to a single skeletal part that is not variable along the vertebral column.

Parallel to the calculation of the MNI, we followed the method developed by Stenberg (1989) [22] by weighting the number of vertebrae and relating all species to the same theoretical standard. For a given species, Stenberg (1989) [21] applied the weight of the independent vertebrae by a multiplier index representing the ratio between the average number of vertebrae of the most common species in the assemblage and the average number of vertebrae of the studied species. This weighted number of vertebrae, called the Corrected Expected Number of Vertebrae (NVcor), makes it possible to establish a proportional relationship with the number of captured individuals. This method is complicated to apply to cyprinids because of the non-differentiation between their vertebrae [23]. However, we calculate an average vertebra count for a standard "generic" cyprinid. We follow Füllner et al. (2016) [24] and Jelu et al. (2021) [25] to calculate the average vertebra count for cyprinids and the other species recovered in Borsodivánka. Other authors [26] also applied this calculation based on the average minimum and maximum vertebra counts observed for each species in the assemblage.

2.3. Taphonomy and Skeletal Representation

In this study, we analyzed different aspects of the fish assemblage, such as biology (fish size) and taphonomy (element representation and element fragmentation). We also assessed bone surface modifications such as digestion marks, compression, uniaxial mechanical deformation, and bite marks [27,28]. We analyzed evidence of burning using five stages of thermal-induced discoloration [29]. These stages are based on heat-induced color alterations described for large [30,31] and small [32–34] mammals. The stages correspond to 0 (no discoloration), 1 (yellowish with reddish-brown spots; <100 °C to 300 °C), 2 (dark brown to black coloration; <400 °C to 550 °C), 3 (charred bone-dark black or blue coloration over 50–100% of the surface; 500 °C to <700 °C), 4 (gray-white coloration, partial calcination; 650 °C to <950 °C), and 5 (calcined bone-white coloration over 50–100% of the surface; >700 °C).

2.4. Freshwater Ecosystem and Fishing Areas

To determine the possible capture areas of the fish and to infer their distance from the site, we analyzed the habitat distribution, ecological requirements, and spawning period of the fish species based on modern and ancient reconstructions following previous studies [7,8,35–37].

To reconstruct the paleoenvironment and landscape of Borsodivánka, we used the habitat weighting method (HWM), also known as the taxonomic habitat index [33,34]. The method is based on the present distribution of each microvertebrate taxon in a given habitat where it is presently found [38–42]. The analysis of zooarchaeological remains recovered in Borsodivánka has yielded taxa that are still extant in Hungary [43]. Therefore, because there are no extinct species at Borsodivánka, it is clear that the small vertebrate species identified in this assemblage had equivalent ecological and habitat requirements to their modern relatives.

For this study, we applied the habitat weighting method to small mammal taxa, although the number of individuals is limited. Several authors [31,40,41] adopted this method. Here, we distinguish the following types of habitats: forest (Fo), shrubland (Sh), grassland (Gr), wetland (We), and rocky (Ro). Each taxon has a score of 1.00, divided between the habitats where the species are found today We obtained each species' score and habitat preference from the IUCN Red List of Threatened Species (https://www.iucnredlist.org/resources/spatial-data-download; accessed on 2 February 2023).

We modified the HWM based on the ecological requirements for each taxon. This methodology is unpublished, and further studies with more material will help to improve it. In this case, we distinguish the following types of ecological requirements: surface (Su), deep (De), fast-flowing (Ff), slow-flowing (Sf), vegetation (Vg), and significant water sources (Lw). All of these categories are based on the modern ecological requirements for the fish taxa in the Borsodivánka assemblage [24,36,43].

3. Results

3.1. Fish Taxonomy (Table 2, Figure 5)

We classified a total of 2790 (51.34%) fish remains as unidentified Teleostei due to their poor preservation and fragmentation level. The most diverse family is Cyprinidae (NISP = 1317, 23.76%) which includes an exceptional diversity of species with varied biological and ecological characteristics. Therefore, identification at the species level is crucial for understanding ancient societies' fishing economies and the landscape around the sites. Unfortunately, the skeletal morphology of this family is remarkably constant from one species to another. The existence of natural hybrids between species complicates their determination [18]. We limited our species-level identifications to the morphological analysis of the most diagnostic bone element: the pharyngeal arch. From the total cyprinid assemblage, we identified 1222 remains as unidentified cyprinids (92.78%), most corresponding to vertebrae. However, we classified several cyprinid species such as common carp (*C. carpio*, NISP = 32, 2.43%), common chub (*S. cephalus*, NISP = 15, 1.14%), roach (*R. rutilus*, NISP = 47, 3.57%), and common nase (*C. nasus*, NISP = 1, 0.08%) (Table 2, Figure 5).

The most frequently identified species is the northern pike (*E. lucius*, NISP = 1236, 22.30%). The family Percidae is represented by two species: European perch (*P. fluviatilis*, NISP = 193, 3.48%) and pikeperch (*S. lucioperca*, NISP = 4, 0.07%). In the assemblage, only one specimen corresponds to the Siluridae family and belongs to the Wels catfish (*S. glanis*, NISP = 1, 0.02%). Finally, the Salmonidae family is present in the assemblage, represented by a single element (0.02%).

Based on the modern comparative collection of the University of Tübingen, all remains belonging to the northern pike, the most common species in the fish assemblage, would correspond to large–very large individuals (more than 60–70 cm, total length). All cyprinid species would correspond to standard sizes compared to the reference collection. The European perch also show standard dimensions (25–30 cm, total length). Since few individuals of Wels catfish and pikeperch are present, a size estimation cannot be calculated.

Table 2. Identified fish taxa from the studied layers in Borsodivánka 2020. NISP: number of identified specimens; MNI: minimum number of individuals. 1, Cyprinidae; 2, Esocidae; 3, Percidae; 4, Siluridae; 5, Salmonidae; 6, Teleostei. House A: layers S1066, S1081, S1100–1103, and S1105; Around House A: layers S1072, S1089, and S1097; House D: layer S1091; Garbage layers between House A and House C: layers S1119, S54–56, S6, and S7.

