Subsistence Economy in the Bronze Age of the Northern European Plain and the Carpathian Basin. A comparison.

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Main seminar - Dynamic changes of subsistence economy in prehistory
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1. Introduction to the Research Question

In this paper I want to take a closer look at the subsistence economy of the Bronze Age of two quite distinct regions of Europe. The first area will be the North European Plain, which I hereby define as the regions of today´s North Germany, Denmark´s Jutland, the northern part of Poland and the Northern Netherlands.The second area is the Carpathian Basin, sometimes also refered to as Pannonian Basin, which constitutes of Hungary, Southern Slovakia and the northwestern part of Romania. As the entirety of subsistence economy would be too large for a regular paper to consider, I will focus on two main aspects: plant economy, which constitutes of agriculture and gathered wild species and animal economy, including the use of wild animal species as well as animal husbandry of domesticates.

There are general hypotheses that can be easily made from previous works, such that there seems to have been a diversification of available crops throughout the Bronze Age, compared to the previous Neolithic times, but these works tend to focus on the interregional changes of one area and do not compare different areas with each other. With this paper and its focus on two very different geographic and cultural regions, I hope to give a preliminary answer to the questions that generally arise when regarding economy of the past times: What impact did environmental influence have? What causes diachronical changes and what are their reasons? And last, but not least: What might the economy of a people tell us about their society?

Methodically, additional to a normal literature work, I have collected the data from the authors and generated graphics out of the tables so created, with which I hope to make the results as understandable as possible.

In the first part of this paper, I will briefly introduce the chronology and characteristics of the Bronze Age of the two regions. Then I will describe the economy split according to plant economy and animal economy. My main interest points hereby lie in the different species of crops and animals used as well as the techniques with which they were cultivated, kept or acquired.
In the second part, I will compare the two different regions and try to understand the reasons for the similarities and differences that can be seen between them. Another purpose of this paper is also to understand links between animal and plant economy, and see how they interact and support or oppose each other, which I will dive into in section five. Finally, I will end with a general outlook on the topic and what further could be done in a more extensive work.

2. Introduction to the Research Areas

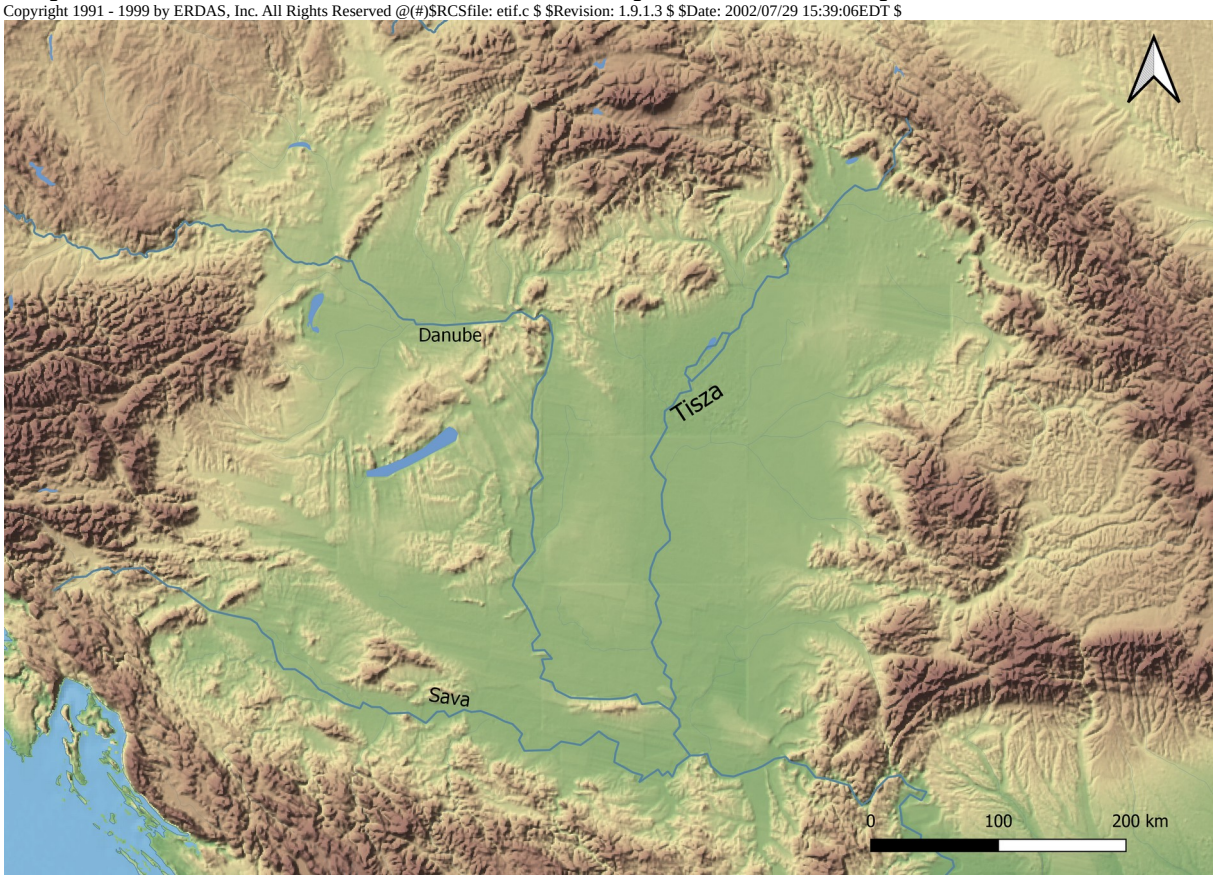
The Bronze Age is one of the three initial periods of the European Prehistory defined in the 19th Century. As such, its research tradition is extremely long and as complicated are the subdivisions of this period that differ depending on the country or even regions within one country, that are concerned. The most broadest distinction that exists in some form or other in all regions however is the partition into Early and Late Bronze Age, most of the times with a Middle Bronze Age inbetween. For this paper, I will stick with these terms and not try to attempt a finer division.
For Northern Europe, there are the two chronology systems of Reinecke and Montelius. Reinecke is more popular for Central Europe and only somewhat relevant in the southernmost areas of the regions I am concerned with. The Netherlands, North Germany, Denmark and North Poland all fall under the influence of the Nordic Bronze Age,

