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# River Paradigm for Sedentary Mammoth Hunters

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## Abstract

Simple forensic systems analysis of Upper Paleolithic mammoth procurement, including analysis of foraging radii, taphonomic representation, portability, caloric costs, hunting and transportation energetics, labor economics, socio-economic and personal vulnerability to predators, and material-handling logistics, prove Upper Paleolithic *Mammuthus primigenius* were not often hunted, scavenged, killed, transported, and butchered on land, nomadic hunting excepted, nor has any comprehensive land-based procurement system yet been shown in archaeological literature regarding significant mammoth bone accumulations. Forensic systems failure analysis results in failure modes at every stage of inchoate land-based acquisition systems associated with significant quantities of mammoth bones.

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Upper Paleolithic mammoths were procured, transported, and butchered in navigable rivers throughout Central and Eastern Europe, as clearly shown in three Mezinian tusk ivory process charts from Mezhyrich, Eliseevichi, and Kyiv-Kirilovskaia, the siting and design of multi-purpose mammoth-bone structures, the weight and mass of mammoth carcasses, and the credibility determination in favor of at least three mammoth hunters providing ivory documents against the theories, speculation, categories, inventions, and inchoate models found in scientific literature. The River Paradigm answers fundamental outstanding questions posed by modern archaeologists.

The Kyiv-Kirilovskaia Process Chart was interpreted in detail for the first time, revealing both cold-smoking and fat-rendering operations. Although not absolutely necessary to establish the River Paradigm, river procurement and terrain provide insights and possibilities regarding Paleolithic mammoth hunting and support the workability of the River Paradigm. The common depiction of mammoths attacked on land by anatomically modern mostly male hunters with long spears is wholly inaccurate for the great majority of mammoths killed by humans during the Upper Paleolithic.

The River Paradigm represented the earliest known organized and vertically integrated subsistence system to employ water power in a production line ending at a central location. The three tusk ivory process charts are perhaps the earliest pictographic writing outside caves, the first known documents, and arguably represent the literal dawn of history.

**Keywords**: Mammoth-bone structures, Palaeoeconomy, ivory process charts, Mezinian Culture, rivers, mammoth hunting

**Methods**. Forensic systems analysis began after the hypotheses or speculation generated by purported land-based procurement (without reference to river hunting, killing, transportation, or river butchery) produced highly improbable and impossible hypotheses, theories, scenarios, and results in scientific literature. Scientific literature regarding mammoth hunting and mammoth-bone structures was reviewed at length. After interpretation of the first process chart, forensic systems analysis proceeded to support the river-based procurement system and disprove speculative land-based procurement systems.

Considering nine flat hearths arranged on a NW/SE axis in several diagrams of mammoth-bone circles, no ingress or egress at Kostenki 11-1a, and the three basic ways in the Paleolithic era to preserve meat and fat in a central location, all involving the removal of moisture, the hypothesis was reached that many of the mammoth-bone circles were the remains of smokehouses for cold-smoking and fat-rendering and were sized to hold meat and fat from mammoths, even though they could be used for multiple purposes.

Most Upper Paleolithic mammoth mega-sites contained complete taphonomic representation (disarticulated) for multiple individual mammoths. It was literally impossible for Paleolithic mammoth hunters to move whole mammoth carcasses weighing from 3 to 6 metric tons on land and practically impossible to move all their parts on land from 2 to 4 km distance. High mammoth MNI numbers, over five (5) MNI up to over 105 MNI of mammoth carcasses, produced

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at mega-sites, could only be achieved by the proven efficiencies of water transport, the downstream flow of rivers.

The Mezhyrich Map, renamed the Mezhyrich Process Chart for purposes of the River Paradigm, displays the outline of a mammoth tied up in the river below the settlement, securing cords, the river flowing from left to right, riverbank, loose bones, a loose tusk, a paleoravine bone bed, a passageway from the river to the settlement, four smokehouses, and four (4) elevated meat/fat caches were also depicted. Common elements were found on drawings of two later-identified ivory pieces, each of which added clear additional details. The process of tissue handling went from bottom to top in the three ivories studied. The size of mammoths correlated with the size of smokehouses and indicated the bulk of meat and fat came in one load, which was then butchered and edible portions loaded into smokehouses for cold-smoking or fat-rendering.

Forensic systems analysis of comparative weights, mammoths versus humans, data from site correlation, and ivory process charts, together with scientific papers, books, data from studies, many artifacts and data points from taphonomic inventories, and river terrain and mammoth anatomy and behavior all support the River Paradigm, now offered as a comprehensive model procurement and utilization system applicable for 25 to 30 millennia in Central and Eastern Europe.

Systems failure analysis of assumed land-based mammoth procurement systems and other outmoded ideas discounts and excludes alternatives to the River Paradigm. Fully considered alternatives to the River Paradigm are the published works by scientists over the course of a century discussing (1) denials, doubts, or minimization of mammoth hunting, (2) mammoth procurement under the assumption that the mammoths were hunted, killed, transported, and butchered on land, and (3) specifically that Upper Paleolithic humans scavenged mammoth remains, killed mammoth herds *in situ*, or sought bones or bone graveyards to collect bones for home-building. Forensic systems analysis shows that the procurement results achieved by mammoth mega-sites could not have been and were not achieved on land, consistent with three Mezinian ivory process charts from 19 kya to 17.5 kya that show mammoths were acquired, transported, and butchered in rivers.

## 1.0 Introduction

In their technically proficient expert studies of organized mammoth hunting culture, archaeologists F. Djindjian (2015), L. Iakovleva (2016), A. Pryor, D. Beresford-Jones, A. Dudin, E. Ikonnikova, J. Hoffecker, C. Gamble (2020), and P. Shipman (2015a), posed the fundamental unanswered questions concerning the people who built multi-purpose mammoth-bone structures (MMBS): How were the mammoth-bone structures used? How did the mammoth palaeoeconomy operate? What were the origins and procurement methods of the bone accumulations? Were bones accumulated from geologic, natural, or hunting actions? The scientific target was understanding the system. (Iakovleva, 2016).

The River Paradigm was presaged in the hypothesis that bone beds preceded multi-purpose mammoth-bone structures (MMBS) at the Pavlovian, eastern Gravettian, and Mezinian sites: “It is useful to wonder if the Pavlovian, eastern Gravettian and Mezinian sites do not belong to a more

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general system specializing in the economy of mammoth." (Iakovleva, et al., 2012). The River Paradigm is that more general system and provides answers to fundamental unanswered questions.

This paper builds on and elaborates the hypotheses, models, results, supporting evidence, referenced research, and forensic systems analysis presented in the author's earlier work, "Explaining the Mammoth Economy, Smokehouses, and the Mezhyrich Map," which is recommended as foundational reading to understand the dynamic River Paradigm. The Kyiv-Kirilovskaia Process Chart was identified with the aid of the Iakovleva Drawing (Fig. 3; Iakovleva, 2016: Fig. 6b) of same and aligns precisely with the sequential Upper Paleolithic system of hunting and killing, transportation, meat processing, and storage based on navigable rivers in Central and Eastern Europe. The Kyiv-Kirilovskaia Process Chart illustrates detailed processes of both fat-rendering and cold-smoking.

Many archaeologists and anthropologists studying organized mammoth hunters assumed that the bones they found on land came from mammoths hunted, transported, killed, and butchered on land. Their hypotheses, theories, and conclusions with land-based assumptions were as a result improbable. Scientific techniques were applied to discreet artifacts, soil, substances, and conditions, but neither the scientific method, hypotheses, nor forensic analysis ever showed how the entire land-based system operated on land.

1.1 **Data**. The answers begin with basic data, the key facts. The weight of woolly mammoth (*Mammuthus primigenius*) carcasses ranged from 3,000 kg to 6,000 kg, some 60 to 90 times heavier than the weight of Paleolithic mammoth hunters at about 67kg. This weight and strength differential governed hunting tactics and the movement of carcasses or mammoth parts, and bars movement of whole mammoth carcasses on land by humans or Neanderthals. Transportation of mammoth parts on land must be minimized under any procurement system, just as water transportation is maximized within the River Paradigm. The efficiency in energy expenditure and time of water transport versus land transport is well-established in many epochs and contexts.

"Upper Paleolithic sites are also much more likely to contain all parts of the mammoth skeleton (e.g. Wojtal and Sobczyk, 2005, Brugère and Fontana, 2009, Bosch, 2012)." (Shipman, 2015). The presence of all skeletal parts for multiple individual mammoths in the settlements with mammoth-bone structures begs the question how they came to be in one place, on land. In the Paleolithic era, the only physical force capable of efficiently or realistically bringing multiple whole individual woolly mammoths together in one place was the downstream movement of navigable rivers, followed by butchery and disarticulation sufficient to permit minimal land transportation uphill to nearby settlements, structures, smokehouses, and bone beds, where the bones were found millennia later. If mammoths were transported on navigable rivers, then necessarily they were killed in rivers, to which mammoths are naturally attracted due to water and mineral requirements, migrations, social activities, and play. Movement of large mammoth heads and skulls with brains, hide, and attached tusks by land for any distance was extremely difficult or impossible. (Haynes, 1991:209).

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The perfect or near-perfect correlation between mammoth-bone structures and nearby navigable rivers, 1.0. as revealed in accurate maps and all archaeological excavations of MMBS, shows that mammoth hunters built MMBS beside navigable rivers in Central and Eastern Europe with favorable upstream hunting territories. In Central Europe, mammoth-bone sites of significance, mega-sites with high MNI, are Kraków Spadzista (confluence of Rudawa and Vistula Rivers, 113 MNI), Predmosti, Czech Republic (Becva River, 105 MNI per Shipman, 2015a), and Dolní Věstonice-Pavlov-Milovice microregion (Dyje River, MNI 100+). All 26 Kostenki-Borsheevo sites are on the Don River, while Mezinian sites are in the Dnieper River Basin. Accurate maps of mammoth settlements with mammoth-bone structures reveal all are located on navigable rivers or floodplains. No mega-sites without navigable rivers have been found. Most notable for this study were the MMBS located at rivers in the middle Dnieper River Basin (Gladkih, et al., 1984), which sites were protected by loess, have been studied extensively, and which represent one peak of mammoth-hunting culture. A map of all Eurasia shows that all or nearly all of the inland mammoth sites, of all sizes and dates, regardless of culture or system, are on rivers. (Markova, et al., 2013: Fig. 2). The River Paradigm confirms that MMBS had to be on navigable rivers.

The five (5) phases of the mammoth palaeoeconomy were determined by the riverine environment, the key facts, the very limited meat and fat processing and storage choices available, and by viewing the entire system as a production or manufacturing process producing smoked meat, rendered fat, and probably pemmican (fully dried meat + rendered fat). The River Paradigm is a system composed of sub-systems, sequential phases: hunting, transportation, meat and fat processing, and followed by storage in elevated meat/fat caches. These phases explain the efficient mammoth palaeoeconomy. Other sub-systems not discussed herein include plant gathering and wood-working.