	Taxa	**House A**		**Around House A**		**Garbage Layers**		**House D**		**Total NISP**	**Total MNI**
		NISP	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**		
1	*C. carpio*			1	1	31	2			32	3
	S. cephalus					15	7			15	7
	R. rutilus	1	1			46	15			47	16
	C. nasus					1	1			1	1
	Unident.	5	-	7	-	1204	-	6	-	1222	-
2	*E. lucius*	8	1	4	1	1221	8	3	1	1236	11
3	*P. fluviatilis*			1	1	192	5			193	6
	S. lucioperca					4	1			4	1
4	*S. glanis*					1	1			1	1
5	Unident					1	1			1	1
6	Unident			39	-	2739	-	12	-	2790	-
	Total NISP	14	-	52	-	5455	-	21	-	5542	-
	Total MNI	-	2	-	3	-	41	-	1	-	47

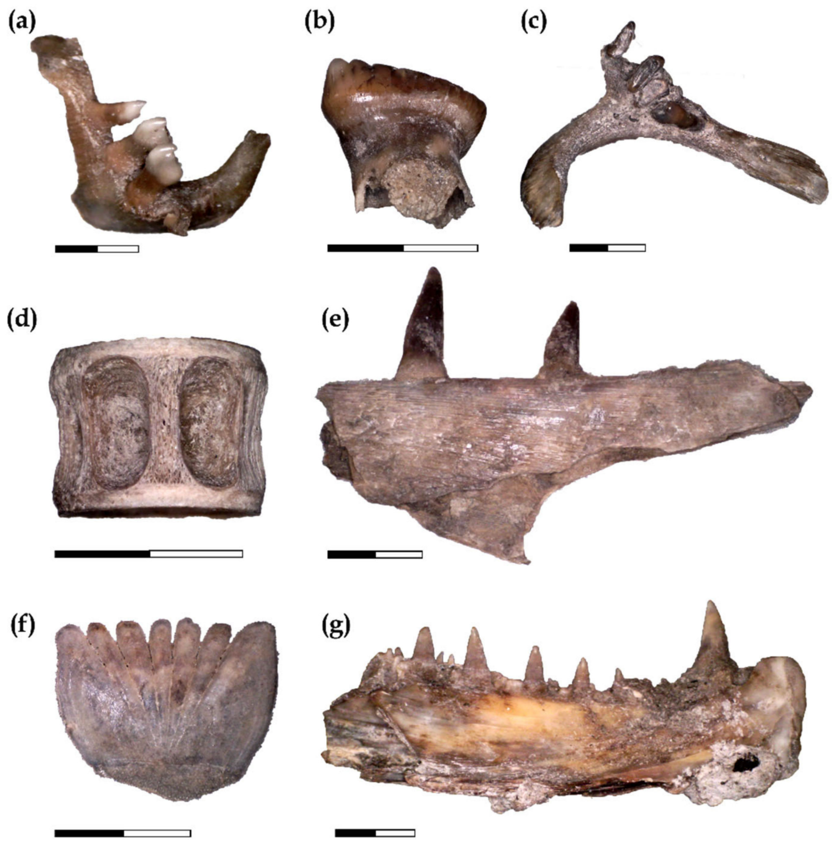

Figure 5. Some examples of fish from Borsodivánka 2020. (**a**) *Chondrostoma nasus* (Probe 49, Layer 7), left pharyngeal arch. (**b**) *Cyprinus carpio* (Probe 44, Layer 7), left 2nd pharyngeal tooth. (**c**) *Rutilus rutilus* (Probe 40, Layer 7), left pharyngeal arch. (**d**) *Esox lucius* (Probe 48, Layer 7), precaudal vertebra. (**e**) *Esox lucius* (Probe 48, Layer 7), a fragment of the left dentary. (**f**) *Perca fluviatilis* (Probe 44, Layer 7), scale. (**g**) *Sander lucioperca* (Probe 49, Layer 7), left dentary incomplete. Scale 5 mm.

Most of the elements classified as unidentified Teleostei correspond to ribs, vertebrae, and neural and branchial spine fragments, showing a high fragmentation level, which makes taxonomic determination impossible.

3.2. Microvertebrate Taxonomy (Table 3, Figure 6)

Table 3 presents all the identified microvertebrate taxa at Borsodivánka (2020 campaign). We classified a total of 74 microvertebrate remains (Figure 6) belonging to Squamata (reptiles, NISP = 15, 20.27%), Anura (amphibians, NISP = 17, 22.97%), Rodentia (rodents, NISP = 41, 55.40%), and Insectivora (insectivores, NISP = 1, 1.36%). Reptiles are represented by the grass snake (*N.* cf. *natrix*, NISP = 8, 53.33%), the Aesculapian ratsnake (*Z. longissimus*, NISP = 4, 26.67%), and the European pond turtle (*E. orbicularis*, NISP = 3, 20%). Amphibians are represented by unidentified Anura (NISP = 13, 76.47%), toads (*Bufo*/*Bufotes* sp., NISP = 1, 5.89%), and frogs (*Rana* sp., NISP = 3, 17.64%).

Table 3. Identified microvertebrate taxa from the studied layers in Borsodivánka from the 2020 campaign. NISP: number of identified specimens; MNI: minimum number of individuals. 1, Squamata; 2, Anura; 3, Rodentia; 4, Insectivora.

	Taxa	House A		Around House A		Garbage Layers		House D		Total NISP	Total MNI
		NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI		
1	*N.* cf. *natrix*			2	1	6	1			8	2
	Z. longissimus	1	1			3	1			4	2
	E. orbicularis					3	1			3	1
2	Unident.	5	-			7	-	1	-	13	-
	Bufo/Bufotes sp.					1	1			1	1
	Rana sp.	1	1	1	1	1	1			3	3
3	Unident.	10	-	2	-	6	1	4	-	22	-
	A. sylvaticus			4	1					4	1
	M. musculus			4	2					4	2
	A. amphibius	1	1							1	1
	M. agre./arva.	5	3	5	2					10	5
4	*T. europaea*					1	1			1	1
	Total NISP	23	-	18	-	28	-	5	-	74	-
	Total MNI	-	6	-	6	-	7	-	-	-	19

Rodents and insectivores represent micromammals. Most of them correspond to unidentified rodents (NISP = 22, 53.66%), followed by the group of the common/field vole (*Microtus arvalis*/*agrestis*, NISP = 10, 24.39%), the house mouse (*Mus musculus*, NISP = 4, 9.76%), the wood mouse (*Apodemus sylvaticus*, NISP = 4, 9.76%), and the European water vole (*Arvicola amphibius*, NISP = 1, 2.43%) and the only individual belonging to the insectivore group corresponds to the European mole (*Talpa europaea*).

3.3. Taphonomy and Fish Skeletal Representation

The recovered fish remains from Borsodivánka are characterized by postcranial elements, namely vertebrae, spines, branchial spines, scales, and ribs (NISP = 4025; 70.6%) (Table 4). Cranial bones (NISP = 592, 10.4%) are less represented.

Figure 6. Some examples of microvertebrate from Borsodivánka 2020. (**a**) *Zamenis longissimus* (Probe 6, Layer S1101), trunk vertebra. (**b**) *Natrix* cf. *natrix* (Probe 29, Layer S55), trunk vertebra. (**c**) *Apodemus sylvaticus*, right maxillary (left, Probe 13, Layer S1097), and mandibular tooth rows (right, Probe 16, Layer S1097). (**d**). *Mus musculus* (Probe 16, Layer S1097), right m1. (**e**) *Arvicola amphibius* (Probe 48, Layer S1100), left M2. (**f**) *Microtus arvalis* (Probe 18, Layer 1066), right m1. (**g**) *Talpa europaea* (Probe 29, Layer S55), lumbar vertebrae region. (**h**) *Rana* sp. (Probe 16, Layer S1097), right premaxilla. (**i**) *Bufo/Bufotes* sp. (Probe 42 Layer S7), left humerus of male. (**j**) *Emys orbicularis* (Probe 44, Layer S7), left humerus in dorsal (left) and lateral (right) views.