North Germany has therefore overtaken the chronological system of Montelius, though different ways to date and structure it seem to exist at the same time. While EFFENBERGER (2018) parts the Bronze Age into three periods for her dissertation, KNEISEL ET AL (2020) only see two periods for Schleswig-Holstein. As the data is taken from EFFENBERGER, I will stick with her chronology in this paper, therefore, the Bronze Age lasts from 1800 to 600 BC here, but it should be noted that there might be newer systems available for the area.
North Germany is closely associated with Denmark, which has a Bronze Age from 1700 to 500 BC (ANDREASEN 2020) . The Nordic Bronze Age showed a rather uniform cultural development, often just dubbed „Nordic culture“, containing the Dagger Period and following Sögel-Wohlde Culture. Influences from the neighbouring cultures in the south, like the Tumulus and Lausitz Cultures can be seen though (JOCKENHÖVEL 2013, THRANE 2013). For the finer distinctions, ANDREASEN´s (2020) structure based on Jensen has been used, allthough this provides only a two-period partition as well.
While an, apparently only vaguely defined, original chronological system exists in the Netherlands, it was argued that its Northern Part should use Montelius‘ system, though absolutely dated, the Bronze Age lasts from 2000 to about 800 BC. The Middle Bronze Age is parted into two for that. (FOKKENS/FONTIJN 2013).
Finally, in Poland the Bronze Age reaches from around 2300/2200 BC to 800 BC. Culturally, the North-West and North-East of the country show quite large differences. While the North-West showed a development from Beaker Culture to its own agrarian cultures, influenced by the Nordic Bronze Age and the Tumulus Culture, the North-Eastern Territory continued a neolithic lifestyle but with a high focus on hunting and gathering. Only later cultures like the Lausitz spread into the area as well (CZEBRESZUK 2013). Interestingly, this split also occurs in the climate; West Poland follows the Atlantic climate zone, whereas the East has continental climate (HARDING 2000).

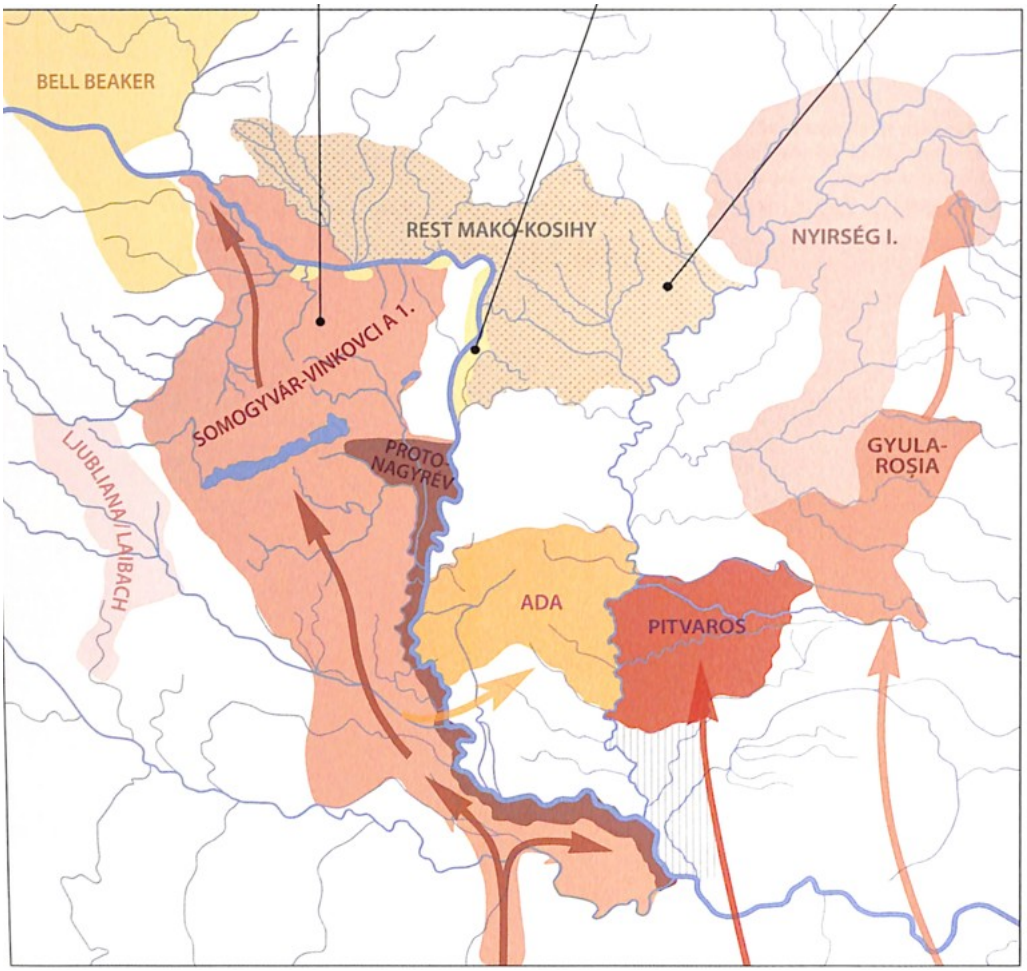
Environmentally speaking, the areas in question all offer rather similar conditions. North Germany is a flat lowland, with the coastlines of the North and Baltic Sea. It is defined by glacial moraines with lakes and bogs (JOCKENHÖVEL 2013). The northern part of the Netherlands constitutes of riverine systems and coastal lowlands (FOKKENS/FONTIJN 2013), though it consists of mineralogically poor sandy soils, while Denmark started the Early Bronze Age with most of its deciduous forest still intact, offering very good conditions for agriculture (THRANE 2013). The Settlements of the Northern European Plain were very similar over the entire area. They are isolated and dispersed, with only one or two farmsteads (DE HINGH 2000, KOOIJMANS 1998) associated with each other. Only in few areas the settlement density increased enough for more agglomerated sites to form (DE HINGH 2000). The houses are longhouses, shifting from two-aisled to three-aisled in the Middle Bronze Age.

In general, the Bronze Age of the Carpathian Basin starts earlier than in the North-European Areas. Hungary has had its own chronological systems, starting with the attempt made by István Bóna (KISS ET AL 2019), most of which disagree with each other in the absolute dates they assign for the different periods. I have oriented myself around what FILATOVA (2022) uses as well, which sets the beginning of the Bronze Age to 2600/2500 BC and ends the period at 800/750 BC. The Late Bronze Age is parted into two periods and there is an earlier transition period from Copper Age to Bronze Age postulated, which are taken over into the table, but will have to be mostly ignored in the further work, as none of the other authors used here, use this partition. Slovakia has its own chronological tradition as well, based on a modified version of the Central European Reinecke system. The Early Bronze Age there continues for a much longer time than in Hungary, which causes the Slovakian Middle Bronze Age to overlap with the Late Bronze Age I of Hungary. Therefore, there is no partition into two Late Bronze Age periods. Despite of this, the transitions seem to appear at the same absolute dates (ILON/MARKOVÁ 2013).