The basic task of proving mammoths were hunted, as opposed to scavenged or killed as herds by environmental factors, slowed discovery of the River Paradigm. (Shipman, 2015). The first scientific studies to prove with direct evidence (point in bone) the actual hunting of mammoths in Central Europe came relatively late. (Wojtal, et al., 2019). Scientists included scavenging or bone collecting as a procurement method. (Pryor, et al., 2020; Bosch, 2012; Demay, et al., 2021a; Soffer, 1985). Shipman (2015a) briefly mentioned hydraulic transport of carcasses, and a few others suggested smoking of meat. Shipman made complex statistical calculations in an effort to determine how 86 mammoths were killed (Shipman, 2015a), but the answer is much simpler with reference to the most relevant contemporary documents, the direct evidence of three ivory process charts.

1.2 **Minimum Number of Individuals** (MNI) Data for mammoth mega-sites confirms the use and efficiency of the manufacturing process and system now termed the River Paradigm. The number of mammoths processed under land-based or land-assumed theories or alleged systems was never explained with any precision or consistency. In fact, the initial MNI for Mezhyrich, 149 (later 109), was so high that young Olga Soffer could not believe it was attributed to hunting. (Soffer, 1986).

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Mammoth MNI for the following selected mega-sites in Central and Eastern Europe are: Milovice I, Czech Republic (92), Dolni Vestonice II, Czech Republic (5), Pavlov I SE, Czech Republic (7) (Wojtal, et al., 2018:Table 13); Eliseevichi, Russia (60) (Demay, et al., 2017:Table 5); Molodova, Ukraine (15), Milovice G, Czech Republic (21), Milovice I, Czech Republic (51), Predmosti, Czech Republic (105), Mezin, Ukraine (44), Kraków Spadzista, Poland (86), Mezhyrich, Ukraine (109), Yudinovo, Russia (35) (Shipman, 2015a: Table 1).

Shipman defines mega-sites as having about 5 MNI mammoths up to over 100 MNI ("hundreds"), cites five (5) mega-sites with single-digit MNI, and sought to determine how and why so many mammoth bones were collected in one place. (Shipman, 2015a).

1.3 **Provenance & Provenience**. The Provenience of all three ivory process charts is reflected in the names of the settlements (mega-sites) where they were found and after which all three were named as process charts. The Provenance for each was that they were buried under loess at those sites until found by excavators and placed in museums. Provenance is bolstered by the three eyewitness accounts incised in ivory, Paleolithic blueprints or process charts, because we know eyewitnesses incised or carved them and that they remained in the custody of mammoth hunters until abandoned on sites. The two ivory objects of note with artistic value are the Kyiv-Kirilovskaia Process Chart and the Pavlov Map (Fig. 4), with what has been interpreted as a depiction of the Dyje River. The Mezhyrich and Eliseevichi Process Charts reveal phases of the River Paradigm with lines and incisions but lack artistic value. The artistic value of ivory tusk portions suggests they may have been totems or badges of authority for people who knew the routine acquisition methods, did not need to refer to a chart, and provided necessary supervision and management of MMBS settlement meat-processing operations. The provenance and provenience of allegedly scavenged or collected bones under land procurement assumptions have never been shown.

The mammoth-hunting cultures that built multi-purpose mammoth-bone structures (MMBS) near navigable rivers before, during, and after the Last Glacial Maximum, stretched from the Central European MMBS sites of Milovice, Pavlov, and Dolni Vestonice (Czech Republic), Grub-Kranawetberg, Krems-Wachtberg, Krems-Hundssteig, and Langmannersdorf (Austria), Kraków Spadzista (Poland), Molodova I-Layer 4 on the Dniester River (Ukraine), the large cluster of Russian Plain sites in the Middle Dnieper Basin including Mezhyrich, Mezin, Kyiv-Kirilovskaia, Eliseevichi (Ukraine & Russia), and then further east to the 26 Russian Plain Kostenki-Borschevo sites on the Don River (Russia). The various cultures in this wide territory through millennia had different lithic toolkits, but those with MMBS shared a predominant interest in pursuing woolly mammoth (*Mammuthus primigenius*) and had the defined physical and dynamic characteristics of MMBS settlements stated below. Close to the Carpathian Mountains and during various centuries or millennia, hunters more often specialized in hunting reindeer, horses, and non-proboscidean species but in the open mammoth-steppe with maximum sunlight, mammoths were intensively hunted. (Demay et al., 2021a: Fig. 14).

By the time the three Mezinian ivory process charts were made, mammoth hunters had been carving or incising figures on tusk ivory for over 375,000 years. (Stepanchuk & Naumenko,

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2025). Ivory with its prized characteristics was during most times a durable and suitable material for representational and abstract art on portable objects. (Heckel, 2009). The ivory process charts were *not* the more common personal ornaments, beads, jewelry, figurines, specialized tools, depictions of live animals or humans, depictions of one thing, portable art (excepting the Kyiv-Kirilovskaia Process Chart), or simple repeated designs, which puts them in a rare class by themselves. Carvings around the entire circumference of a tusk segment, like the Kyiv-Kirilovskaia Process Chart and Pavlov Map, are similarly rare.

The need to bring whole mammoth carcasses downstream by water to a central location for processing and storage meant that Paleolithic hunters chose their sites with that hydraulic requirement in mind. Mammoths were secured and docked in rivers nearby MMBS where the butchery and meat processing commenced and where hunters spent winters behind thick MMBS walls.

The River Paradigm, previously including the Smokehouse and River Transport Hypotheses, is the first comprehensive explanation of the mammoth palaeoeconomy using the physical facts and findings of scientists. Inchoate theories based on the land transportation of mammoths, or not attributing primary importance to riverine terrain, resulted in improbable scenarios, including "fast access scavenging," killing herds *in situ*, whole herds freezing at one spot, and the suggestion that mammoth hunters went in search of bone graveyards to build their structures.

1.4 **Systems Thinking**. The culture of sedentary organized mammoth hunters can be viewed as an overall system with sub-systems. The entire Mezinian Culture might be considered one system, although we start with the system for each mammoth-bone structure settlement (and close neighboring settlements). The primary incorporated procurement systems were, following Flannery (1968), mammal procurement and plant procurement. The mammal procurement system specialized in mammoth hunting, but included sub-systems for procuring wolves, trapping arctic foxes, killing bison, horses, reindeer, and miscellaneous mammals obtained in small numbers or during different millennia or regions. Each animal was hunted differently, although larger ungulates in addition to mammoths were likely hunted in rivers. Seasonality and scheduling represented regulatory mechanisms, as did river flow and mammoth migration. Mammoths were hunted with the spring thaw and warmer months. Procurement of mammoths included the sub-systems identified as river hunting and river transport. Rivers and river terrain, mammoth migrations, and mammoth attraction to rivers helped preserve equilibrium, as did the four seasons. Hunting success and failure provide constant immediate feedback on hunting activities and omissions. Accumulations of mammoth skulls within river terrain indicate system stability and equilibrium during the occupation of sites, dependent upon regular mammoth movements to rivers and favorable climate. Riverine mammoth hunters had a constant ecological orientation to the navigable rivers on which they lived and mammoth herds entered.

The Kyiv-Kirilovskaia Process Chart, with the same common elements also seen in Mezhyrich and Eliseevichi Process Charts, fits precisely into and helps confirm the River Paradigm. Specific production activities and actions within the River Paradigm, including all five

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phases of the mammoth palaeoeconomy, are modeled and provided in chronological production order in Exhibit A – Sequential Systems Diagram of Probable or Possible Detailed Production Activities within the River Paradigm.

1.5 **Order of Establishing River Paradigm & Identification of Process Charts**. The Smokehouse Hypothesis was supported by multiple mammoth-bone circles, nine flat hearths aligned on a NW/SE axis, an abundance of burnt bone, the necessity of removing moisture from both meat and fat, modern structures to dry elephant meat as to size, the size of structure needed to accommodate just-in-time processing of a bulk product, the absence of accepted scientific ideas or consensus, and the asking of fundamental questions. The River Transport Hypothesis is fully supported by the weight of mammoths, accumulated skeletal parts in settlements, and three ivory process charts depicting mammoths tied up and butchered in rivers.

The River Paradigm, including all five incorporated phases of the mammoth palaeoeconomy and the two earlier hypotheses focusing on mainly two phases, is supported or proven one way by economic determinism and the profitability of the organized mammoth palaeoeconomy. Each phase of the mammoth palaeoeconomy was dependent upon the physical arrangements of the previous economic phase and determined the physical handling of the subsequent economic or processing phase. The River Paradigm can best be understood now as an orderly manufacturing or processing system, with all phases, artifacts, terrain, and the multiple separate facts and evidence fitting neatly within the efficient production system. Output proves efficiency of the system. Mammoths were found alive and ended up as processed tissues in elevated meat/fat caches, useful bones, tusks, tools, insulation, etc. The profitability or success of the River Paradigm at any location is judged simply by the number of mammoths taken, with the Mezinian Culture providing some of the highest production. The inefficiency of nomadic hunting is reflected by the sparsity of artifacts and by the systems failure analysis demonstrating land-based systems cannot kill and process anywhere near the numbers of the river-based system.

The Mezhyrich Process Chart (11cm x 21cm) was identified as a process chart first, while the Eliseevichi Process Chart was only identified on the internet during 2025 peer review. This is why only the first identification ("Mezhyrich Map") is mentioned in the title of the author's previous paper, "Explaining the Mammoth Economy, Smokehouses, and the Mezhyrich Map." (Gleissner, 2025). Both the Mezhyrich and Eliseevichi process charts were discussed in detail within the author's previous paper, as was the River Paradigm, but not with those two words.

The newly identified Kyiv-Kirilovskaia Process Chart, the third such ivory object identified as a process chart, like the previous two, confirms the Smokehouse and River Transport Hypotheses, now included in the River Paradigm. Kyiv-Kirilovskaia is 100 km from Mezhyrich. (Soffer, 1985: Table 4.7).

The River Paradigm might be called the River Hunting-Transportation-Butchery-Smokehouse-Elevated Meat/Fat Cache Paradigm, but for simplicity is shortened to the concise name. Because the ivory plaques depicted, confirmed, or allowed realization of the entire process from hunting through elevated meat storage, the term "process chart" was adopted in lieu of "map" as commonly used in reference to the "Mezhyrich Map." Either term or "system diagram" might

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have been used, but the chosen term reflects the River Paradigm. The Kyiv-Kirilovskaia Process Chart carved or incised on a tusk segment is three-dimensional, not two-dimensional, and is more abstract and artistic in its depictions. The Square Projected Photograph (Fig. 1a), the Iakovleva Drawing (Fig. 3), and Figure 1d, a photograph, place or show the Kyiv-Kirilovskaia Process Chart in two dimensions, greatly improving understanding and interpretation. The artistic and somewhat abstract and deconstructed Kyiv-Kirilovskaia Process Chart was identified most recently thanks to the Iakovleva Drawing of that ivory tusk segment (Fig. 3; Iakovleva, 2016: Fig. 6b).