By element, 1086 fish remains correspond to unidentified elements (19.1%), followed by scales (NISP = 1045, 18.3%), precaudal vertebrae (NISP = 918, 16.1%), spines (NISP = 821, 14.4%), caudal vertebrae (NISP = 700, 12.3%), cranial elements (NISP = 592, 10.4%), ribs (NISP = 319, 5.6%) and fragments of vertebrae (NISP = 221, 3.9%).

The relative proportion of species in terms of the estimated number of caught individuals was assessed through NVcor and Nci (Table 5). The results confirm the strong predominance of cyprinids (72.22%), followed by the northern pike (*E. lucius*; 16.67%). The European perch (*P. fluviatilis*; 8.33%) and pikeperch (*S. lucioperca*; 2.78%) are less frequent.

Table 4. Taxa, number and percentage of the anatomical element recovered in Borsodivánka during the 2020 campaign. Ce, cranial element; Cv, caudal vertebra; Pv, precaudal vertebra; Fv, fragment of vertebra; Sp, spine; Sc, scale; Ri, rib; Un, unidentified element.

Taxa	Skeletal Elements								Total
	Ce	Cv	Pv	Fv	Sp	Sc	Ri	Un	
C. carpio	26		8						34
S. cephalus	16								16
R. rutilus	47								47
C. nasus	1								1
Cyprinidae	128	524	582						1234
E. lucius	181	83	281			714			1259
P. fluviatilis	9	91	45			48			193
S. lucioperca	2	1	1						4
S. glanis	1								1
Salmonidae			1						1
Teleostei	181	1		221	821	283	319	1086	2912
Total	592	700	918	221	821	1045	319	1086	5702

Table 5. Relative abundance of fish taxa represented in Borsodivánka 2020. Nvert, number of vertebrae recovered from the assemblage; NVcor, corrected expected number of vertebrae; Nci, number (estimated) of captured individuals.

Taxa	Nvert	% Nver	NVcor	Nci	%Nci
Cyprinidae	1105	69.45	42	26	72.22
E. lucius	352	22.12	60	6	16.67
P. fluviatilis	132	8.30	40	3	8.33
S. luciperca	2	0.13	46	1	2.78
Total	1591	100	-	36	100

The abundance of spines, branchial spines, ribs, vertebrae fragments, and unidentified fragments (N = 3492, 61.2%) may indicate the processing of fish by humans involving the removal of the spines and branchial spines for consumption. Further studies of related fishing artifacts, such as hooks or harpoons, would improve our understanding of human fishing techniques at Borsodivánka. The inhabitants in this region likely used composite tools or fishing traps made of wood or plant fibers, which are not preserved.

The analysis of burnt remains from Borsodivánka based on five stages (from 0 to 5) of thermal-induced discoloration [29–31] indicates that 5557 (97.46%) remains are unburnt (stage 0). Twenty-two (0.4%) remains show stage 1, five (0.09%) indicate stage 2, three (0.05%) remains show stage 3, stage 4 is represented by 73 remains (1.28%), and 42 (0.72%) remains show stage 5 (Table 6). Based on the thermal discoloration stages, we could confirm that the majority of the fish assemblage is unburnt, some were modified by medium temperatures (100 °C–700 °C), and just 2% of the assemblage shows evidence of high temperatures (>700 °C, stages 4–5) [30].

3.4. Freshwater Ecosystem and Fishing Areas

The microvertebrate and fish assemblages described here permit a better description of the freshwater ecosystem at Borsodivánka.

The results of the palaeoenvironmental reconstruction obtained using the habitat weighting method based on reptiles, amphibians, and micromammals indicate that forest, shrublands, grasslands, and essential wetland components characterized the paleoenvironment of Borsodivánka. The presence of species from freshwater ecosystems, such as *N.* cf. natrix, *E. orbicularis*, *M. musculus*, *A. amphibius*, and *M. agrestis/arvalis*, supports these results. (Table 7, Figure 7). The forest, shrubland, and grassland components indicate that, during the Bronze Age at Borsodivánka, a diverse ecosystem mosaic coexisted simultaneously with a well-developed forest and growing areas. Prior archaeobotanical studies also support this diversity [14].

Table 6. The number of fish remains and burning stages observed on Borsodivánka fish remains (2020 campaign).

Taxa	Burning Stages						Total
	0	**1**	**2**	**3**	**4**	**5**	
C. carpio	33		1				34
S. cephalus	16						16
R. rutilus	47						47
C. nasus	1						1
Cyprinidae	1191	1		2	26	14	1234
E. lucius	1190	21	4	1	23	20	1259
P. fluviatilis	191				1	1	193
S. lucioperca	4						4
S. glanis	1						1
Salmonidae	1						1
Teleostei	2882				23	7	2912
Total	5557	22	5	3	73	42	5702

Table 7. Scores attributed to each key microvertebrate species found at Borsodivánka during the 2020 campaign according to its ecological requirements, used for the habitat weighting method Forest (Fo), Shrubland (Sh), Grassland (Gr), Wetland (We), and Rocky (Ro). 1. Squamata, 2. Rodentia, 3. Insectivora.

Taxa	Species	Ecological Requirements					
		Fo	**Sh**	**Gr**	**De**	**We**	**Ro**
1	*N.* cf. *natrix*	0.25	0.25	0.25		0.25	
	Z. longissimus	0.25	0.25	0.25			0.25
	E. orbicularis					1	
2	*A. sylvaticus*	0.33	0.33	0.33			
	M. musculus		0.33	0.33		0.33	
	A. amphibius	0.33		0.33		0.33	
	M. agre/arva.	0.25	0.25	0.25		0.25	
3	*T. europaea*	0.33	0.33	0.33			

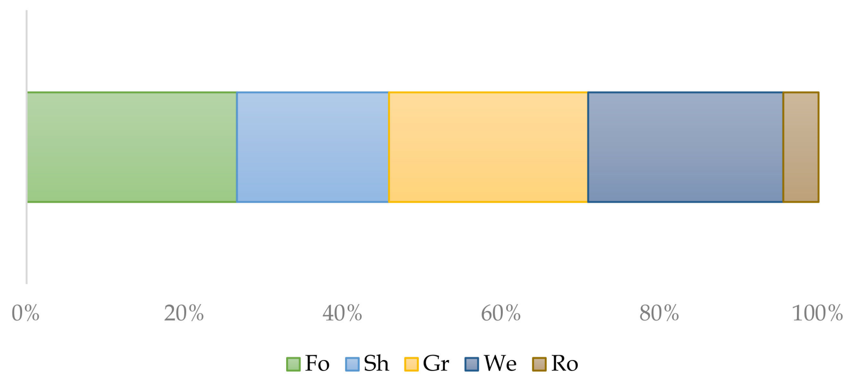

Figure 7. Based on NMI, results of the habitat weighting method for the microvertebrate assemblage at Borsodivánka (2020 campaign): Forest (Fo), Shrubland (Sh), Grassland (Gr), Wetland (We), and Rocky (Ro).