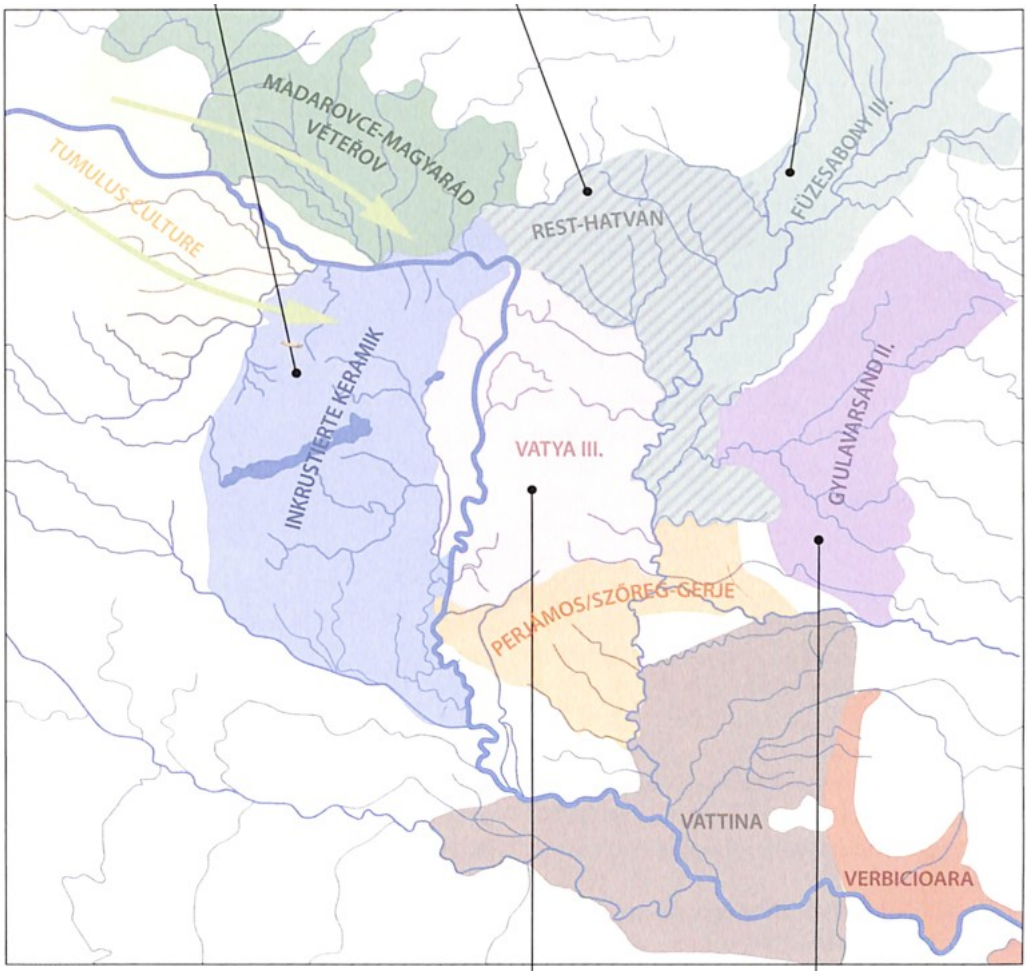
Topographical Maps of the two research areas. As can be seen, just by geology alone, the Carpathian Basin is a much more diverse landscape than North Europe.



Unlike the Northern European Plain, the Carpathian Basin shows a very diverse range of climatic zones, containing oceanic and Atlantic weather in the Western Part, Sub-Carpathian highland weather in the mountain ranges and a sub-Mediterranean climate in the South. The land is covered with forest steppe and the alluvial plains of the Danube and the Tisza, forming a rather diverse environmental spectrum (ILON/MARKOVÁ 2013, FILATOVA 2022). This also shows in the many different local cultures forming in the Bronze Age and the variety of settlement types present in the time, forming a very complex picture of the region. While settlements of the early Bronze Age usually were small and dispersed, they also could be fortified on hilltops (e.g. Kosihy-Čaka), whereas the Interfluvial region between the two rivers showed a development towards tell sites (e.g. Hatvan, Nagyrév) in the Middle Bronze Age. They were abandoned after 1300 BC (GYULAI 2010).
Two maps from FILATOVA (2022) are provided here, which show the region during the Early and the Middle Bronze Age to offer some orientation. Additionally, Table 1 shows the different chronology systems in relation to one another.



Cultures in Hungary in the Early Bronze Age. From FILATOVA (2020). Fig. 14.



Cultures in the Middle Bronze Age in Hungary. From FILATOVA (2020), Fig. 15.

3. Plant Economy

3.1 Source Criticism

Obviously, one of the biggest influences in any archaeological work, are the preservation conditions. Unfortunately for the archaeobotanist, organic material does not survive, as long as it is not waterlogged. The only possibility in dry sites is charring, which can happen during parching of cereal grains or cooking procedures. However, this leads to a bias in such species, that require these steps.

Additionally, some plants that are already rarely burned, if ever, also barely survive the charring itself, such as lin seeds or any leaves of plants. It can be assumed for all data presented here, that the amount of oil plants, gathered plants and pulses is severely underrepresented (FILATOVA 2020, HARDING 2000). As only glume wheats require parching, there is also a slight bias for the preservation of these, instead of free-threshing wheats (HARDING 2000, ANDREASEN 2020). However, parching of glume wheats is not necessarily required to remove hulls (DE HINGH 2000), so it is unclear how much this bias might actually exist.

In addition to these methodical biases, there is also the issue of a lack of available data for certain regions. While this paper is and cannot be in any way called an extensive overview over all available data, there still are areas that are simply lacking in the general research as well. For instance, the whole Late Bronze Age of the Carpathian Basin, except for the region west of the Danube, is still in need of further research (GYULAI 2010) and generally, tell sites have been much better investigated than flat settlements so far (FILATOVA 2020). The Early Bronze Age of the Netherlands, North Germany and certain parts of Denmark are lacking as well (EFFENBERGER 2018). In the Netherlands, a lot of sites are located in West Frisia, as this area shows a much earlier development of small settlements as the other regions, which promoted their preservation (DE HINGH 2000).