These three pictographic process charts were created in the Mezinian mammoth-hunting culture between 19,000 and 17,500 cal BP, within the Middle Dnieper River drainage basin. (see, Djindjian & Iakovleva, 2021:122 as to inclusive dates). With an original Mohs hardness rating between 2 and 4, the physical and chemical properties of mammoth ivory—soft enough to incise, score, or carve yet dense and durable over time—enabled preservation of the Kyiv-Kirilovskaia tusk segment under some 13 to 22 meters of soil. (Soffer, 1985: 65).

## 2.0 Kyiv-Kirilovskaia Process Chart

The Kyiv-Kirilovskaia tusk ivory depiction is incised or carved on the distal end of a smaller mammoth tusk (Fig. 2), not on a plaque made from outer portions of a larger tusk as the ivory plaques from Mezhyrich and Eliseevichi were probably made. As was the case with the ivory from Mezhyrich and Eliseevichi, a drawing of the tusk incisions, the Iakovleva Drawing of the Kyiv-Kirilovskaia Process Chart (Fig. 3), reveals much more detail than any single photograph of the same ivory object. After 17,500 or more years buried in loess, the three ivory artifacts on curved ivory required microscopic examination and then drawings of the fine but worn depicted features.

Except for Figure 1d, simple photographs (without projection of multiple photographs into two dimensions) of the three ivory process charts do not reveal much about the entire meat-processing scenarios depicted. Many portions of each photograph or microscopic view are obscured by curved ivory surfaces, deterioration, some weak or shallow incisions and re-incisions, contamination, smudges, long burial underground, discoloration, poor photographic lighting, older photographic technology, and broken ivory. Each ivory process chart could use large-scale optical magnification, appropriate lighting, and projection into two dimensions with modern computerized photography applications and equipment (and perhaps X-ray radiography and CT scanning to look behind smudge marks or surface defects). Drawings of each of the three process charts reveal the most information but are necessarily inexact. There are multiple similar drawings of the Mezhyrich Process Chart, but the museum drawing of same shows the important process steps. (Gleissner, 2025: Fig. 3). The minute and tiny incisions required magnification and then hand-drawing. The black lines in drawings are much more visible than the faint lines incised on ivory some 17,500 to 19,000 years ago.

### 2.1 Features and Spatial Data Points of the Kyiv-Kirilovskaia Process Chart

Both the Iakovleva Drawing (Fig. 3) and the Square Projected Photograph (Fig. 1a) are projections of three-dimensional curved surfaces into two dimensions. The projected Iakovleva Drawing and the Square Projected Photograph in Fig. 1a share common elements with the other two ivory process

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charts. The Iakovleva Drawing, the Square Projected Photograph (Fig. 1a), and one simple photograph (Fig. 1d), *considered together* with knowledge of the River Paradigm, depict the following spatial or pattern data points or features:

2.1.1 tied tuskless mammoth
2.1.2 flowing river
2.1.3 smokehouse & fat-rendering station
2.1.4 slope depiction
2.1.5 three (or more) ropes
2.1.6 disarticulated rib bones

The Square Projected Photograph (Fig. 1a), made from multiple photographs of the Kyiv-Kirilovskaia tusk is directly below, followed by three simple photographs of the same tusk segment (Fig. 1b, 1c, 1d).

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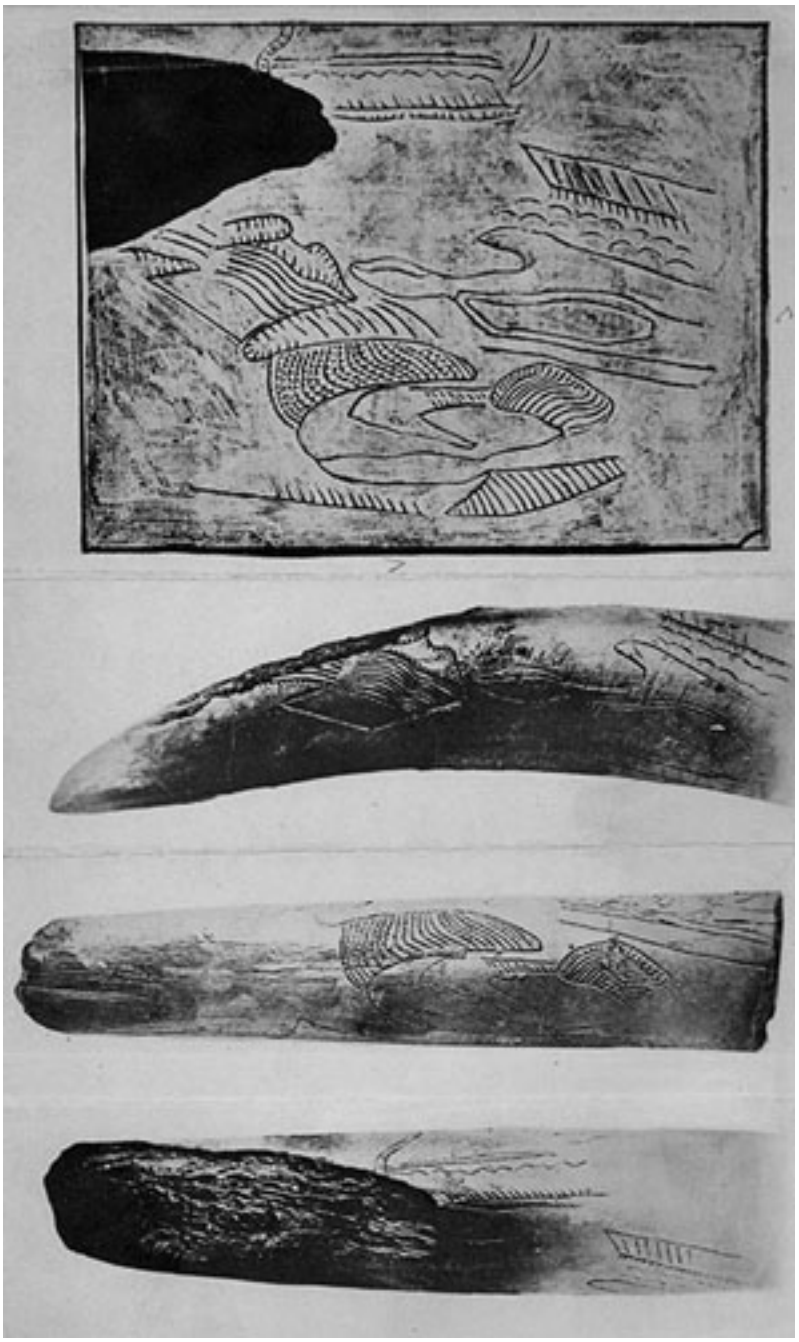

1a

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1b

1c

1d

**Fig**. **1** Kyiv-Kirilovskaia Tusk Photographs
including Fig. 1a, 1b, 1c, 1d
Internet Encyclopedia of Ukraine
Creative Commons license author of photo unknown

2.1.1 *Tied Tuskless Mammoth*. The depicted mammoth (Fig. 3, 3a, different perspective in Fig. 1a) is the most recognizable and emphatic feature in the Iakovleva Drawing of the Kyiv-Kirilovskaia Process Chart (Iakovleva, L., 2016: Fig. 6b). The mammoth is depicted in a left side profile view, tied with rope by the trunk end, and that rope is secured by three stakes in the riverbank ground. (Fig. 3, 3a). The left eye resembles the numeral "2." (Fig. 3, 3a). The mammoth shown standing up is surrounded by river, depicted by straight lines to the left and to the right by river lines with tiny markings, triangles, or notches all pointed downward. The mammoth profile is upright and squarely presented in the Iakovleva Drawing (Fig. 3, 3a) but faces (from a slanted position) the bottom right corner of the Square Projected Photograph (Fig. 1a). The Iakovleva Drawing displays aesthetically pleasing and distinct designs, details, lines, and patterns (Fig. 3) not visible in the Square Projected Photograph (Fig. 1a) or in the detail of any single photograph.

2.1.2 *Flowing River*. The river is depicted in three successive styles or motifs of curved parallel lines (Fig. 3) and appears to be crossed or covered in two places. The river is depicted with clean curved parallel lines, except for the central segment, which displays notches or small

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triangles on each line, and is provisionally suggested to represent water flowing over or around the partially submerged mammoth. (Fig. 3, 3a, 3b, 3c). The flowing river is best appreciated in the Square Projected Photograph. The small lines at the end of the long rope align with the flow of the river, indicating that portion of the rope is under water. (Fig. 1a).

2.1.3 *Smokehouse & Fat Rendering Station*. The two different rhomboid/rectangular structures appear to have different designs and probably functions, which suggests one is a smokehouse and the other a fat-rendering station. The smokehouse and/or fat rendering station are more easily identified in Fig. 1a at the top and upper right of the Square Projected Photograph, and also directly in Fig. 1d. Those structures are visible in Fig. 1d in their original artistic perspective.

Some short lines or nicks may symbolize fire. Billows of smoke are depicted in connection with each structure by short, curved lines (Fig. 1a & Fig. 3). The object appearing like a huge poultry wishbone in the top of Fig. 1a, to the right of center, may be portraying a mammoth skull with original or inserted tusks protruding.

*Smokehouse*. Inside the structure identified as a smokehouse (center top of Fig. 1a) are depicted smoke billows in one undulating line, representing smoke containment, with the billows near the depicted ceiling.

*Fat-rendering station*. The upper right structure in Fig. 1a can be seen as a fat-rendering station with larger and hotter fires than in the smokehouse. Inside the structure identified as a fat-rendering station are probably representations of strips of subcutaneous fat (Fig. 1a). The strips of subcutaneous or other mammoth fat are portrayed as thicker lines. In the Iakovleva Drawing, the strips of rendered fat look like cross-ties in railroad tracks (Fig. 3). Edible portions of mammoths were half fat and half lean meat (Agam & Barkai, 2016), the same proportions as pemmican (Speth 2025); hence the presence of fat-rendering structures or stations is predictable in addition to, inside of, or as temporary uses of smokehouses.

2.1.4 *Slope Depiction.* The eight (8) roughly parallel lines in the Iakovleva Drawing, corresponding to the six (6) roughly parallel lines in Fig. 1a, viewed from the perspectives shown in Fig. 1a and Fig. 1d, can be interpreted as a slope. The slope begins with the longest single unencumbered line in the Iakovleva Drawing, which in that Drawing starts near the lower left corner and points to near the upper right corner, ending "in the air." That is the first of eight lines ending in the line forming the base of what is provisionally termed a fat-rendering station. The second and third lines from the bottom form a double line, as do the fourth and fifth lines from the bottom, and as do the sixth and seventh lines from the bottom (Fig. 3). All eight lines are only discernable in the Iakovleva Drawing, where the slope inclines upward towards the fat-rendering station in the lower right corner of the Iakovleva Drawing (Fig. 3). Four of the lines, two double lines, form what looks like an island (Fig. 3). The space between the second and third lines from the bottom hooks around the "island" and becomes the space between the seventh and eighth lines.