Based on their ecological requirements, the fish taxa at Borsodivánka imply the presence of a significant water source with some vegetation. Most of the species are common in deep and slow-flowing waters. Previous studies also indicate some Bronze Age sites with fish typical for slow currents with the soft substrate [7,8,44]. Streams flowing down from the Bükk mountain and the Tisza River with its floodplain fit all these categories, representing the main water source close to Borsodivánka (Table 8).

Table 8. Scores attributed to each key fish species found at Borsodivánka during the 2020 campaign according to its ecological requirements, used for the modified habitat weighting method: surface waters (Su), deep waters (De), fast-flowing waters (Ff), slow-flowing waters (Sf), vegetation ground (Vg), and large water sources (Lw).

Taxa	NISP	%	Ecological Requirements					
			Su	De	Ff	Sf	Vg	Lw
Teleostei	2912	51.07						
Cyprinidae	1234	21.64						
Salmonidae	1	0.02						
C. carpio	34	0.60				1	0.5	0.5
S. cephalus	16	0.28				1		1
R. rutilus	47	0.82	0.5	0.5			0.5	0.5
C. nasus	1	0.02		1	1			
E. lucius	1259	22.08	1			1	0.5	0.5
P. fluviatilis	193	3.38		1		1		
S. lucioperca	4	0.07		1		1		1
S. glanis	1	0.02		1		1		1
Total	5702	100	1.5	4.5	1	6	1.5	4.5

4. Discussion

4.1. Landscape Reconstruction and Freshwater Ecosystems at Borsodivánka

We provide the first zooarchaeological data for a better understanding of the freshwater ecosystem and surrounding landscape of Borsodivánka based on fish and microvertebrates. Here, we combined data from micromammals, reptiles, amphibians, and fish as an essential tool for landscape reconstruction around the site during the Bronze Age. At Borsodivánka, a mosaic landscape is evidenced by the coexistence of a well-developed forest, open areas, and a mature freshwater inland ecosystem.

The micromammals present in the Borsodivánka assemblage support the presence of this varied and patchy landscape. The wood mouse (*A. sylvaticus*) inhabits forests, grasslands, and cultivated fields, tending to seek out more wooded areas in winter. The European mole (*T. europaea*) is typical in temperate habitats with soils deep enough to allow tunneling. These include arable fields, deciduous woodland, and permanent pasture. The voles of the group *M. arvalis/agrestis* are found in a range of habitats, including meadows, field borders, plantations, woodland verges, clearings, upland heaths, dunes, marshes, bogs, and river banks, and tend to prefer wet areas [18]. In addition, one species of snake present in Borsodivánka, the Aesculapian ratsnake (*Z. longissimus*), prefers forested, warm but not hot, moderately humid but not wet, hilly or rocky habitats with proper insolation and varied but, not sparse vegetation that provides sufficient variation in local microclimates, helping the reptile with thermoregulation. Most of their range is typically characterized by relatively intact or fairly cultivated warmer temperate broadleaf forests, including the more humid variety, such as along river valleys and riverbeds (but not marshes) and forest steppes [45].

In conclusion, the microvertebrate assemblage in Borsodivánka presents several species indicating a well-developed forest, shrubland, and grassland. According to the archaeobotanical data, land for farming must have been available due to the occurrence of cereals in Borsodivánka (*T. spelta*, *T. monococcum*, *H. vulgare vulgare*, and *T. dicoccon*) [14]. The presence of the mouse (*M. musculus*), as well as ruderals (such as *Sambucus ebulus* and *Hyoscyamus niger*) and the presence of cattle dung with reed (cows could have been kept close to the tell), would indicate anthropogenic areas around the tell.

Based on our research, the presence of a mature freshwater inland ecosystem in Borsodivánka is evident. Reptiles such as the grass snake (*N.* cf. *natrix*) and the European pond turtle (*E. orbicularis*); amphibians such as toads (*Bufo*/*Bufotes* sp.) and frogs (*Rana* sp.); and micromammals such as the European water vole (*A. amphibius*) support the reconstruction of this landscape. However, the fish assemblage provided the most information about this freshwater ecosystem in Borsodivánka.

Cyprinidae species are the most common in the assemblage, such as the roach (*R. rutilus*), the common carp (*C. carpio*), the common chub (*S. cephalus*), and the common nase (*C. nasus*). The common carp (*C. carpio*) and the other cyprinids are typical of stagnant, muddy waters of relatively high temperatures and concomitant low rates of dissolved oxygen [24,46].

The second-most frequent family is Esocidae, with just one species, the northern pike (*E. lucius*). Pikes like cool water but have a wide range of environmental tolerances concerning water temperature and clarity, as well as varying concentrations of dissolved oxygen [24,46]. Percidae is less present with two species, the European perch (*P. fluviatilis*) and the pikeperch (*S. lucioperca*). The European perch lives in slow-flowing rivers, deep lakes, and ponds. It tends to avoid cold or fast-flowing waters, but some specimens penetrate waters of these types, although they do not breed in this habitat. The pikeperch is characteristic of clear waters with hard substrate oxygen [24]. Across the assemblage, only one specimen corresponds to the Siluridae family and belongs to the Wels catfish (*S. glanis*). Catfish mostly prefer deep and warm waters with rich aquatic vegetation oxygen [23].

Similar taxa are present in other Bronze Age Hungarian sites such as Százhalombatta [6]. Our study of Borsodivánka is in agreement since cyprinids and pike represent the majority of the assemblage. Other species, such as pikeperch and catfish, are generally less frequent [7]. However, we recovered remains of common nase, common chub, and European perch for the first time, updating the list of known taxa in Hungary during the Bronze Age. Finally, the Salmonidae family is present in the assemblage with one element, excluding that this fish association fits into the Trout Zone of the river [47,48]. This association with mostly nase, European perch, common carp, pike, and Wels catfish characterizes a mature river system with deep and slow-flowing waters. It indicates that Borsodivánka was located close to the downstream (Nase and Bream zones) with a maximum water temperature of 20–25 °C [47,48].

4.2. Borsodivánka Environment in the Carpathians Context during the Bronze Age

Traditionally, studies based on landscape reconstructions argued that, in general terms, the dry and warm climate of the Late Neolithic and Copper Age gradually became wet and cool during the Bronze Age, promoting a well-developed forest in this Carpathian region [9].