For this section, 744 data points have been collected from 49 sites/regions[1]. The publications of DE HINGH (2000), EFFENBERGER (2018), HARDING (2000), KUČAN (2007), ROBINSON (2003), STIKA/HEISS (2013) and WASYLIKOWA ET AL (1991) were used. Poland is the most underrepresented area, as it only appears as a general region with sixty entries. Unfortunately, HARDING (2000) does also not provide a partition into time periods either, so for that country, only very general remarks can be made. Germany, the Netherlands and Denmark appear relatively evenly. The different time periods are all well-represented in data points, though the number of entries increases with time. 11 Sites date to the Early Bronze Age, 11 to the Middle Bronze Age and 14 to the Late Bronze Age. Additionally there are a few sites that are ascribed very long time intervals, which will be ignored for this analysis. Unfortunately, every publication uses different ways to count the present plant material, which resulted in five different columns of values: Percentage, Abundance, Absolute Number, the Percentage of the Material in the Site (Stetigkeit) and Presence-Absence. Of this, only the last can be inferred from any of the given others. To solve this issue, a new column of „Semi-Quantitative“ values was added, with the five categories „0“, „x“ (0-25%), „xx“ (25-50%), „xxx“ (50-75%), „xxxx“ (75-100%). „0“ in this case stands for a taxon not being present, whereas the other categories mark the amount of a taxon being there. When only absolute numbers were present, the total amount was considered to be 100% and the percentages were estimated from this. As the frequency does not actually give information about the amount of material present, but rather, how often they appeared, the categories „x?“, „xx?“, „xxx?“ and „xxxx?“ were used instead, marking the spread of the taxa. If only the presence was known, and no further information of the amount given, a „?“ was signed in instead. From these categories, the tables were then generated with Python Code („Semiq.py“ for the Amount and „Semiq2.py“ for the Frequencies). Only the sites clearly belonging to one of the three periods were used for the tables in order to show a clear picture of possible diachronical change and not crowd them too much.

For the Carpathian Basin 1230 data points were collected, yielding the richest amount of data in this paper. 19 Sites belong to the Early Bronze Age, 38 to the Middle Bronze Age and 24 to the Late Bronze Age. The used publications are FILATOVA (2020, 2022), GYULAI (2010), HARDING (2000), STIKA/HEISS (2013), SZEVÉRENYI ET AL(2015) and WASYLIKOWA ET AL (1991). As FILATOVA (2022) also gave the archaeological cultures for her data, some information is known on these.

1 In the rest of the paper, only the word „site“ will be used. However, it should be noted that in the context of the collected data this does not always refer to an actual excavation site, but can also refer to a larger region (e.g. Djursland) or even a whole country (e.g. Poland).

Additionally, overlaps with BARTOSIEWICZ (2022) allowed adding some information on settlement type. However, due to lack of place, I decided not to compare these here.

Six different ways were used by the various authors to give the number of finds. I deployed the same system as described above for these and the tables were generated in the same way.

In the following, the results extracted from the collected data will be presented, with the sources added to it.

3.2 Plant Economy in the North-European Plain

As can be seen for the Early Bronze Age, emmer (*Triticum dicoccum*) and barley (*Hordeum vulgare*) appear in the highest numbers, though emmer appears less often (SITKA/HEISS 2013), except in Southern Schleswig-Holstein, were it appears as the main crop (EFFENBERGER 2018). If the barley can be further differentiated, it usually seems to be the naked variety (*Hordeum vulgare nudum*) that is dominant. Millet (*Panicum miliaceum*) does not occur yet. In lower numbers einkorn (*T. monococcum*), spelt (*T. spelta*) and free-threshing wheats (*T. aestivum/T. durum*) occur as well. This is also the case for Denmark (ROBINSON 2003). For the Early Bronze Age of the Netherlands, sites are unfortunately quite lacking. Only the general overview of EFFENBERGER (2018) exists, which indicates naked barley as the dominant crop.

Of the wild plants, acorn (*Quercus sp.*), hazelnut (*Corylus avellana*) and species such as *Rubus fruticosus* and *Prunus spinosa* were still collected on almost all sites studied by EFFENBERGER (2018, Denmark and North Germany). *Pisum sativum* finds are widespread in Mecklenburg-Vorpommern and South Schleswig-Holstein. EFFENBERGER (2018) sees broad bean (*Vicia faba*) appearing in the Early Bronze Age. Single finds of linnen (*Linum usitatissimum*) indicate its use as an oil crop in Denmark. In North Germany, spelt only occurred from the Middle Bronze Age onwards.

In the Middle Bronze Age, emmer and barley are still highly popular, but now, millet also starts to appear in small quantities. In the Netherlands, hulled and naked barley, millet, emmer, spelt, einkorn and bread wheat are all present during that time. Hulled barley appears dominant over naked barley here as well (DE HINGH 2000).

The Late Bronze Age shows the most changes: while Barley is still usually the most important crop, in South Schleswig Holstein, Mecklenburg-Vorpommern, Eastern Zealand (JENSEN ET AL 2020) and the Southern North Sea Coast, the hulled variety (*Hordeum vulgare vulgare*) has overtaken over the naked variant. Even in the areas where this is not the case, the amount of hulled barley has increased significantly, often to being almost equal with its naked variety. Second-place is still emmer, but millet has also become rather popular. Einkorn is still present, but basically irrelevant. Northern Jutland shows a large amount of bread wheat (ANDREASEN 2020) instead. Pulses are more frequent now, broad bean (*Vicia faba*), appearing in more areas (KUČAN 2007), lentil (*Lens culinaris*) and pea (*Pisum sativum*) commonly being found or first appearing elsewhere (EFFENBERGER 2018), though from the data it is difficult to assess their importance, as no amounts are given. According to KUČAN (2007), pea is generally only present in small numbers and decreases especially in the Netherlands. Wild plants still occur often, hazelnut, *Rubus sp.* and acorns present in many areas. *Malus sylvestris* is found on a few sites. Additionally to linnen, gold-of-

pleasure (*Camelina sativa*) now can be found in increasing numbers and appears to be relatively common in most of North Germany and Denmark (e.g. KUČAN 2007). Additionally, poppy (*Papaver somniferum*) is also present in Mecklenburg-Vorpommern.

For Poland it can only be said, that *Triticum aestivum* appears in unusually high numbers, allthough millet and barley do also play a large role throughout the Bronze Age there. Towards the Late Bornze Age, the use of millet increases. Emmer and einkorn are also present and rye and oat appear in small numbers (WASYLIKOWA ET AL 1991). Lentil, pea and broad bean are cultivated as pulse crops (CZEBRESZUK 2013). Flax, Gold-of-pleasure and poppy appear as oil plants and mustard is mentioned as a potential oil crop as well (CZEBRESZUK 2013). Hazelnuts, *Rubus sp*., as well as cherries and acorns can be found as gathered plants (WASYLIKOWA ET AL 1991). In North Germany, additionally to already mentioned species, *Rosa sp.*, *Fragraria vesca*, *Crataegus monogyna* and *Juniperus communis* also appear in the assemblages (KUČAN 2007). *Carpinus betulus* seeds might also have been consumed (EFFENBERGER 2018). This indicates, that gathering was widely deployed, but estimating the role it played at the time is not possible with the available data.