*Slope depicted by superimposed steps*. Slope is also depicted in a series of 14 superimposed steps (Fig. 3c). Those steps approach the end of what is provisionally termed the smokehouse (Fig. 3, 3c), similar to the 19 steps portrayed in the Eliseevichi Process Chart (Gleissner, 2025: Fig. 4). Steps at all sites were a physical connection between river butchery and higher smokehouses. In

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the Iakovleva Drawing, the 14 steps start out at a 90-degree angle to the slope described with eight (8) lines, but if both structures are on the same or nearby level above the river, then both are uphill from the river. (Fig. 3, 3c). Slopes were a universal feature above navigable rivers chosen for mega-sites. The 14 steps to and from river level superimposed on portions of the Kyiv-Kirilovskaia Process Chart are *very similar* to the 19 steps shown in the Eliseevichi Process Chart)(Iakovleva, L., 2016: Fig. 6b).

**Fig. 2**

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Kyiv Kirilovskaia Process Chart Tusk Segment
(Iakovleva, L., 2016: Fig. 6a)
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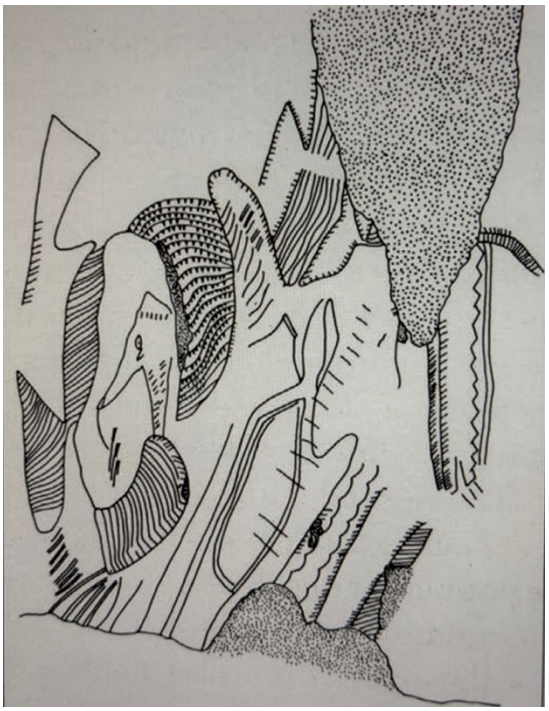

**Fig**. **3** – Iakovleva Drawing of the Kyiv-Kirilovskaia Process Chart
(Iakovleva, L., 2016: Fig. 6b)
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2.1.5 *Three or more ropes.* The long rope on the left side of the Iakovleva Drawing is interpreted by the author to represent one of the several cords used to tie, dock, and secure floating mammoths to the riverbank below the Kyiv-Kirilovskaia settlement. The rope is drawn to arise from the river, which is consistent with the mammoth floating in the river. Another shorter rope is possibly depicted at the top of the Iakovleva Drawing, beside the non-descript large missing portion of the tusk and pointing in the same direction as the longer rope. A third rope, already mentioned, connects the mammoth trunk to three stakes in the ground. A rope from the base of the "lobster claw" runs to what looks like a short rib and then connects to the last long rib in that line. The "lobster claw" may represent tusks, although it connects to the terrain slope and remains unidentified.

2.1.6 *Disarticulated rib bones*. Disarticulated rib bones are depicted placed parallel to each other at two different places in the Iakovleva Drawing, and each grouping contains both large and small bones, with the large and small bones segregated in each of the two groupings (Fig. 3). The bones in each grouping are in parallel alignment but segregated into shorter and longer bones. One grouping is closest to the lower left corner of Fig. 3. The other grouping of butchered bones are also in parallel formation, short and longer segregated, on an abstract portion or "appendix" of land (or mammoth carcass) depicted over the river, in the center of the Iakovleva Drawing, barely

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into the top half of Fig. 3. (Iakovleva, L., 2016: Fig. 6b, the Iakovleva Drawing). The two groupings may stylistically represent bones removed during butchery and placed temporarily on the riverbank. The butchered bones are shown clean of meat and fat, which was not perhaps their condition immediately after butchery (Fig. 3). At most, the Iakovleva Drawing depicts 30 rib bones out of the 40 rib bones woolly mammoths possessed (Fig. 3). Larger mammoth bones are not depicted, probably due to space concerns, nor is a tusk clearly discernable (Fig. 3).

**Fig**. **3a –** Close-up of tied tuskless mammoth profile in Iakovleva Drawing. Permission granted by Elsevier.

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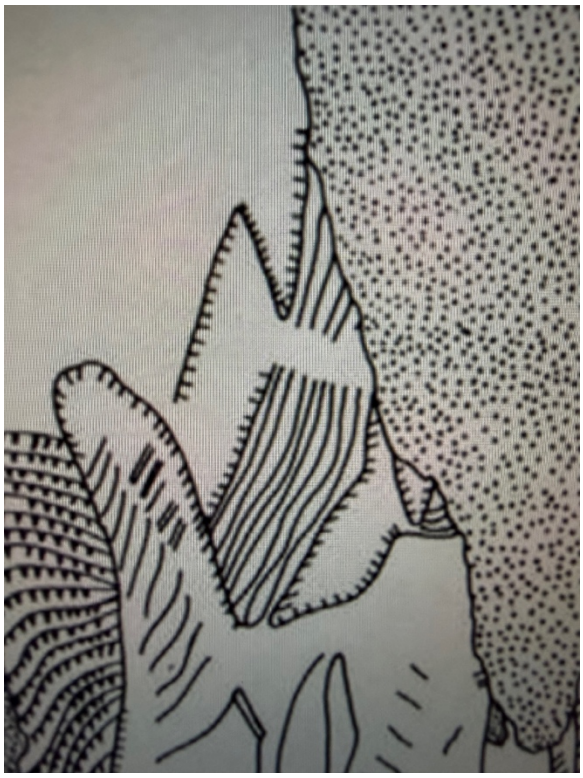

**Fig**. **3b –** Close-up of Iakovleva Drawing: Small bridge (?) across river depicted by absence of river lines, perhaps from shore to carcass or to missing portion of tusk. Permission granted by Elsevier.

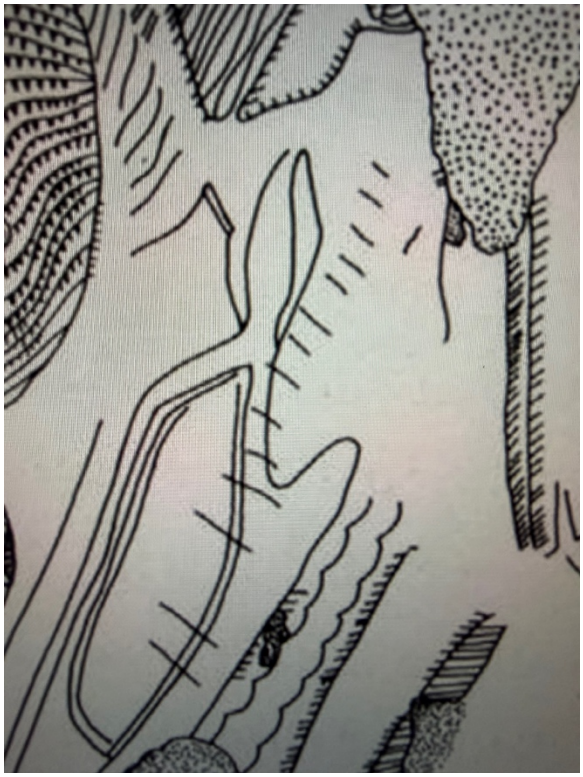

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**Fig. 3c** Close-up of Iakovleva Drawing: Showing 14 steps to and from river level superimposed on portions of the Kyiv-Kirilovskaia Process Chart, similar to the 19 steps in the Eliseevichi Process Chart)(Iakovleva, L., 2016: Fig. 6b). The "island" and "lobster claw" may or may not be terrain features. Permission granted by Elsevier.

The Kyiv-Kirilovskaia Process Chart lacks perspective due to the tight conical shape of the ivory tusk, space limitations, and abstract deconstructed depiction. Projection into the two-dimensional Square Projected Photograph adds perspective consistent with the topography of MMBS sites. Comparison of Fig. 1a to Figures 1b, 1c, and 1d demonstrates the difficulty of interpreting a curved process chart incised on the outside of a smaller tusk and also the necessity of Iakovleva's Drawing (Fig. 3) for detail.

The Iakovleva Drawing is much finer and more detailed than the image displayed on the Square Projected Photograph (Fig. 1a), in the poor Soffer photograph of the same tusk segment (Soffer, 1985: Fig. 2.54), in the color photograph of the tusk segment (Fig. 2), or in the cruder drawings of the Mezhyrich and Eliseevichi ivory process charts. (Gleissner, 2025: Fig. 3 & 4). The layout and position of the Square Photographic Projection (Fig. 1a) provides a perspective of the river running down from left to right and smokehouses or fat-rendering stations at the top (Fig. 1a). The square photographic projection (Fig. 1a) can more easily be viewed as a third butchery scene in the river to match the scenes in the Mezhyrich and Eliseevichi Process Charts. The two structures in Fig. 1a, presumably a smokehouse and a fat-rendering station, are not discernable as such in the Iakovleva Drawing. Although actual butchery is not depicted, the cameo profile of the tied and docked mammoth (standing up), the loose butchered bones arranged in parallel fashion, the depicted destinations for meat and/or fat, and the known proximity of butchery to smokehouses and fat-rendering stations leaves little doubt of butchery (Fig. 1a, 3, 3a). The most definite depiction of a mammoth is in the Iakovleva Drawing, but the profile image is of a live mammoth, not one being butchered in the river as in the two ivory plaques.

The Kyiv-Kirilovskaia artist had to deconstruct the scene because there was not nearly enough space to carve or incise a river and settlement landscape perspective in one view as the flatter (but still curved) ivory plaques provided (Gleissner, 2025: Fig. 3 & 4). The scenes depicted were on opposite sides of the tusk, so a singular perspective or small map was physically not possible or practical. The river is shown flowing under an extended land form, riverbank, or "appendix" with butchered bones placed in parallel order (Fig. 3, 3b). The river goes under a possible walkway, plank, or perhaps tree in the back of Fig. 3, defined by the straight river lines whose ends form opposing straight lines perpendicular to the flow of the river (Fig. 3, 3b).