However, recent studies in Hungary indicate a more complex climate evolution scheme in the Carpathians. Palynological studies confirm the persistence of wooded steppe in the Great Hungarian Plain during the Holocene [2]. The authors also described the presence of typical temperate summergreen tree taxa from floodplain forests, such as *Corylus*, *Fraxinus*, *Quercus*, and *Ulmus*, which we also assume for Borsodivánka. The occurrence of the genus *Alnus* indicates the vicinity of a water source, such as a lake or river. However, the presence of the common reed (*P. australis*) indicates nearby water sources, since this species is an aquatic grass [5]. The authors also observed an increase in herbaceous taxa, principally Graminae, characteristic of steppe and meadow communities, suggesting that human impact may have been a major factor in the decrease in tree cover [2].

In the Eastern Carpathians, other research indicates rapid climatic changes during the Middle to Late Holocene transition, noting a temperature decrease that agrees with other Northern Hemisphere records. Abrupt temperature declines occurred at 6.2, 5.4, 5.0, 4.7, and 4.2 cal ka BP in this region, featuring a prominent decrease from 5.4 to 4.2 cal ka BP [3].

The occurrence of plants related to human land use and the increase in emergent wetland plants is recorded after a well-expressed 4.2 cal ka BP cold event. During the Middle

Bronze Age (around 1600 BC), some researchers postulate a link between the landscape and societal changes in Hungary during the Bronze Age [3], indicating a period characterized by fluctuating humidity but a relatively warm climate between 4 and 3.5 cal ka BP. These climatic conditions were appropriate for agriculture and demographic growth. One prominent feature that characterizes the Middle Bronze Age is the formation of the named tells or stratified settlement mounds [1,4]. Between 3.55 and 3.45 cal ka BP (Koszider period), a short-lived environmental deterioration and a decrease in soil activity occurred, contributing to the demographic increase inferred for this period. The authors conclude that environmental variations were associated with societal changes during the Middle Bronze Age, indicating that settlement pattern changes reflect climate conditions.

On a regional scale, this climate evolution scheme is also complex. Studies based on isotope analysis indicate periods of dry/warm and humid/cold conditions between 3.2 and 3.9 cal ka BP at Trió Cave and Ordacsehi-Bugaszeg (Southern Hungary) [5]. The period between 3.9 and 3.7 cal ka BP begins with a peak representing a period of high humidity. However, a dry period is recorded around 3.8 ka that ends with an abrupt change to very humid conditions at 3.7 ka. Between 3.65 and 3.5 cal ka BP, the authors indicate a short-term increase in dry conditions related to an environmental deterioration event. Short-term dry periods occur around 3.5 and 3.3 cal ka BP. However, a humidity peak with cooler conditions is present between 3.5 to 3.4 cal ka BP. Finally, warmer and drier conditions follow this humidity peak of around 3.35 and 3.2 cal ka BP. Around 3.2 cal ka BP, drier and warmer conditions are present, but settlements were still lower [4,45].

Locally, based on the relatively short period of occupation at Borsodivánka ((3665 +/− 35 BP to 3359 +/− 27 BP), the presence of a well-developed forest and a mature freshwater ecosystem around the site indicates a relatively humid period during the Middle Bronze Age occupations. It coincides, regionally, with fluctuating humidity levels but a relatively warm climate between 4 and 3.5 cal ka BP in the Carpathians [3]. This coalesced with a humidity peak with cooler conditions between 3.5 to 3.4 cal ka BP in southern Hungary, although short-term dry periods occur around 3.5 and 3.3 cal Ka BP in this area [4]. At Borsodivánka, the forest coexists with shrubland, grassland, pastures, and land for agricultural purposes in the broader area.

Further detailed studies based on absolute dating and paleoclimatic reconstructions are required to provide better evidence of the coalescence between regional scale palaeoenvironmental conditions in the Carpathians and a more local landscape reconstruction at Borsodivánka and the other Tisza floodplain sites to study the settlement patterns in the context of 'tell societies' during the Middle Bronze Age.

4.3. Fishing at Borsodivánka (Tisza Region) and Hungary during the Bronze Age

The role of fishing at Borsodivánka must have been significant, given the choice of settlement location, fish processing, and the number of fish bones in the assemblage. Also, the selection of exploited fish species indicates a preference for two taxa: the northern pike (*E. lucius*, NISP = 1259, 22.08%) and cyprinids (NISP = 1332, 23.36%) (unidentified Cyprinidae, NISP = 1234, 21.64%; common carp (*C. carpio*, NISP = 34, 0.60%), common chub (*S. cephalus*, NISP = 16, 0.28%), roach (*R. rutilus*, NISP = 47, 0.82%) and common nase (*C. nasus*, NISP = 1, 0.02%).

The downstream fish association in Borsodivánka indicates organized fishing in this river section. However, incursions into more distant fishing grounds cannot be excluded. The species identified in the corpus, particularly cyprinids, northern pike, and common perch, generally prefer waters with moderate currents. These species are, therefore, mainly found on the main channel banks or in secondary arms.

Although it is complex to reconstruct past fishing methods, several authors argue that different techniques and tools can be useful [44,49,50]. Traps (or nets) designed to capture small individuals are the most likely fishing technique to explain the observed common perch and small cyprinid species such as roach, common chub, and common nase at Borsodivánka. We cannot rule out that the pikeperch, slightly larger but more elongated than cyprinids, could have been caught in these same traps [44]. Such traps could have been set in moderately deep water in diverse environments [51]. However, catching larger fish, such as the northern pike, common carp, and catfish, must have required some form of active fishing, possibly in relatively deep waters, with harpoons, bows, arrows, or even by hand, which only targets specific individuals [44,50].

Researchers indicate that spawning is vital to human communities because it is a predictable time when many fish species move close to the back and can be easily targeted [9]. The fish species recovered in Borsodivánka show different spawning periods. Pike spawn between February and March; the common carp, the perch, the nase, the pikeperch, and the roach spawn between April and May; and the Wels catfish spawn between May and June. [7,8,24,36,50]. Based on the more relevant presence of cyprinids and northern perch, we can conclude that, at Borsodivánka, if the inhabitants followed the spawning periods of those taxa, two probable periods of fishing periods were present: February–March and April–May.

Our burning analysis concludes that most fish remains show no visible burning (97.46%). It could indicate fish were not directly roasted over the fire. The recovered fish remains from Borsodivánka are characterized by postcranial elements such as vertebrae, spines, branchial spines, scales, and ribs (70.6%), and the cranial bones are underrepresented (10.4%). This shows that the fish in Borsodivánka were beheaded before their consumption (researchers mostly recovered the fish remains from the secondary position waste layer S7). The head constitutes 10–20% of the total fish weight and is cut off as an inedible part. The absence of cutmarks on cranial elements is usually because freshwater fish can be beheaded manually [52]. The beheading process would indicate that the fish were gutted and then processed for long-term consumption with their skin intact, as is the practice in present-day populations across the world. The most common long-term (several months) preservation processes are salting, sun-drying, and smoking [53–58]. However, we cannot exclude the cooking process, since this process occurs under 700 °C with no visible evidence of burning [58].