Oats appear in very low numbers in most areas, but cannot be discerned further usually. They likely still were only weeds in the other cereals at this point in time (CZEBRESZUK 2013, ROBINSON 2003, KUČAN 2007). EFFENBERGER (2018) believes them to be cultivated though.

3.3 Plant Economy in the Carpathian Basin

As can be seen from FILATOVA´s (2022) data, in the Early Bronze Age the role of agriculture seems to still be quite variable. While at most sites barely any other plant finds occur, at others much more wild plants can be found, cereals apparently playing no role at all. Pulses like lentil, pea and horsebean already occur, but also seem to vary in their importance. Common and bitter vetch are usually irrelevant (STIKA/HEISS 2013). Flax is used both as an oil plant as well as for linen, as some thread finds prove (GYULAI 2010). Millet shows in unusually high proportions at a few sites. Cereal-wise (hulled) barley seems to be the most important crop. Additionally emmer, club wheat and spelt also occur (STIKA/HEISS 2013). It is noted that these patterns show a continuity with the Late Neolithic period. Real changes only start to appear with the Middle Bronze Age (KNEISEL ET AL 2015, WASYLIKOWA ET AL 1991)

The pattern of high regional variability continues in the Middle Bronze Age. Next to barley, einkorn (*T. Monococcum*) and emmer (*T. dicoccum*) appear relatively frequently. Pea, grass pea, lentil and horse bean all occur. Cereals like club-wheat and spelt, and pulses like bitter vetch, broad bean and common vetch also occur at some sites, but do not reach high numbers (FILATOVA 2020). Small-seed lentil also shows (GYULAI 2010). Other than in the Northern areas, naked and hulled barley do not show a trend in their numbers, occuring in different ratios at different sites.

Whether einkorn or emmer is the most dominant crop seems to depend on the region. In the Northeast and Eastern part, as well as the area between the Danube and the Tisza, the regions of the Transdanubian Encrusted Pottery and Vatya, einkorn appears the most, whereas in the area of the Otomani and Hatvan cultures, emmer prevailed (GYULAI 2010, FILATOVA 2020). As oil crops, gold-of-pleasure, safflower and poppy appear additionally to flax (STIKA/HEISS 2013).

The Late Bronze Age is signified by relatively large amounts of millet. While emmer still occurs frequently, some sites also show large amounts of bread wheat (*T. Aestivum*, KNEISEL ET Al 2015). Gold-of-pleasure is now fully established, while barley and einkorn decrease and spelt increases slightly (STIKA/HEISS 2013). Black mustard (*Brassica nigra*) occurs as another potential oil plant, being rather important in the Late Bronze Age together with Gold-of-pleasure. Like in the northern areas, oats, as well as rye appear in low numbers, still only being weeds (KNEISEL ET AL 2015). STIKA AND HEISS (2013) also consider foxtail millet as a cultivate.

Gathered plants in the area were *Prunus sp.*, as well as hazelnut, cornelian cherry, blackthorn, grapevine and acorn (FILATOVA 2020). *Malus sylvestris* occurs on several sites as well (GYULAI 2010). The storage of *Chenopodium album* speaks either for its cultivation as a crop or gathering in large quantities (WASYLIKOWA ET AL 1991) as a crop replacement. Occasionally, rye brome was also consumed as a food and grape pips can be found (STIKA/HEISS 2013).

According to GYULAI (2010) Otomani tells show large numbers of husked wheats, einkorn, emmer and naked wheat, but no millet, while the Hatvan/Füzesabony complex relied almost completely on it (FILATOVA 2022). The Otomani also gathered *Chenopodium album* and grew pea, lentil and bitter vetch (GYULAI 2010). At Gavá sites, hulled wheats like einkorn and emmer remained most popular, with barley and millet in equal proportions. The Tumulus culture, with open, small settlements (FILATOVA 2022), cultivated pea, bitter vetch, grass pea and millet. However, they show a shift to more extensive agriculture, relying more on Animal Husbandry and showing a large proportion of wild plants. The Urnfield complex grew emmer instead of barley (GYULAI 2010).

Just these few examples make it clear, that the agriculture in the Carpathian Basin was highly variable. Therefore, authors that provide only a general overview (e.g. „Hungary“ in HARDING 2000) show an extremely simplified picture of the area.

4. Animal Economy

4.1 Source Criticism

Bones have a higher chance of survival than plant material and do not require charring for that. Still, a methodic bias still exists, depending on the care taken in searching for bone material. Small bones such as of fish and smaller animals are overlooked more easily and do not preserve as well either (SCHEIBNER 2015, VAN AMERONGEN 2015). Because of that, taxa such as fish tend to be underrepresented. Chronologically, the Early Bronze Age is lacking in finds, except for Slovakia and Hungary and only the Late Bronze Age can actually be considered rich in animal bones (BENECKE 1998). A general problem in the Carpathian Basin is yet again the focus on certain areas only. Tell settlements are therefore much better investigated than flat settlement types (FILATOVA 2020), though this appears as the oppsite in the collected data here.

A general issue is the distinction between the caprines sheep and goat, which is almost impossible in archaeological material. They occur listed together in one category in the following section because of that. Cattle, due to its large bones prone to fragmentation, tends to be overrepresented in numbers, while pig and caprines are better to compare (BARTOSIEWICZ 2022). This is a problem in this work, as only Bartosiewicz (2022) gave the number of identifiable specimens and not just the

number of bones present, a difference that was ignored in favor of having more data available. Therefore, the comparisons made here cannot be seen as fully correct.

In total, 16 sites were collected for the Northern European Plain, this section therefore being the lowest in available data. Of these, almost all of them are from the Netherlands, as this area is the only one with studies that are easily available. There is 1 Early Bronze Age Site and 1 Middle Bronze Age Site. Unfortunately, no clear Late Bronze Age site is recorded, only 7 sites that date to the Middle and Late Bronze Age. Therefore, not much can be said about the diachronic development of the Northern European Plain. The quality of the data is also quite variable. The majority of the data stems from VAN AMERONGEN (2015) and VAN AMERONGEN (2014). Only about 50 of 365 data points can be attributed to BENECKE (1994), HARDING (2000) and SCHEIBNER (2015). VAN AMERONGEN (2014, 2015) has her data on species level, but only provides presence or absence of taxa, whereas HARDING (2000) and BENECKE (1998) give percentages. SCHEIBNER (2015) does as well, but only allows the distinction between livestock and wild animals. None of the authors gave information on the archaeological culture, so no differentiation was attempted.