### 2.2 Common Images & Features of the Three Ivory Process Charts

Common images in all three ivory process charts are: a river, a mammoth tied to the riverbank, ropes or cords, loose bones and tusks, multi-purpose mammoth-bone structures (MMBS) in one or more of several forms (dwellings, smokehouses, or fat-rendering stations) and slopes (as steps or perspective) up from rivers. Elevated meat/fat caches are identified only in the Mezhyrich and Eliseevichi Process Charts and were not multi-purpose structures. Unrecognized features and structures exist in all three ivory process charts. Slopes are easy to detect in the Mezhyrich and Eliseevichi ivories and mainly recognized by superimposed steps in the Kyiv-

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Kirilovskaia ivory or from the perspective shown in Fig. 1a. Floating mammoth carcasses are depicted realistically in the Mezhyrich and Eliseevichi Process Charts, but in the Kyiv-Kirilovskaia Process Chart, only the front half of a left side profile of a tuskless standing mammoth is stylistically depicted: The distal end of the mammoth trunk is tied with a rope and the rope secured at the other end with three stakes in the ground. (Fig. 3, 3a).

Through these process charts (also sometimes known as maps, plaques, or churingas) and possibly symbols of authority, we gain a deeper, more dynamic and fact-based understanding of the mammoth palaeoeconomy. Mammoth hunters centralized and standardized the entire process from founding the MMBS settlement on navigable rivers through systematic hunting, killing, transport, processing, storage, and consumption. Each site operated in the same basic way based on all the efficiencies and the mammoth-bone circles they left behind. The three ivory process depictions reveal the water transport of mammoth carcasses and docking in the river, which hydraulic process is the *only* explanation for the whole mammoth skeletons (disarticulated) found in MMBS settlements. Water transport indicates climate was not at its coldest and driest, because arid conditions resulted in lower river levels and may not have provided sufficient river flow to transport mammoth carcasses.

Paleolithic artists depicted their everyday activities. (Svoboda, J., 2017). The three process charts display the main carcass-processing activities of Mezinian mammoth hunters and constitute incised eyewitness accounts of their system on ivory. Steps depicted in these charts were used repeatedly after butchery, while mammoth parts were taken to smokehouses and other processing stations from the level of the river, and for return down to the river level.

These ivories supply the behavioral and economic paradigm for the palaeoeconomy in Eastern and Central Europe. They are each a set of data points and archaeological facts, “an accurate observation that carries unambiguous information relative to human-hominid behavior.” (Binford, 1981: 18). “Advances have generally been made through the discoveries of new materials and not by virtue of the successive growth of knowledge that generally accompanies the use of scientific methods.” (Binford, 1981: 292). The meaning of identified process charts was “discovered” on the internet, in published works on the internet, and in books by Pidoplichko/Allsworth Jones (1998), Soffer (1985), and others. Pidoplichko interpreted the four huts in the Mezhyrich Map as four dwellings, three of which he excavated, which is not contrary to their use as smokehouses or with the external hearths found. Soffer linked the Mezhyrich and Eliseevichi ivories stylistically and as to their unknown purpose.

2.3 **Data Points**. Thousands of data points arise from skeletal element representation data within taphonomic inventories of Upper Paleolithic mega-sites. These data points show entire disarticulated skeletons are represented, for many mammoths, and those many data points could only arise from the delivery of mammoth carcasses to the dock of the settlement—as clearly shown in all three ivory process charts—and the short uphill land transport of mammoth parts to the settlement.

Each ivory process chart provides a minimum of some five (5) to seven (7) spatial data points. Those individual common elements provide additional data points in terms of correlation

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with the other two process charts. The five, six, or seven (5-7) spatial data points in each ivory can be multiplied by three (3) ivories for 15 to 21 specific spatial data points combined in the three objects. Since the pattern provides additional information in the form of correlation with the other two process charts, we can double or triple the number of spatial data points to from 30 to 63. Pattern data points, distances from other sites, and distances between sites and rivers, arise from mapping the sites of Mezhyrich, Kyiv-Kirilovskaia, and Eliseevichi, which are some 400 km apart at the farthest and generally close to their associated rivers. No other ivory carvings from the Mezinian Culture or other culture approach the complexity, correlations, meaning and information provided by these three incisions on ivory. Because Paleolithic cultures portrayed their common activities, and because we know from multiple Upper Paleolithic taphonomic inventories that whole carcasses were brought to docks below settlements, as shown by each ivory process chart, there should be little doubt that the three process charts explain the Upper Paleolithic procurement and processing of woolly mammoths.

2.4 **Pavlov Map**. An engraved or incised distal mammoth tusk segment from Pavlov I, the Pavlov Map, is said to depict the Dyje River and nearby hills and is popularly said to be the oldest map in the world (30,000 ya) (Fig. 4). The artistic value of the Pavlov Map equals the artistic value of the Kyiv-Kirilovskaia Process Chart, and both items are carved on distal portions of tusk. A river butchery or meat processing scene does not appear in the artistic and stylistic Pavlov Map (Fig. 4) tusk carving. All four of the tusk ivory objects discussed herein feature rivers.

**Fig**. **4** Pavlov Map (37cm length)
Petr Novák, Wikipedia Creative Commons Attribution-Share Alike 2.5 Generic license.

**Oblonnia**, **Ukraine Tusk**. A partially incised deteriorated ivory tusk was uncovered at the Oblonnia Archaeological Site, on the Desna River, but no significant information or recognizable feature was derived by the author from its limited non-descript ornamental patterns and isolated long lines. The tusk ornamentation appears incomplete compared to the four other tusk ivory items reviewed, except it may contain the bare outline of a river with three long lines. It is slightly longer than the Pavlov Map and most of it is unworked per examination of photographs. It might have been intended as an authority symbol after completion.

[https://www.encyclopediaofukraine.com/display.asp?linkpath=pages%5CO].

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2.5 **Proposed Purpose of Four Tusk Ivory Items**. The ivory process charts and the Pavlov Map were possibly symbols of authority recognizing the physical possessor of the item as holding management responsibilities during production of smoked or dried meat and rendered fat. Management of production activities was required. If the chief or lead manager worked for some hours, he or she might hand the ivory symbol to another leader who would then have the authority to manage work activities. In this way, someone was always in charge, work shifts and scheduling enabled, coordination achieved and work better focused. The group, mainly kinfolk, would soon demonstrate or vocalize who best managed them for different tasks, and multiple people could be given the management job at one time or another.

Authority to direct the majority of workers was important because some sub-systems, such as hunting, butchering, and distribution of mammoth tissues to workshops or smokehouses may have required scheduling of work, a required regulatory mechanism in systems, among most of the available hands. Cold-smoking and fat-rendering required fewer hands. Production of lithics or jewelry may have been the job of just one person.

## 3.0 Defining Characteristics of the River Paradigm.

3.1 Three physical characteristics define the River Paradigm:

3.1.1 *On rivers*. The riverine environment drove and determined how mammoth hunters hunted and then utilized their kills. All of the MMBS settlement base camps were founded on navigable rivers, sometimes near the confluence of two rivers. Upstream warm-weather outposts were specialized hunting camps, also on rivers. Temporary foraging camps likely existed for hunts or plant gathering in the mammoth steppe. This assumed perfect correlation ($r = 1.0$) links MMBS settlements with nearby navigable rivers. Navigable rivers offered upstream hunting opportunities, fishing resources, habitats for useful plants, and facilitated travel by boats, walking beside rivers, and walking or dog-sledding on frozen rivers. Site selection intentionally pre-determined all phases of the mammoth palaeoeconomy, invariably prioritizing river procurement, transportation, butchery and overall efficiency. Some mammoths may have been brought to places on smaller rivers, but unless the river could support the floating of mammoths every year, MMBS were not likely built. Valea Morilor in Moldova, a fairly new discovery, was on a small river, only had six mammoths represented, and the structure was thought to be a wind-break shelter. (Obada et al., 2012). Rivers may have been navigable for transportation of carcasses only during some weeks or months of the year.

Mammoth-hunting predecessors and a few successors built MMBS on navigable rivers in what are now Austria, Czech Republic, Poland, Moldova, Russia, and Ukraine, using the same industrial model, a complex subsistence system in pursuit of mammoths.

3.1.2 *Substantial MMBS*. Multi-purpose mammoth-bone structures (MMBS) with thick insulating walls indicated all-year habitation. Those MMBS could serve as fat-rendering stations, smokehouses, workshops, storage space, or meeting rooms for religious, civic, or ceremonial purposes. Purpose-built smokehouses with nine flat hearths running down the NW/SE axis were equivalent signifiers, although some of those may not have been insulated due to their sizes. Cold-smoking, drying, and fat-rendering could have been accomplished in portable chooms (tipis).

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3.1.3 *Entire disarticulated skeletons present*. Multiple entire disarticulated mammoth skeletons in the MMBS settlements prove river transport of mammoth skeletons after mammoths were killed upstream in the rivers.

3.2 **Five Standardized Phases of the Mammoth Palaeoeconomy**. The five standardized phases of the mammoth palaeoeconomy, the major subsistence strategy at MMBS sites over the course of millennia, constituted a large-scale cultural pattern, a system, the River Paradigm:

3.2.1 **Procurement in Rivers**. Procurement in rivers assured human control of both hunting activities and the prey carcass. The riverine location was the key feature in the mammoth procurement strategy. The superior elevated height hunters obtained when mammoths descended into the riverbed or floodplain provided advantages, especially when the mammoths' mobility was restrained or constrained by river currents, mud, ice, slick riverbanks, and constructed traps, funnels, underwater points, hunting platforms, or barriers, dogs, and hunters. Given that mammoths could not swim upstream against a substantial current, a barrier, trap, or snare could have been built to stop downstream movement, wound mammoths with underwater sharp objects, or keep mammoths immobile and subject to projectiles or spears from safe positions. The exact hunting techniques are not critical to understanding the paradigm, because we know mammoths were procured in rivers where they were more vulnerable. A variety of procurement techniques explains the natural advantages of the River Paradigm.

Research indicates that atlatls equalize female and male projectile velocity (Bebber et al., 2023). The percentage of available hunters could include almost all the healthier adults and some juveniles, regardless of gender. "Early subsistence economies that emphasized big game would have encouraged participation from all able individuals." (Haas et al., 2020).

3.2.2 **River transport**. Mammoth carcasses were floated to settlements. That is how they were docked below the settlements, as shown in all three ivory process charts. How far they could be floated is unknown, but during times of high river water, mammoths could be floated for longer distances.

3.2.3 **Initial butchery in river**. The ivory process charts show mammoth carcasses in the water, partially submerged in water (except for the Kyiv-Kirilovskaia ivory, in which the mammoth is stylistically surrounded by river water), the heads and tusks under water, and tied off to the riverbanks. Butchering in the river, which meant butchering in the boat formed by the partially butchered mammoth, required that the soft belly be up, not the backbone.

3.2.4 **Cold-Smoking**, **drying**, **and fat-rendering**. To preserve meat in Paleolithic times, moisture had to be removed through cold-smoking, full drying, or fat-rendering. Those were the only practically available options for preservation. Fully dried meat could be smashed with rocks and placed with rendered fat to make pemmican (Speth, 2025). Fat must be rendered with heat to remove moisture, but pure fat is easier to render than from other tissues. Neanderthals 125 kya had to work very hard just to obtain bone grease (Kindler et al., 2025), which shows how prized mammoths and fat were.