In the Carpathian region during the Bronze Age, "obvious" fishing apparatuses such as hooks are scarce [7,59]. In northern-eastern Hungary, the presence of seven huge bronze hooks indicates active fishing in the fortified Late Bronze Age settlement of Telkibánya-Cser-hegy [59]. The hooks present a barb, whose function is to keep the point embedded in the fish's mouth, and a terminal hook for attaching the line. The author indicates that, in modern Hungarian fishing culture, similar fish hooks are used when fishing for catfish (*S. glanis*) along rivers. Researchers also describe the presence of small boat-like vessels in Rakamaz (northeast Hungary) [60] and argued that those vessels were the miniaturse of real objects. Such representations would indicate an important aspect of the everyday life of the Bronze Age populations, such as transport or active fishing [61,62].

5. Conclusions

This study reconstructs, for the first time, a mosaic landscape with a focus on freshwater ecosystems at Borsodivánka during the Bronze Age. In this work, microvertebrates and fish support the presence of a wetland with floodplain forests and a mature freshwater ecosystem, the Tisza River and its floodplain, which was the primary water source close to the site. We also describe a mélange of open areas (shrubland and grassland), distinguishing a probable land for agricultural purposes with cereals and lentils.

The fish community is typical of deep and slow-flowing waters, and these results emphasize the importance of this resource for the population at Borsodivánka in combination with the exploitation of wild and domestic animals and agriculture. Fishing could have been practiced in various simple ways, often by "gathering" prey in residual flood pools that may have served as natural fish traps. Large fish such as northern pikes (60–70 cm), common carp, and catfish suggest active fishing, presumably during early spring, the spawning period for most species present at the site.

Most of the fish remains came from layer 7 (S7), supporting the idea that this layer was a waste or garbage layer in which charred residues from crop processing, food preparation, dung, and other waste were deposited.

Exploring more fish assemblages from other sites in the Tisza floodplain and nearby areas could improve our knowledge of fishing strategies as part of human subsistence practices for prehistoric sedentary communities the in the central portion of the Carpathian Basin.

Author Contributions: A.B.-L. analyzed and studied the microvertebrate and the fish assemblage. K.P.F., M.S., T.L.K. and N.N. provided archaeological, zooarchaeological, and geological context. A.R. and T.Z. provided archaeobotanical and micromorphological context. A.B.-L. largely wrote the manuscript, but all authors contributed to all sections of the manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: The work of the BORBAS project and our excavations at Borsodivánka are kindly supported by the Universities of Miskolc and Cologne, the Herman Ottó Museum at Miskolc, and the Hungarian National Museum in Budapest (no funding number). BORBAS gratefully acknowledges the financial support of the Foundation for the Study and Preservation of Tells in the Prehistoric Old World, Esslingen am Neckar.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: The authors appreciate the cooperation of everyone involved for their support during the field and lab work. We want to thank Britt M. Starkovich and Nicholas J. Conard (Senckenberg Centre for Human Evolution and Paleoenvironment, University of Tübingen) for granting access to the comparative collections.

Conflicts of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Fischl, K.P.; Kienlin, B.; Tugya, B. Bronze Age Settlement Research in North-Eastern Hungary. *Bronzkori Településkutatások Északkelet-Magyarországon. Archeo. Műhely.* **2015**, *12*, 117–134.
2. Magyari, E.K.; Chapman, J.C.; Passmore, D.G.; Allen, J.R.M.; Huntley, J.P.; Huntley, B. Holocene persistence of wooded steppe in the Great Hungarian Plain. *J. Biogeogr.* **2010**, *37*, 915–935. [CrossRef]
3. Ramos-Román, M.J.; De Jonge, C.; Magyari, E.; Veres, D.; Ulvonen, L.; Develle, A.-L.; Seppä, H. Lipid biomarker (brGDGT)—and pollen-based reconstruction of temperature change during the Middle to Late Holocene transition in the Carpathians. *Glob. Planet. Change* **2022**, *215*, 103859. [CrossRef]
4. Fischl, K.P.; Kiss, V.; Kulcsár, G.; Szeverényi, V. Transformations in the Carpathian Basin around 1600 B.C. In *1600—Cultural Change in the Shadow of the Thera-Eruption? Tagungen des Landesmuseums für Vorgeschichte Halle (9). Landesamt für Denkmalpflege und Archaölogie Sachsen-Anhalt*; Meller, H., Bertemes, F., Bork, H.-R., Risch, R., Eds.; Landesmuseum für Vorgeschichte: Halle, Germany, 2013; pp. 355–372.
5. Demény, A.; Kern, Z.; Czuppon, G.; Németh, A.; Schöll-Barna, G.; Siklñosy, Z.; Leél-Össy, S.; Cook, G.; Serlegi, G.; Bajnóczi, B.; et al. Middle Bronze Age humidity and temperature variations, and societal changes in East-Central Europe. *Quat. Int.* **2019**, *504*, 80–95. [CrossRef]
6. Tugya, B. The archaeozoological research results of the BORBAS project. In Proceedings of the BORBAS 10th Anniversary Event, Hungary, Germany, 29–30 August 2022.
7. Ilon, G.; Bartosiewicz, L.; Galik, A. Research tradition and the archaeological reconstruction of fishing in the small Hungarian Plain. *Hung. Archaeol. Winter.* **2016**, *2016*, 1–13.
8. Vretemark, M.; Sten, S. Animal bones from the Bronze Age tell settlement of Százhalombatta-Földvár in Hungary. Százhalombatta Archaeological Expedition. *SAX Series* **2020**, *3*, 1–127.
9. Kienlin, T.L.; Fischl, K.P.; Pusztai, T. Borsod Region Bronze Age Settlement (BORBAS). In *Catalogue of the Early to Middle Bronze Age Tell Sites Covered by Magnetometry and Surface Survey*; Dr. Rudolf Habelt GmbH: Bonn, Germany, 2018; pp. 1–428.
10. Fischl, K.P.; Pusztai, T.; Kienlin, T.L.; Á Baláz, Á.; Gucsi, L. Learn from the Charred Logs of your Neighbour's House. Reconstruction of a Unique Bronze Age Building. *Hung. Archaeol. E–J* **2022**, *11*, 1–9.
11. Fischl, K.P.; Gucsi, L.; Kienlin, T.L.; Puztai, T.; Balázs, Á. A Middle Bronze Age Foundatin Sacrifice from Borsodivánka-Nagyhalom. *Muz. Jud. Satu Mare.* **2022**, *37–38*, 69–85.