For the Carpathian Basin, a total of 84 sites have been collected. The data stems from SZEVÉRENYI ET AL (2015), HARDING (2000), BENECKE (1998) and BARTOSIEWICZ (2022). BARTOSIEWICZ (2022) adds the settlement type to his data, so 7 sites are known to be hillfort settlements, 42 are simple, flat settlements and 16 are Tells. 31 Sites belong to the Early Bronze Age, while 28 can be ordered to the Middle Bronze Age and 17 to the Late Bronze Age. As for these sites, both the normal percentage and number of identifiable species are fully quantifiable, a bar chart is given for these instead.

4.2 Animal Economy in the North European Plain

The Early Bronze Age represented only in the site of Zwaagdijk shows a large amount of cattle, followed by caprines and then pig. The people of the site depended almost exclusively on domesticates, with only a few wild animals (wild boar, roe deer) and fish in addition, which contrasts the Late Neolithic sites contained in the data. This picture doesn´t change when moving to the Middle and Late Bronze Age sites, which can not be distinguished. However, as the number of sites are so low, not much more can be said about the animal economy from these. The available data does not suggest major changes between the earlier and later periods. Potentially, wild fauna input has decreased slightly, but there really is not enough data to say this might not be a coincidence. The three sites not from the Netherlands can only be considered over the whole period of the Bronze Age. Cattle also dominates these assemblages, though to a lesser percentage as that of the Netherlands. Pig and caprines seem rather important as well, the pig outnumbering in two of the sites. As BENECKE (1998) writes, this pattern appears to be the same for Poland as well.

As it can be seen from VAN AMERONGEN´s (2015) work, while the percentage of fish was rather low and fishing only played a minor role in the economy, many different fish species (e.g. pike, perch, bream or eel) were consumed at sites with nearby water systems such as in the Netherlands. Fishing was likely a seasonal activity, adapted to the migration and spawning cycles of the fish hunted. This would make fishing in spring and early summer or autumn likely. Deep sea fishing, for instance for

herring, atlantic cod or sea bass was also practiced in the Northern European areas (THRANE 2013, VAN AMERONGEN 2015).

4.3 Animal Economy in the Carpathian Basin

The Early Bronze Age Sites of the Carpathian Basin mostly show a similar picture as the few North European ones: cattle is usually dominant, though the percentage is slightly lower than in the North. Some sites occur that deflect from this pattern though, showing a very large number of wild animals (Nagyrév, Budapest-Sztregova utca), caprines (Kaposvár 61. út Kisapostag) or horse (Mezölak) instead. At other sites, cattle does appear as the largest percentage, but the difference to especially the caprines is rather low. It seems therefore, that the animal husbandry had a very varying role between the different local cultures present: the Kyjatice (Late Bronze Age) showed a very high number of wild animals, whereas the Gáva culture relied on cattle instead. In the Early Bronze Age however, most sites of the Nagyrév and the Beaker-Csepel culture did not hunt much, a peak in hunting appearing in the Middle Bronze Age instead. During that time, pigs appear to increase as well. However, the standing of pig versus caprine animals also seems to be dependent on the culture. The Nagyrév, Vatya and Hatvan therefore preferred caprines, whereas the Zók and Otomani kept more pigs. Horses were kept in the entire region as well and both used as a source of meat and as a source for draught power, as finds of harnesses proof. At the end of the Bronze Age, the use of horses increase due to Cimmerian influence (ILON/MARKOVÁ 2013). Of the hunted animals, most of which are red deer (SZEVÉRENYI ET AL 2015), but wild boar, aurochs and hare were also hunted (BENECKE 1998). Additionally molluscs were also consumed (SZEVÉRENYI ET AL 2015). Dogs appear in low percentages and were likely not consumed, but kept as herding and household dogs (SZEVÉRENYI ET AL 2015).

While fish bones have only been found in very small numbers, this is probably due to preservation conditions and not because people did not exploit the available water resources such as the Danube and the Tisza (CZEBRESZUK 2013).

5. Other economical characteristics

While this paper is focused on a consideration of the species, there are other aspects of economy as well that should be mentioned briefly here, which appear to be changing in the Bronze Age.

Considering the variety of species, especially the pulses, available, the implementation of a rotation system or mixed-cropping system („Gemengeanbau“) is suggested by several authors (JENSEN ET AL 2020, SZEVÉRENYI ET AL 2015, FILATOVA 2020). For instance, pea and lentil, barley and einkorn (FILATOVA 2020), lentil and barley (EFFENBERGER 2018) or naked and hulled barley (DE HINGH 2000) might have been grown together, while the pulses and cereals were rotated with each other (FILATOVA 2020). Potentially, peas could also have been sown over barley in some Carpathian sites (GYULAI 2010). This would have helped a better exploitation of the available soil. A fallow period might have been incorporated in this cycle as well (FILATOVA 2020, KNEISEL ET AL 2015), though DE HINGH (2000) suggests that if there was a fallow period, it must have been very short, because of the many short-lived weed species in her assemblages. If in practice, cattle might have been kept on the empty fields, leading to indirect manure. Manure is only indicated by the increase of nitrogen-

loving weed species in the assemblages (DE HINGH 2000), but remains hard to prove. It seems likely that manure was practiced over a large area though. Especially in the Netherlands with its poor soil conditions (DE HINGH 2000) manure is almost a necessity for long-term agriculture and the sandy soils in the Geest Regions of North Germany and Denmark, which were preferred for crop cultivation as they are easy to plough, require manure, as they also deplete very fast (ROBINSON 2003, DE HINGH 2000). Additionally to cattle dung, waste dispersal (SZEVÉRENYI ET AL 2015), pottery fragments, heather sods, peat and mud from swamps (DE HINGH 2000, ROBINSON 2003) could also be used. In the Netherlands, this was bound to the development of the so-called „Celtic Field Systems“, which came up at the end of the Middle Bronze Age, on which dung was mixed with the topsoil (FOKKENS/FONTIJN 2013) and the fields were structured differently than before. Manure is barely mentioned by the authors for the Carpathian Basin, but this might actually be a research bias instead of an actual lack of manuring in the region.

In the Bronze Age, the ard, drawn by cattle, was introduced for ploughing (FOKKENS/FONTIJN 2013, HARDING 2000, THRANE 2013, BENECKE 1998). The ard can only effectively be used with fields that were cleared of big stones, therefore indicating more permanent fields. They likely were used as long as the settlement/farmhouse persisted, which was up to 25 - 40 years, then shifted to another location (HARDING 2000, JOCKENHÖVEL 2013). While the fields needed more land than in previous times, as can be seen from the increase of anthropogenic indicators (FILATOVA 2020), they were much better able to cope with poor soil conditions (KNEISEL ET AL 2015). However, the new ploughing technique led to more soil erosion on slopes.