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Smokehouses were probably used for cold-smoking, fat-rendering, complete meat drying, and meat roasting. To conserve fuel, they may have cold-smoked, fully dried, and rendered fat at the same time, with the same fire perhaps in the same smokehouse, but procedures undoubtedly varied by separate structures, bands, and MMBS sites. Outside or external hearths were used, perhaps with movable chooms or in open air.

The mammoth people with MMBS probably prepared pemmican as most hunter-gatherers did, with half dried meat and half rendered fat, whatever fruits or other substances could be added to improve taste, and then the food sewn into a hair-out bison hide (Speth, 2025). Paleolithic hunters needed fat. (Speth, 2025). Pemmican did not taste very good (to modern tastes), and its continued use should be attributed to the necessity of fat consumption to avoid rabbit starvation (protein poisoning) (Speth, 2025).

3.2.5 **Storage**. Binford (1980) wrote that foragers seldom store food. MMBS settlements employed elevated meat storage, which provided enhanced protection against predators, pests, bacteria, and potential contamination. For indigenous peoples, above-ground storage is much more common than in-ground storage (Speth, 2025). Soffer (1985:255) stated that the underground storage in the Upper Paleolithic Russian Plain held mammoth, horse, and reindeer bones and antlers, not meat. Elevation promoted improved air circulation and circumvented the challenges associated with excavating and securing permafrost. Small bone piles and tusks found outside MMBS may represent the ruins of elevated meat/fat caches, less wood structure or supports.

Mammoth hunters may have stored whole mammoth or bison carcasses upstream in the usually cold and annually freezing rivers for a year or more if secured deep enough to cover the carcass. Meat stored in the river did not progress to rancid condition while frozen or when surrounded by frigid running water (Fisher, 2021).

3.3 **Dangers of Close Contact Hunting Avoided**. The close contact mammoth hunters without atlatls, dogs, or bows and arrows, Neanderthals, disappeared.

The popular depiction of AMH mammoth hunters, Man the Mighty Hunter, fighting mammoths on even steppe ground is not likely very accurate due to obvious hunter safety risks that could be avoided. AMH mammoth hunters probably developed ways to kill mammoths in rivers from a superior position and without endangering themselves too much or at all. High mammoth numbers could not have been achieved if there was even a 5% chance of death or serious injury from close contact hunting one mammoth. The few remains of mammoths killed by close contact hunting are not prevalent in the archaeological record, due to the limited number killed that way, and because the carcasses stayed on the open ground and deteriorated more rapidly than those taken in the River Paradigm.

Supporters of land acquisition agree that hunting massive, strong, fast-moving mammoths was dangerous, required organization and the most advanced weapons, was difficult to confront if in a herd, often required multiple spear-strikes to kill, and that hunters surely took advantage of, among other things, mammoths' inability to go up or down steep slopes. (Demay, et al., 2021b: 207). The River Paradigm minimized or eliminated close contact hunting because riverine terrain, preparation, and dogs facilitated safety.

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Mammoth vital organs were very well-protected by ribs, bones, hides, hair, fur, tusks, skulls, trunks, and the land speed of mammoths. Close contact mammoth hunting was dangerous based on Neanderthal skeletal findings, ethnographical data, and common sense. Most atlatl darts or spears, arrows, and javelins did not penetrate enough to kill mammoths. The use of poison in multiple piercings could reliably kill, slow, immobilize, or disorient mammoths without risking close contact hunting. Use of poison would explain the very limited number of point-in-bone findings documenting mammoth hunting, because poison only had to enter the bloodstream, not traumatically damage vital organs or cause excessive loss of blood. Poison worked faster in the bloodstream if the mammoths were then driven. (Borgia, 2019). Microliths were needed for arrows, thrown spears, and darts, to convey the poison probably used by most MMBS people, and have been found at MMBS settlements.

Poisons commonly used by indigenous hunters across the world varied as to the plants, animals, and insects used for various formulas, and as to the physiologic action induced (Prance, 1999) in the nervous, respiratory, gastrointestinal, cardiovascular, or renal systems (Riede & Lombard, 2024). Use of natural aconite poison was widespread among indigenous hunters throughout East Asia and into the Aleutian Islands (Heizer, 1938). Various beetles are poisonous. Some modern elephant poachers, wary of the ban on shooting elephants, reverted to using easily produced yet potent natural Acokanthera poison administered by spears or arrows (Micheni).

Why risk close contact hunting of mammoths when structures, hidden points and traps, obstacles, barriers, prepared riverbanks, dogs, poison, atlatls, superior heights, and long spears inserted safely from behind protective structures in the river could avoid it completely?

3.4 **Warm-weather outposts**. Warm-weather outposts to hunt the upstream portions of rivers were probably formed with portable chooms (i.e. tipis). The River Paradigm is bolstered by the observation that MMBS settlements are located at low topographic levels, in contrast to higher upstream sites classified as warm-season camps (Shydlovskyi et al., 2022). Warm-season camps, also on rivers, were to help hunt the whole stretch of river from those hunting outposts down to the MMBS main base camp/settlement where butchery, meat-smoking, fat-rendering, and storage occurred (Gleissner, 2025).

3.5 **Neanderthals at Molodova I-Layer 4**. Neanderthals built mammoth-bone structures (MMBS) with the defining characteristics at Molodova I-Layer 4 on the Dniester River before 44,000 year ago. (Demay et al., 2012). The mammoth-bone structures at Molodova I-Layer 4 mark the known beginning of the economic and physical pattern of MMBS. The possibility of Neanderthal sites at the very bottom of Kostenki layers, perhaps without MMBS, cannot be excluded. (Dinnis, et al., 2021). Neanderthals hunted straight-tusked elephants 125,000 years ago at Neumark-Nord, Germany, (Gaudzinski-Windheuser et al., 2023), probably by sneaking up on them while in the pond or lake water.

## 4.0 Efficiencies & Necessity of the River Paradigm

4.1 **Efficiencies.** Mammoths were well worth acquiring, because unlike most lean ungulates and herbivores (Speth, 2025), their edible portions were about 50% fat and 50% protein. (Agam & Barkai, 2016). Optimal Hunting Theory supports the obvious efficiencies of the River

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Paradigm and excludes nomadic hunting and land-based theories. The River Paradigm, a systematic 5-phase production process, and overall hunting culture enjoyed both productive and allocative efficiencies:

*Lower acquisition costs*. By hunting, killing, and transporting mammoths in the same river or riverbed, the higher acquisition costs of finding, hunting, killing, tracking, and transporting mammoths was greatly reduced over nomadic hunting. Nomads had to find and track mammoths around 360-degrees of unfamiliar and uneven terrain, bushes, trees, and obstacles, for as long as it took the mammoths to die. The rivers allowed hunters to create pre-positioned stands, platforms, barriers, and surprise traps, gave hunters a clear shot with their atlatls across water, and constrained mammoth movement.

*Energetic transportation costs minimized*. Water transport was maximized while land transport was minimized. We may assume mammoth hunters made a rational choice to maximize their net rate of energy gain (calories in versus energy/time spent). Water transport of mammoth carcasses was more efficient than land transportation of mammoth parts, bones, and carcasses. Optimal methods were employed to produce goods that the band of mammoth people wanted the most. Reduced transportation time and costs came from faster and less burdensome river transport of entire mammoth carcasses with paths on the sides of rivers easing movement up and down river terrain as opposed to different routes every time with nomadic or land-based hunting. Nomadic hunters would have to move smoking chooms, meat/fat racks, tools, and containers to each kill site if they even progressed to those more sophisticated manufacturing tools.

*Potential energetic value maximized*. Starting with about three (3) to six (6) metric tons of raw carcass, the material yield was great, as 100% of huge mammoth carcasses were delivered to docks. The River Paradigm very likely extracted the highest obtainable percentage of the mammoth's potential energetic value. This was true compared to nomadic hunters, and it is likely still true today for many elephants killed on land with high-powered rifles in Africa. Given that 70% of the energetic value came from fat (Speth, 2025:5), we could call smokehouses "rendering houses" when used for that purpose. To people threatened with starvation, mammoths were bonanzas.

*Logistical hunting efficiency compared to nomadic hunting*. Nomadic hunters often drove mammoths away from themselves, with mammoths selecting escape destinations. Sedentary hunters drove mammoths toward their meat processing and storage facilities on pre-determined river routes, denying escape from the river. Water brought the entire carcass in pristine condition to the MMBS settlements.

*Longer vulnerability within rivers*. In the rivers, mammoths would be subject to atlatl and spear attack for multiple kilometers, and the distance from hunter on riverbank or hunting stand and mammoth in water more often remained within atlatl range. With nomadic hunting, unless the lone bull mammoth was surprised with a belly thrust of a spear while asleep or distracted, the mammoth had to be chased, and hunting distance re-established, if possible, in more even terrain with alert prey.

*Schlepp effect reduced to zero*. Waste from the Schlepp Effect was virtually eliminated.

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*Sanitary efficiency*. Spoilage and contamination were lessened because the carcass was in pristine condition compared to land procurement. Poisons did not affect tissue edibility. Meat and fat were likely placed in baskets by the butchers and then walked to their processing stations. Smokehouses immediately protected meat from flies.

*Just-in-Time Manufacturing*. Butchery started after the conveyor belt of water delivered the bulk material to the dock. Raw tissues were taken directly to processing locations within the settlement, and processed meat and fat taken directly to elevated meat/fat caches.

*Dynamic efficiency*. Mammoth people were both producers and consumers. Mammoth people could constantly discuss improvements to the processes.

*Controlled and shortened persistence hunting*. The channeling of mammoths, continual attacks with atlatls, the use of barriers and underwater obstacles in the river, and the immobilization and safety required for thrusting spear attacks, together constituted a form of shortened and controlled persistence hunting.

*Hunting Dogs*. Evidence of Paleolithic dogs has been found at three Mezinian MMBS sites: Mezhyrich, Mezin, and Eliseevichi. (Germonpré et al. 2009). In *Our Oldest Companions,* Shipman observed a strong connection between dogs and mammoth hunting (Shipman, 2021:16, 27, Ch. 5- What is Domestication?). Gemonpre & Sablin (2017) found large canids, including wolf (*Canis lupus*) and/or dog (*Canis familiaris*), co-occurred with woolly mammoths (*Mammuthus primigenius*) much of the time. (Germonpré & Sablin, 2017:Table 2.1). Dogs substantially aided the hunt for mammoths and other game and likely kept younger mammoths (and following mothers) in rivers during hunts. Dogs and human hunters from the higher riverbank positions would be more intimidating than if at ground level with mammoths.

*Increased Production Speed & Volume*: By breaking mammoth procurement into distinct, repetitive steps, tasks were performed faster, leading to higher output rates. Every mammoth kill on land was different and required workers to travel to kill sites by different routes with fewer available tools.

*Specialization, Centralization & Division of Labor*: The River Paradigm enhanced centralization, and the division and specialization of labor, because mammoth people could focus on specific specialized tasks, all facilitated by bringing meat, fat, bone, ivory, lithic, and wood processing together at one central location, near tools and shelter.