12. Röpke, A.; Wilde, V.; Fischl, K.P.P.; Kienlin, T.L. *Phytolith-Rich Layers from the Early Bronze Age Tell at Borsodivánka (Hungary)-Preliminary Taphonomic and Archaeological Implications*; AK Geoarchäologie: Tübingen, Germany, 2016.
13. Röpke, A.K.; Zerl, T.; Fischl, K.P.; Kienlin, T. From floors to middens and back again—Life on the Bronze Age tell Borsodivánka-Nagyhalom (Hungary). In Proceedings of the EAA 2018 Barcelona Conference, Barcelona, Spain, 5–8 September 2018.
14. Zerl, T.; Röpke, A.; Kienlin, T.; Fischl, K.P. Erste Ergebnisse der archäobotanischen Untersuchungen auf dem bronzezeitlichen Tell von Borsodivánka, Ungarn. In Proceedings of the AK Archäobotanik Tübingen Conference, Tübingen, Germany, 13–15 May 2016.
15. Conroy, J.W.H.; Watt, J.; Webb, J.B.; Jones, A. *A Guide to the Identification of Prey Remains in Otter Spraint*; The Mammal Society: London, UK, 2005; pp. 1–48.
16. Lepiksaar, J. Introduction to Osteology, of Fishes for Paleozoologists. 1994. Available online: https://vdocuments.mx/johannes-lepiksaar-introduction-to-osteology-of-fishes-.html?page=82 (accessed on 2 February 2023).
17. Watt, J.; Pierce, G.J.; Boyle, P.R. *Guide to the Identification of North Sea Fish Using Premaxillae and Vertebrae*; ICES Cooperative Research Report, 220; International Council for the Exploration of the Sea: Copenhagen, Denmark, 1997; pp. 1–231.
18. Cuenca-Bescós, G.; Morcillo-Amo, Á. *Roedores, Edades y Paisajes en el Cuaternario de la Península Ibérica*; Aragosaurus-IUCA-Universidad de Zaragoza: Zaragoza, Germany, 2022; p. 416.
19. Cannon, D.Y. *Marine Fish Osteology: A Manual for Archaeologists. Archaeology Press*; Simon Fraser University: Burnaby, Germany, 1987; pp. 1–146.
20. Wheeler, A.; Jones, A.K.G. *Fishes. Cambridge Manuals in Archaeology*; Cambridge University Press: London, UK, 2009; pp. 1–224.
21. Grayson, D.K. *Quantitative Zooarchaeology*; Academic Press: New York, NY, USA, 1984; pp. 1–202.
22. Sternberg, M. La consommation du poisson à Lattes (IIIe-Ier s. Av. N. È.). Méthodes d'étude et premiers résultats in Introduction à l'étude de l'environnement de Lattes antique. *Lattara* **1989**, *2*, 101–120.
23. Libois, R.; Hallet-Libois, C. *Eléments Pour l'identification des Restes Crâniens des Poissons Dulçaquicoles de Belgique et du Nord de la France: 2. Cypriniformes*; Association pour la Promotion et la Diffusion des Connaissances Archéologiques: Juan-les-Pins, France, 1988; pp. 1–24.
24. Füllner, G.; Pfeifer, M.; Völker, F.; Yarske, A. *Atlas der Fische Sachsens. Landesamt für Umwelt, Landwirtschaft und Geologie*; Senckenberg Publications: Münich, Germany, 2016; pp. 1–407.
25. Jelu, I.; Wouters, W.; Van Neer, W. The use of vertebral measurements for body length and weight reconstruction of pike (*Esox lucius*) from archaeological sites. *Archaeo. Anthr. Sci.* **2021**, *13*, 72. [CrossRef]
26. Bridault, A.; Binois-Roman, A.; Frontin, D.; Cupillard, C.; Petit, C. Mesolithic Freshwater Fishing: A Zooarchaeological Case Study. *Open Archaeol.* **2022**, *8*, 739–764. [CrossRef]
27. Guillaud, E.; Lebreton, L.; Béarez, P. Taphonomic signature of Eurasian eagle owl (*Bubo bubo*) on fish remains. *Folia Zool.* **2018**, *67*, 143–153. [CrossRef]
28. Frontini, R.; Roselló-Izquierdo, E.; Morales-Muñiz, A.; Denys, C.; Guillaud, E.; Fernández-Jalvo, Y.; Pesquero-Fernández, M.D. Compression and digestion as agents of vertebral deformation in Sciaenidae, Merlucidae and Gadidae remains an experimental study to interpret archaeological assemblages. *J. Archaeol. Method Theory* **2021**, *29*, 480–507. [CrossRef]
29. Cáceres, I.; Bravo, P.; Esteban, M.; Expósito, I.; Saladié, P. Fresh and heated bones breakage. An experimental approach. In *Current Topics on Taphonomy and Fossilization*; De Renzi, M., Pardo, M., Belinchón, M., Peñalver, E., Montoya, P., Márquez-Aliaga, A., Eds.; Universitat Rovira i Virgili: Tarragona, Spain, 2022; pp. 471–479.
30. Shipman, P.; Foster, G.; Shoeninger, M. Burnt bones and teeth: An experimental study of color, morphology, crystal structure and shrinkage. *J. Archaeol. Sci.* **1984**, *11*, 307–325. [CrossRef]
31. Stiner, M.C.; Kuhn, S.L.; Weiner, S.; Bar-Yusef, O. Differential burning, recrystallization and fragmentation of archaeological bone. *J. Archaeol. Sci.* **1995**, *22*, 223–237. [CrossRef]
32. Lloveras, L.; Moreno-García, M.; Nadal, J. Butchery, cooking and human consumption marks on rabbit (*Oryctolagus cuniculus*) bones: An experimental study. *J. Taphon.* **2009**, *7*, 179–201.
33. Medina, M.E.; Teta, P.; Rivero, D. Burning damage and small-mammal human consumption in Quebrada del Real 1 (Córdoba, Argentina): An experimental approach. *J. Archaeol. Sci.* **2012**, *39*, 737–743. [CrossRef]
34. Walker, M.J.; Anesin, D.; Angelucci, D.E.; Avilés-Fernández, A.; Berna, F.; Buitrago-López, A.; Fernández-Jalvo, Y.; Haber-Uriarte, M.; López-Jiménez, A.; López-Martínez, M.; et al. Findings, context, and significance of combustion at the late Early Pleistocene Palaeolithic site of Cueva Negra del Estrecho del Río Quípar (Caravaca de la Cruz, Spain). *Antiquity* **2015**, *90*, 571–589. [CrossRef]
35. Kettle, A.J.; Morales-Muñiz, A.; Roselló-Izquierdo, E.; Heinrich, D.; Vøllestad, L.A. Refugia of marine fish in the Northeast Atlantic during the Last Glacial Maximum: Concordant assessment from archaeozoology and palaeotemperature reconstructions. *Clim. Past* **2010**, *6*, 1351–1389. [CrossRef]
36. Doadrio, I.; Perea, S.; Garzón-Heydt, P.; González, J.L. *Ictiofauna Continental Española. Bases Para su Seguimiento*; Ministerio de Medio Ambiente y Medio Rural y Maritimo (MARM): Madrid, Spain, 2011; pp. 1–376.
37. Živaljevic, I.R.S.; Vukovic-Bogdanovic, S.I.; Bogdanovic, I.S. Ad palatinas acipensem mittite mensas: Fish remains from Viminacium. *Starinar* **2019**, *69*, 183–202. [CrossRef]
38. Evans, E.M.N.; van Couvering, J.A.H.; Andrews, P. Palaeoecology of Miocene sites in western Kenya. *J. Hum. Evol.* **1981**, *10*, 99–116. [CrossRef]
39. Andrews, P. Taphonomic effects of faunal impoverishment and faunal mixing. *Palaeogeogr. Palaeclimatology Palaeoecol.* **2006**, *241*, 572–589. [CrossRef]