For the harvest, sickles, either of flint or of bronze were used, and the stalks were cut somewhere above two-thirds of the halm or underneath the ear (GYULAI 2010), as only medium and tall-growing weeds are dominant in the weed assemblages (FILATOVA 2020), though in other areas like the Netherlands, the evidence is lacking to assess this. The harvest took place before the grain was fully dry (GYULAI 2010). Up to two annual harvests were practiced (SZEVERÉNYI ET AL 2015), but winter crops still seem to have been mostly unknown, except for some sites in the Carpathian Basin (EFFENBERGER 2018, ANDREASEN 2020, GYULAI 2010). Crops were therefore either sown in autumn (GYULAI 2010), or more often, in spring (FILATOVA 2020). This however sets ploughing into autumn time, when nitrogen is released that cannot be used as there is no directly following vegetation period, which therefore leads to further soil depletion (EFFENBERGER 2018). This makes an even stronger case for manuring of the fields.

The harvest was then stored away in storage houses or, more regularly, in pits (DE HINGH 2000, JENSEN ET AL 2020, KNEISEL ET AL 2015, ILON/MARKOVÁ 2013, THRANE 2013) oftentimes as spikelets to avoid insects (EFFENBERGER 2018). Occasionally, for instance at Vatya, Füzesabony and Maros communities, storage vessels were also used (FILATOVA 2020). The grain was stored separate by species (ANDREASEN 2020, KUČAN 2007). In the Carpathian Basin, fortified settlements appear at the Late Bronze Age, in which larger storage facilities are erected, turning storage into a collective instead of household-based process (KNEISEL ET AL 2015).

The fields themselves were usually small (ROBINSON 2003) and in the surrounding of the settlements (FILATOVA 2020, EFFENBERGER 2018). It is not proven whether they were separated or in that sense „owned“ by somebody, though fences or hedges are speculated upon as separators

(HARDING 2000, DE HINGH 2000). Cattles seem to have occasionally been kept in parcels as well (DE HINGH 2000). The Bronze Age is also the first period, where stables can be proven to exist.

In terms of Animal Husbandry, it seems as if cattle was kept into adult age (1 – 3.5 years old) and caprines until six months old before being slaughtered in autumn and spring. Pigs grew from six months to 3.5 years old (SZEVÉRENYI ET AL 2015). Over the course of the Bronze Age, the average age of the slaughtered animals also increases, indicating that their secondary uses grew in importance. As cattle has a slower reproduction rate, it was kept until maturity and slaughtered at the end of its working lives (BARTOSIEWICZ 2013).

6. Interpretation

6.1 Regional Comparison

What can be said of both the Animal Husbandry and the Crop Cultivation, is that there is a much less uniform picture of the Carpathian Basin, than of the Northern European Plain. Much more local variability persists there during the Bronze Age, each culture apparently putting a different main focus (SZÉVERENYI ET AL 2015). Some sites even show very large numbers of wild animal bones (BENECKE 1998) and wild plant species (FILATOVA 2022).

It seems not unlikely that this may be at least partially caused by environmental factors. As pointed out, the Carpathian Basin is very diverse in its climate and vegetation. Both animal and plant species have different needs and tolerances. For instance, caprines are more suitable for dry, higher sites, while pigs prefer wetter environments and forests (FILATOVA 2020, BARTOSIEWICZ 2022). Different soil conditions as well as personal preference are likely the reason for the different emphasises sites place on plant taxa as well.

The ratio between caprines, cattle and pigs is therefore culture-dependent in the Carpathian Basin. Horses appear in higher numbers than in the North, indicating the closeness to the Eastern steppe areas where the horse originated from (BENECKE 1998).

In the Northern European Plain, cattle clearly has the most dominant position. It seems to take on a new value, potentially even as a prestige good (THRANE 2013), which may also be a reason for the increased care put on its keeping (see below).

In terms of cultivation, the trend of naked barley to hulled barley only happens in the Northern areas, while the Carpathian Basin, yet again, shows no uniform preference. It seems though, as if barley overall plays a lesser role in the Carpathian Basin, maybe because it requires different soils than available in the region. Einkorn however seems to have been more important in the South (STIKA/HEISS 2013). Similarly, the role of pulses appears to be less important in the north than in the south (BEHRE 1998).

What seems a similarity in both regions is a continuity in the economy form the Late Neolithic to the Early Bronze Age of fewer plant species in cultivation, real changes only starting to occur from the Middle Bronze Age onwards (KNEISEL ET AL 2015). In the Middle Bronze Age – therefore a bit earlier in the Carpathian Basin, than in the Northern areas – new species like millet start to appear, and become abundant in the Late Bronze Age (HARDING 2000). The importance of pulses also

increases with time and Gold-of-pleasure as well as Black Mustard in the Carpathian Basin appear as further oil crops (KNEISEL ET AL 2015). An increase of population is speculated for the beginning of the Bronze Age (ILON/MARKOVÁ 2013), which might have increased the need for food, therefore leading to both an intensification and diversification of the cultivation. As can be seen in all research areas, woodland clearances increased over the entire Bronze Age indicating that new farmland was required (CZEBRESZUK 2013, ROBINSON 2003, HARDING 2000, BEHRE 1998, EFFENBERGER 2018). This might have aided the establishment of fortified settlements such as in the Carpathian Basin with large storage facilities and potentially centralised social power, which appeared in the Late Bronze Age (KNEISEL ET AL 2015).

While hunting steadily decreases to almost complete irrelevance in the North European Areas, it seems to retain some importance in the Carpathian Basin, increasing again in the Middle Bronze Age, especially in the Otomani Culture. Fishing appears to have been practiced to low degrees at the coastal and riverine areas in North Europe, but domesticates were much more important (BENECKE 1998).

6.2 Connections between Crop Cultivation and Animal Husbandry

As was shown above, cattle developes to the most important domesticate in the Bronze Age in Northern Europe. As was mentioned, it was not just useful as meat, but also as a draught animal, directly supporting the agriculture by pulling the ard, as well as providing dung for manure. Cattle was consequently turning into a valuable good at the time, which might have increased the wish to take better care of it.