*Consistency & Quality Control*: Standardized processes using the same hunting, transportation, butchery, slope steps, ravines, smokehouse racks, and smokehouses allowed for more uniform products, reducing variability and defects. Consistency of mammoth procurement is demonstrated in MMBS with foundations made of many mammoth skulls.

*Lowered Production Costs (Economies of Scale):* High-volume bulk production spreads fixed costs like smokehouses, dwellings, and weapon and clothing manufacturing, over more edible packages, lowering the cost per package of meat and fat. Nomads had to set up meat processing at kills.

*Improved Workflow Efficiency*: Moving materials via river with minimal routine land transportation was efficient; constructed smokehouses were superior in several ways to nomadic

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choom smokehouses. Butchery could start immediately after docking, and smokehouses loaded with meat and fat could commence food processing soon thereafter.

*Efficient Resource Utilization*: Scavenger losses were eliminated at kill sites and in transport. Excess mammoth carcasses could be stored in frigid river water.

*Scalability & Flexibility*: Any size mammoth or other ungulate could provide carcasses for processing; smokehouses could be used for different purposes; stored tools could be used in butchery and meat processing. Nomads could not transport as many tools.

*Enhanced Safety*: The River Paradigm reduced or eliminated unsafe close contact mammoth hunting and eliminated fights with predators/scavengers over carcasses and parts transported overland.

*Improved Hunter-Gatherer Morale*: Efficient workflows reduced fatigue and frustration, increasing satisfaction; shown by abandonment of nomadic hunting, fewer bone accumulations by nomadic hunters, and continued return to and overall success of MMBS.

*Multi-purpose Mammoth-bone Structures* (MMBS). At Mezhyrich, there were four MMBS, external hearths likely from choom smokehouses or fat rendering stations or open air fires, and four elevated meat/fat caches, yet Mezhyrich took 109 mammoths. Construction of single-use structures, other than elevated meat/fat caches, either MMBS or portable chooms, would take too much material, time, and energy if not absolutely necessary. Structure needs included cold-smoking, fat-rendering, all-weather habitation, storage; civic, religious, and social meetings; sleeping and family quarters; lithic, clothing, material, tool, and weapon manufacturing and processing; and portable choom use for warm-weather outposts.

*Protection from Rain, Wind, Sleet, Frost & Snow*. Compared to nomadic hunters, sedentary MMBS dwellers enjoyed better protection from the elements.

4.2 **Necessity of River Paradigm**. Mammoth hunters to achieve economic viability did what they had to do, *because it was the only way to do those things.* There was only one place to situate mega-site settlements: on a navigable river. The settlement sites were perfectly correlated with navigable rivers, riverine terrain, and mammoths entering upstream locations to meet their heavy water requirements, pass during migrations, obtain vital minerals, or socialize. Large sites were commonly constructed on terraces overlooking rivers, where the banks often featured raised ground on at least one side of the river. There was only one way to bring whole mammoths to a central location, which determined where they had to kill the mammoths. There was only one convenient location to butcher the mammoths: at the dock of the mammoth in the river directly below the tissue processing facilities and bone bed, reducing portage of parts to a minimum and excluding predators. The removal of moisture was the only way to preserve meat and fat, and that could be performed in smokehouses. Elevated meat/fat caches were the only way to store meat safely.

Because the subsistence system performed in the only efficient ways possible, with undoubted minor variations and growing efficiency over time and circumstances, the River Paradigm lasted over the course of some 25,000 to 30,000 years, dependent upon favorable erratic Ice Age climate, flowing river water, herds of woolly mammoths, and unknown factors.

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Mammoths were naturally drawn to rivers by thirst. River hunting was necessary to gain substantial hunting advantages over mammoths and bring carcasses to MMBS settlements. While procurement in rivers is not explicitly depicted in the ivory process charts, it was the path to initiate river transport, which was the only way to bring whole mammoths to settlements. Mammoths killed on islands, mudflats, or nearby floodplains might have been pulled into the river with everyone in the settlement pulling on ropes attached to the mammoth, by rising waters or excavation, or by butchering large portions and floating them down the rivers.

The three ivory process charts, created independently by each site, are inscribed eyewitness accounts by people who were there when this procurement and processing activity transpired, and constitute physical and expressive proof of the River Paradigm.

## 5.0 Forensic Systems Failure Analysis of Land-Based Procurement

5.1 **Systems Analysis Generally**. The impossibility or improbability of land-based mammoth procurement, sufficient to bring multiple entire mammoth skeletons to any one settlement, is shown through forensic systems failure analysis. No complete land-based procurement system has yet been reconstructed for sedentary mammoth hunters. By pushing land-based ideas to their sequential points of system failure, we see the collapse of land-based procurement speculation. Inchoate explanations and scenarios suggesting land-based acquisition constitute a mix of nomadic and sedentary systems and techniques. A land-based procurement system assumes land-based hunting or scavenging, land-based killing of individual mammoths or whole herds, bone seeking and/or bone collecting, land-based transportation or herding of whole or partial mammoths, and land-based butchery of *Mammuthus primigenius*. Compared to the five phases of the mammoth palaeoeconomy enunciated under the River Paradigm, land-based procurement fails at each of the five phases.

5.2 Failed Ideas: ***Doubts About Hunting***. As Djindjian recounts (Djindjian, 2015), hunting has been doubted and scavenging and bone collecting favored by some for a century. (Chubur, 2014; Soffer, 1985: 258-259; Soffer, 1986; Péan & Patou-Mathis, 2003; Shydlovskyi et al., 2022). Russian-speaking Dr. Olga Soffer launched her scavenging, bone graveyard-seeking, and bone-collecting hypotheses soon after receipt of her Ph.D., work at Mezhyrich, and her unique visits to and extremely valuable and voluminous archaeological data from the Soviet Union during the Cold War, which gave her ideas outsized influence. (Soffer, 1985, 1986).

Doubts: “As a result of zooarcheological studies for several decades, it is known nowadays that the presence of large mammal remains in a Paleolithic site does not mean that this animal either has been hunted or even eaten by humans.” (Péan & Patou-Mathis, 2003). “First it must be told that it is still difficult to differentiate between hunting and fast access scavenging.” (Péan & Patou-Mathis, 2003). Milovice-G was either a “kill site or a quick access scavenge site.” (Péan & Patou-Mathis, 2003). “Paleolithic people seem to have trapped herds of mammoths (without old individuals) in specific natural areas before they killed them.” (Péan & Patou-Mathis, 2003).

Demay, et al. (2012:214) list an assortment of conjectures by different scientists and others regarding the purpose and meaning of MMBS at Molodova I-Layer 4, including (1) hunting blind, (2) natural accumulation, (3) circular symbolic ring bound to Neanderthal beliefs, (4) recurrent

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settlement where humans pushed away garbage and then built a centrifugal living structure, (5) wind break for long-term occupation, (6) monumental or ceremonial architecture; and to which list we could add regarding MMBS elsewhere: (7) religious ideas of their creators (Gavrilov 2024), (8) symbol of copulation at Mezhyrich (Baitenov, 2021, after Gavrilov), and (9) ritualized middens (Sablin et al., 2023). Ukrainian archaeologist and professor Oleksander Chernysh (1918-1993), the excavator who spent his career investigating and studying Paleolithic sites in Ukraine, specializing in Molodova, correctly opined the subject MMBS at Molodova I-Level 4 was a dwelling with meat cooking and smoking. (Demay, et al., 2012:214, 224). The diversity of conjectures listed did not favor nutrition, hunting procurement, or reference the Dneister River on which all the Molodova MMBS were located. Scavenging, non-systemic bone collecting or gathering, anti-hunting, and annual bone cemetery search hypotheses and writings lack any solid evidence, original provenience, or complete provenance and should yield to the River Paradigm. The motivation for gathering bones, scavenging, or moving to bone graveyards pales in comparison to nutritional priorities and production in the Ice Age.

The Upper Paleolithic hunting paradigm over decades steadily gained ground against the scavenger/bone collecting and doubting hypotheses on the issue of mammoth acquisition. (Agam & Barkai, 2018; Brugère et al., 2009; Germonpré et al., 2008; Pidoplichko/Allsworth-Jones, 1998:104). In 2009, the hunting of mammoths at Milovice was fully supported by archaeologists; 86 individual mammoth skeletons were found. (Brugère et al., 2009). Brugère et al. (2009) found hunting was the means of acquisition and presaged what would later be framed the Smokehouse Hypothesis, now part of the River Paradigm: "During the excavation, several light hearths were found (around the bone deposits) which seem to have been low calorific hearths, in use for a short time. So a partial meat-smoking or drying activity practiced at these places is not excluded."

5.3 **Large Land-Based Hunting Territory Logistical Analysis**: This passage claims mammoth hunters had a huge hunting territory on land: "This I termed the "semi-[sedentary] strategy" (Djindjian, 2009): a large territory of about 100 000 km$^2$, a settlement occupied for eight to ten months and used as a main dwelling, and movements dedicated to seasonal or specialized hunting and to raw material procurement." (Iakovleva et al., 2012). As a circle, this territory had a radius of 178.4 km. Territory of this extent may be indicative of the seasonal *mammoth* range surrounding any settlement. But the logistic, labor, calorie expenditure, defense requirements, and travel difficulties for 67 kg *sedentary* mammoth hunters hunting this vast territory on land are insurmountable. Only nomadic hunters could hunt over a land territory of 100,000 km$^2$. The River Paradigm permits hunting mammoths that roam over 100,000 km$^2$, but only procures them at the optimal locations, in navigable rivers.

The River Paradigm supposes these mammoth hunters were sedentary, which is now the consensus per Demay, et al. (2021a), even though they had warm-weather hunting camps upstream on the same rivers. The depiction of elevated meat/fat caches at Mezhyrich and Eliseevichi and the thick walls of MMBS are strong indicators of sedentarism. Mammoth hunters spent their winters inside thick-walled MMBS, but in warm weather they hunted, floated carcasses after ice thawed, butchered, walked meat and fat uphill to smokehouses, processed all the different tissues,

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and put bones in their bone bed(s). Classifying mammoth hunters as semi-sedentary mixes the hunting techniques and lifestyles of wandering nomadic hunters with sedentary hunters.

5.4 **Foraging Radii Analysis**. Given the small human foraging radii, finding or scavenging carcasses with meat would be virtually impossible within a 178.4 km radius circle. "[F]oraging radii were 2–3 km during the Early Holocene, whereas during the Middle Holocene these radii were 6–7 km...in a high elevation desert in NW Argentina." (Pintar & Rodriguez, 2015). In the southern Sierra Nevada, Morgan (2008) found an extreme pre-historic human foraging limit of 9.4 km, with a caching limit for acorns of 5 km. From MMBS, most of any foraging or scavenging radii would be useless because mammoths avoided the smell, sight, and sounds of humans. Because MMBS were all backed up to rivers, foraging and scavenging on land was practically limited to the 180-degree arc away from the river. Hunting radii might be longer, but with each lengthening of the hunting radius, the transportation burden of mammoth tissues rises.