40. Blain, H.-A.; Bailon, S.; Cuenca-Bescós, G. The Early-Middle Pleistocene palaeoenvironmental change based on the squamate reptile and amphibian proxies at the Gran Dolina site, Atapuerca, Spain. *Palaeogeogr. Palaeclimatology Palaeoecol.* **2008**, *261*, 177–192. [CrossRef]
41. López-García, J.M. *Los Micromamíferos del Pleistoceno Superior de la Península Ibérica: Evolución de la Diversidad Taxonómica y Cambios Paleoambientales y Paleoclimáticos*; Editorial Académica Española: Tarragona, Spain, 2011; pp. 1–416.
42. Rey-Rodríguez, I.; López-García, J.M.; Blain, H.-A.; Stoetzel, E.; Denys, C.; Fernández-García, M.; Tumung, L.; Ollé, A.; Bazgir, B. Exploring the landscape and climatic conditions of Neanderthals and anatomically modern humans in the Middle East: The rodent assemblage from the late Pleistocene of Kadar Cave (Khorramabad Valley, Iran). *Quat. Sci. Rev.* **2020**, *236*, 106278. [CrossRef]
43. Kirchhofer, A.; Hefti, D. Conservation of Endangered Freshwater Fish in Europe. In *Advances in Life Sciences*; Birkhöser: Bern, Switzerland, 1996; pp. 1–202.
44. Bartosiewicz, L.; Bonsall, C. Prehistoric Fishing along the Danube. *Antaeus* **2004**, *27*, 253–272.
45. Musilová, R. Ecology and status of the Aesculapian snake (*Zamenis longissimus*) in northwest Bohemia. Ph.D. Thesis, University of Sciences, Prague, Czech Republic, 2011; pp. 1–111.
46. Pénzes, B.; Tölg, I. *Halbiológia Horgászoknak*; Natura: Budapest, Hungary, 1977; pp. 1–349.
47. Huet, M. Aperçu des relations entre la pente et les populations piscicoles des eaux courantes. *Schweiz. Z. Für Hydrol.* **1949**, *11*, 332–351. [CrossRef]
48. Huet, M. Biologie, profils en long et en travers des eaux courantes. *Bull. Fr. De Piscic.* **1954**, *175*, 41–53. [CrossRef]
49. Bököny, S. The development and history of domestic animals in Hungary: The Neolithic through the Middle Ages. *Am. Anthropol.* **1971**, *73*, 640–674. [CrossRef]
50. Bykowski, P.; Dutkiewicz, D. Freshwater fish processing and equipment in small plants. *FAO Fish. Circular.* **1996**, *905*, 1–59.
51. Svanberg, I.; Locker, A. Ethnoichthyology of freshwater fish in Europe: A review of vanishing traditional fisheries and their cultural significance in changing landscapes from the later medieval period with a focus on northern Europe. *J. Ethnobiol. Ethnomedicine* **2020**, *16*, 68. [CrossRef]
52. Kostov, V.; Naumovski, M.; Nastova-Gjorgjioska, R.; Milijanovic, B. Spawning season and spawning habit of nase *Chondrostoma nasus* (L. 1758) from the river Vardar . In Proceedings of the Symposium of Livestock Production with International Participation, Sturga, North Macedonia, 23–25 May 2000; pp. 179–184.
53. Adeyeye, S.A.O. Traditional fish processing in Nigeria: A critical review. *Nutr. Food Sci.* **2016**, *46*, 321–335. [CrossRef]
54. Brut, J.R. Dried and smoked fishery products. Preparation and consumption. In *Fish Smoking and Drying*; Brut, J.R., Ed.; Elsevier Applied Science: London, UK, 1988; pp. 121–160.
55. Knudson, K.K.; Frink, L. Ethnoarchaeological analysis of Arctic fish processing: Chemical characterization of soils on Nelson Island, Alaska. *J. Archaeol. Sci.* **2010**, *37*, 769–783. [CrossRef]
56. Lernau, O.; Cotton, H.; Goren, Y. Salted fish and fish sauce from Masada: A preliminary report. *Archaeofauna* **1996**, *5*, 35–41.
57. Zohar, I.; Cooke, R. The role of dried fish: A taphonomical model of fish butchering and long-term preservation. *J. Arch. Sci.* **2019**, *26*, 101864. [CrossRef]
58. Zohar, I.; Alperson-Afil, N.; Goren-Inbar, N.; Prévost, M.; Tütken, T.; Sisma-Ventura, G.; Hershkovitz, I.; Najorka, J. Evidence for the coking of fish 780,000 years ago at Gesher Benot Ya'aqov, Israel. *Nat. Ecol. Evol.* **2022**, *6*, 2016–2028. [CrossRef]
59. Szabó, G.V. Territories and Boundaries. The fish in the fort: Telkibánya-Cser-hegy. In *Bronze Age Treasures in Hungary*; Benkő, E., Jerem, E., Kovács, G., Laszlovszky, J., Eds.; The Quest for Buried Weapons, Tools and Jewelry; Archaeolingua Alapítávany: Budapest, Hungary, 2019; pp. 147–155.
60. Oravecz, H. An Early Bronze Age boat-like representation from Rakamaz, Northeast Hungary. *Commun. Archaeol. Hung.* **2013**, *2013*, 5–20. [CrossRef]
61. Kiss, V. Contacts along the Danube: A Boat Model from the Early Bronze Age. In Proceedings of the International Conference Bronze and Early Iron Age Interconnections and Contemporary Developments between the Aegean and the Regions of the Balkan Peninsula, Central and Northern Europe, Zagreb, Croatia, 11–14 April 2007; Volume 27, pp. 119–133.
62. Shalganova, T. The Lower Danube Encrusted Pottery Culture. In *Prehistoric Bulgaria*; Bailey, D., Panayotov, I., Eds.; Prehistory Press: Sofia, Bulgaria, 1995; pp. 85–86.