Therefore, the two-aisled longhouse changed to the three-aisled longhouse in Northern Europe, latest in the Middle Bronze Age, but likely already starting beforehand (ROBINSON 2003). It is probable, though not proven at all sites, that his happened in order to stall cattle in the house. The extent of this is debated. BEHRE (1998) and KOOIJMANS (1998) argue that a year-long stalling of the cattle is not possible, considering the labour-intensive process of gathering and storing the then needed fodder, such as dried leaves. However DE HINGH (2000) and JENSEN ET AL (2020) raise the possibility that hulled barley, which was seen to be increasing in amount over the Bronze Age could have been used as animal fodder as well. With this, a year-long stalling would not be impossible, as the growing of the crops and subsequent storing would have been work that already needed to be done anyway, instead of an additional task. The resulting availability of cattle dung over the entire year could have then been used to increase the crop yields. In fact, evidence from 1500 BC onwards shows that manure was used as a fertilizer at some sites (BARTOSIEWICZ 2013, CZEBRESZUK 2013). Additionally, hulled barley is more tolerant of fertilizers, handling it better than other crops (JENSEN ET AL 2020). At the same time with the three-aisled longhouse, circular structures start to appear more, which might have been used to store fodder or were used as additional animal pens (BEHRE 1998, ROBINSON 2003). In essence, a self-sustaining cycle would result from this scenario. Of course, not enough evidence has been gathered yet to prove that the three-aisled longhouse was used for the keeping of animals in all cases nor that manure was really widely applied in the area, but the possibility was certainly there.

Another factor which might have led to the need for cattle-stalling and the growing of hulled barley are the worsening weather conditions. The Bronze Age overlaps with the Subboreal phase, which is

also called the Flandrian Interglacial (GYULAI 2010). It experienced a slowly worsening climate all over Europe, especially in the Late Bronze Age, with cooler summers and overall wetter conditions (FILATOVA 2022), which hulled barley is speculated to be more resistant against than its naked variant (DE HINGH 2000). The cattle might have needed to be stalled for protection against the weather as well (BEHRE 1998). Considering that the Carpathian Basin is described to be very variable in its climatic conditions (FILATOVA 2020), the effects of the climate change might not have been felt as acutely and uniform over the area as it did in the Northern European Plain. Therefore, while the Northern Areas show a large amount of uniform developments, this is not the case for the Carpathian Basin, where the economy is mostly bound to the culture.

However, both regions show a growing diversity in their agriculture, probably to adapt to the risk of crop failures by widening the potential food available. Millet is known for its short vegetation period and its tolerance of most soils (HARDING 2000, KNEISEL ET AL 2015), making it ideal as an „emergency crop“ when other crops failed. Similarly, Gold-of-pleasure is less demanding and more resistant (EFFENBERGER 2018) as flax, tolerant of salty soils and grows in only 12 – 14 weeks (DE HINGH 2000), while hulled barley is more resistant against wet conditions (JENSEN ET AL 2020). On the other hand, millet requires intensive weeding and hoeing, while resulting in relatively low yields, as does Gold-of-pleasure. Hulled barley, if consumed as human food, requires the removal of its hulls, allthough FILATOVA (2020) debates this. Therefore, the Bronze Age people seem to have actively preferred crops that were more labour-intensive, but provided a more secure food supply. If limited to a small number of species, who additionally all require rather similar conditions, the tolerance of economy against varying environmental factors is very low. Therefore diversity was practiced as a means of ensuring security (HARDING 2000, KNEISEL ET AL 2015, FILATOVA 2020). Sowing crops together on one field also helped in risk-reduction, as one could hope for at least one of the crops to actually come to fruition (DE HINGH 2000). Pulses were grown in increasing number, maybe indicating that the positive effect these plants have on soil fertility had been noticed by the Bronze Age people. However, they also require a rather large input of labour to grow well (DE HINGH 2000). In addition, some plants such as white henfoot (*Chenopodium album*) might have been grown as a crop or collected as a crop replacement, and acorns were collected in large quantities. Individual oak trees might even have been managed, in order to increase the yield from them (DE HINGH 2000). All of this indicates security as one, if not the most important factor in the decision on what crops should be grown. The admission of so many care-intensive species as well as ongoing, though decreasing activities of gathering and hunting/fishing shows the widespread implementation of time and labour management and communal labour specialisation, indicating societies on their way to further social stratification and complexity. Nevertheless, it should not be forgotten that apart from security, a wish for more culinary diversity might also have been a motivator for widening the cultivated species (DE HINGH 2000).

Apart from more diverse crops, another risk-reduction strategy might have been an increased reliance on Animal Husbandry and extensive, instead of intensive agriculture, which appears in some sites of the Tumulus Culture in the Carpathian Basin (FILATOVA 2022), as shown above. She also considers millet to be a low-investment crop. It seems therefore, as if the opinions on agricultural practices are more contradictory as one might expect.

Considering that some Carpathian Cultures like the Otomani/Füzesabony complex spread as far north as to South Poland (CZEBRESZUK 2013), it seems obvious that contact must have occurred

between the Northern European Bronze Age and the Carpathian Basin. A south to north transition of techniques has been observed for both the Neolithic and the Bronze Age, still, from the data presented and the differences seen between the regions, the Northern Areas did not just blindly copy anything that reached them from the South, they adapted it to their own local conditions, changed and discarded it if necessary, therefore developing and maintaining their own identities (JOCKENHÖVEL 2013).

Lastly, in terms of Gathering Plants, not all of these might have been used for human consumption. For instance *Chenopodium polyspermum*, which can be eaten like *Chenopodium album*, might also have served as a bait for fishing (GYULAI 2010). While acorns were certainly consumed by humans, I believe they might also have served as (additional) animal fodder, only being used as food in emergencies, which would further aid the practice of keeping the animals stalled.

7. Conclusion

As could be seen, the two regions show very distinct developments, yet, the overall trend to more cultivation and less wild taxa does appear in both regions. It seems that, after the Neolithic introduced crop cultivation and animal husbandry to the people of Europe, the following Bronze Age served as a period of stabilizing and improving practices. Risk-reduction strategies were developed and deployed, thus reducing the danger of failures and famines, which probably had been a problem in the earlier time period, therefore moving agriculture away from its experimental beginning phase to a stable, well-working system, able to support the societal developments to more complexity. While gathered plants decrease over the period of the Bronze Age, they do not completely disappear, so perhaps, the confidence into the agricultural supply might still not have been complete in the period yet.

This paper cannot be seen as extensive in any way and the areas which lack data have been made clear throughout the work. Still, I believe that it does offer a decent summary of the economical practices in the Bronze Age. For the future, it would be most beneficial if data like the one collected here, were published in a better way: most of the times, the actual number of sites investigated was not even known and often, I had to resort to printed bar charts of percentages, instead of the real data behind them. If a uniform way to publish taxa amounts could be found, this would also be beneficial for future scientists such as myself, who at the current time, have to resort to semi-quanitative analysis, as values are not comparable and metrics often do not even get explained. If the archaeological science wants to stay productive in the long-term, making data from previous publications available, will be one of the most important steps that we can take.

8. Additional Material

The csv files for the data analysis are provided in the folder, as well as the code to generate the diagrams and splitted tables. As the generated graphics would mostly not be readable in this format, they are added in their own files in the results folder.

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