Scavenging theories tend not to distinguish the scavenging of bones from the scavenging of edible tissues. Scavenging bones tends to minimize the paramount importance of nutrition, even though Paleolithic builders borrowed used building materials from former sites. One complex study that purported to find "scavenged" bones at Kostenki 11-1a found bones previously obtained by hunting and killing that were previously abandoned in the Kostenki neighborhood of MMBS sites, recycled, and placed in the MMBS at Kostenki 11-1a. (Rey-Iglesia et al., 2025).

5.5 **Energetic analysis based on weight and distance**. If a 4,000 kg mammoth was killed on land five (5) km from a settlement, the 67 kg mammoth people, if they could each carry 50 kg of mammoth tissue, and the mammoth butchered completely and precisely into 50 kg packages, would have to walk a collective total of 800 km on uneven terrain under their heavy loads, making 80 10-km round trips = 160 5-km one-way trips. Of course, mammoth bones and hides could not be divided neatly into 50 kg packages and carrying that much weight would require back-packs and reduction in load for smaller individuals. Large bones with meat attached and particularly skulls with brains and tusks would prove difficult to impossible to move on land. Dr. Gary Haynes wrote "heavier elements, such as skulls with tusks, would seem to have been excessively troublesome to transport any distance." (Haynes, 1991: 209). The transportation stage or phase of the inchoate land-based system of acquisition refutes land transportation.

5.6 **Labor costs to defend against predators**. Carcass fights over the huge carcass would have been inevitable. Each mammoth person in transit would be subject to attack by wolves, hyenas, brown bears, lions, eagles, or wolverines, and the annoyance of flies, birds, arctic foxes, etc. Some of the strongest hunters might have to serve as guards ready to repel wolves, brown bears, and lions. Guarding would require a convoy system, which convoys would require additional time to schedule and organize. Labor requirements for guarding of carcasses and meat in transit was not necessary under the River Paradigm, which provided delivery in rivers, secure docks within settlements, and river moats surrounding butchered carcasses.

5.7 **Procurement near settlements very unlikely**. Mammoths, if like elephants, had one of the best senses of smell in the animal kingdom. Mammoths would avoid the constant smell of humans at MMBS settlements, as modern hunters of large game verify. Finding, much less

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killing, a mammoth close to a settlement on land would be almost impossible. If mammoths were evenly distributed and taken within a hunting territory of 100,000 km$^2$, settlements could not take the numbers of mammoths shown harvested at mega-sites, and far less productive nomadic hunting would have been employed.

5.8 Failed Idea: ***Killing a herd in situ***: Mammoths were difficult or impossible to herd or bring into a narrow location. The mammoth bone accumulations are on the slopes of riverbank hills, mammoths had flat feet and, like modern elephants, mammoths disliked or avoided walking uphill unless natural steps were provided. (Riverbank slopes worked in favor of the River Paradigm.) Mammoths could not be "herded" up a slope. If they were herded into one place, it would be impossible to kill a whole herd at that spot without them running off or over the hunters after the first mammoth was attacked or threatened. Iakovleva et al. (2012) did not find that killing a herd *in situ* was demonstrated, an understatement.

5.9 Failed Ideas: ***Fast-access & late-access scavenging***: The most advanced Paleolithic industrialists and producers were characterized as nomadic scavengers: "We propose that resource-acquisition from dry found mammoth carcasses can be classified as a form of "gathering" and resource-harvesting from fresh found carcasses can be classified as 'scavenging.'" (Demay et al., 2021b). Gathering and scavenging from dry-found or fresh-found carcasses would be rare given the limited foraging radii and paltry resources obtained compared to the value of one whole fresh mammoth carcass delivered by river to the MMBS settlement. Mammoth people who lived in MMBS probably did not waste their time scavenging or gathering mammoth bones, because they had to spend enormous amounts of time processing 100% of each pristine mammoth delivered whole to their docks. The River Paradigm literally delivered resources.

To explain the relatively pristine condition of bones in a scavenging mode of acquisition, the concept of "fast-access scavenging" was invented, meaning that humans arrived at the carcass and bones before scavengers and predators. Also envisioned was "late access scavenging, i.e. after predators have taken the best parts." (Pean & Patou-Mathis, 2003).

Millions of years of both scavenger and human evolution refute the theories of Upper Paleolithic fast-access and late-access scavenging. The real scavengers (also predators), wolves, wolverines, lions, hyenas, brown bears, arctic fox, buzzards, crows, hawks, eagles, flies, insects, etc., evolved over millions of years to have senses of smell or eyesight many times greater than the noses and eyesight of humans, and the ability to move about on the air or on four legs much faster than humans. Some scavengers ran in packs, and many searched for food at night. Slow bi-pedal humans with relatively poor olfactory abilities, who did not often venture out at night, could not out-race real scavengers by "fast-access scavenging," nor would much edible tissue be found after "late-access scavenging." Human mammoth scavengers would have to avoid carcass fights and attacks by predators during transit. In no way could humans win the access race every time with the great majority of bones showing no carnivore activity. Bi-pedal scavengers with limited foraging radius arriving late to kills would confront wolves, brown bears, lions, hyenas, or wolverines, none of which would surrender a huge carcass without a fight.

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5.10 Failed Ideas: ***Prominence of Bone Graveyards & Natural Mass Deaths***. Russian and Soviet archaeologists opined fairly early on, incorrectly in most cases, that accumulations of bones were natural mass die-offs. (Haynes, 1991:315). Soffer never found any such sites but believed in them. Bones collected from these alleged mammoth graveyards were said to be what was used to build MMBS (Haynes, 1991:315), but provenience and provenance were never shown or attempted. The bones excavated at mega-sites appeared to be from healthy individuals and some showed cut marks indicative of hunting. Few mass die-offs from non-cultural causes were found. In time, with thousands of bones uncovered, the hunting acquisition of most of them became clear. Sites thought to be based on bone graveyards such as Kraków Spadzista in Poland and several others were later found to be hunting sites. The River Paradigm adds weight to hunting acquisition over natural die-offs, bone collecting, and scavenging.

In the chapter on Subsistence & Faunal Resources in her 1985 tome, Soffer right away starts talking about the gathering of bones and the downplaying of "active hunting." (Soffer, 1985: 258-259). In 1986, newly prominent Dr. Olga Soffer said "that the role of the mammoth hunter has been vastly exaggerated, and that there was a good deal of collection of bones that went on with these people." (Soffer, 1986). The MMBS were solid structures that were not abandoned every year to find more bones with which to build new ones. Nutrition, not building materials, was the Ice Age priority. The annual bone-search for bones was Soffer's 1985 speculation, repeated as late as 2022 (Shydlovskyi, et al., 2022).

As Dr. Pat Shipman wrote in *The Invaders*, "The problem is figuring out how all those mammoths died in the same places." (Shipman, 2015b:182). Anthropologist Dr. Olga Soffer told her, "For God's sake stop buying the Hemingway myth that they killed every single mammoth—they settled near bone cemeteries and used them as lumber yards." (Shipman, 2015b:182).

5.11 Failed Idea: ***AMH Killing Mammoths on Even or Open Steppe Ground***: This close contact method is how mammoth hunting is often portrayed in the popular press, and in some museums, but it takes little account of hunter safety, mammoth attacks, atlatl use, the time hunted mammoths took to die, the advantages of river terrain or the River Paradigm as reflected in the ivory process charts. Few Paleolithic hunters could with one spear thrust penetrate to the mammoth's vital organs. Death by blood loss or poison was a slow process. Hunting one mammoth from a matriarchal herd on steppe land would be too easily noticed by the herd and dangerous, because female mammoths, with a huge long-term genetic investment in each calf, aggressively defended their young (if they resembled elephants). (Tsavo Trust, 2026). Hunted elephants are more aggressive towards humans, kill and wound many humans in Africa and India, sometimes charge humans, remember past negative encounters with humans, and pass on their defensive and aggressive behaviors and attitudes from generation to generation. (Wakoli & Sitati, 2012). Agam & Barkai (2018) outline the many different ways elephants can be killed, mainly in African terrain, climate, and vegetation, and a few of those tactics could be used in the Paleolithic riverine environment, such as traps, snares, downward slopes, and catching mammoths mired in mud, but most of outlined hunting methods were not available, not practical, or too dangerous.

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Paleolithic riverine hunting avoided unsafe close contact. The close contact mammoth hunters were Neanderthals, who used long spears, but who went extinct and whose bones reveal much traumatic breakage. Spears in close contact hunting had to be inserted surreptitiously in the belly while the lone bull mammoth was asleep or distracted; or used the hard way by getting past the hair, hides, subcutaneous fat, muscles, scapulas, and ribs with a long spear to hit vital organs or cause significant blood loss, before the heavier and more powerful mammoth killed or injured the hunter or ran away on first contact. On land, mammoths can flee in any direction.

The popular depiction usually involves only male spear hunters, but Bebber et al. (2023) showed that atlatl use equalized female and male projectile weapon velocity. Poison application to points also equalized the gender of hunters. The River Paradigm with the aid of poison enlarges the ranks of mammoth hunters to include women and teenagers, which was helpful for persistent attacks over riverine distances.

The River Paradigm envisions atlatl (or javelin, spear, or bow & arrow) attack from a superior prepared height position, with poisoned darts or atlatl spears impelled with a clear shot, and close contact attack with long spears only when the mammoth is immobilized by a river barrier, trap, poison, or exhaustion after being chased downstream several kilometers by dogs and humans, or is struck at any time on, from, or behind prepared platforms, heights, obstacles above or below the water line, or stands.

The isolation of one specific land hunting technique, holding a spear and letting the charging mammoth impale itself on the spear, was not likely productive of many mammoths and probably killed hunters. Fighting on even ground was something for humans to avoid by killing mammoths in rivers. The proposed method by Byram et al. (2024) requires mammoths to ignore the sharp spear in their faces and not dispose of it with a slap of their trunks, and it simplistically narrows many animal and human positions into one technique that required hunter and hunted to meet head-on and not vary their behavior. (Cf. Byram et al., 2024).

5.12 ***Butchery on land***. Speculative land butchery is portrayed in Upper Paleolithic archaeological literature very differently than the actual Paleolithic butcherers performed and memorialized it: Ivory process charts *versus* Demay et al. (2021b: Fig. 7.2).

**6.0 Abandonment of MMBS Sites**. “People become sedentary when nature provides a sufficiently rich and reliable assortment of resources at a single location.” (Dow & Reed, 2015). The prevailing archaeological thought now is that MMBS settlements were occupied all year, (Demay et al., 2020), and the River Paradigm supports sedentism. Sedentism increased fertility. (Page et al., 2016).

The number of years individual MMBS sites were inhabited in one occupation before abandonment, leaving one cultural layer, cannot easily be determined and did not correspond to the wide ranges of radiocarbon dates obtained within MMBS sites. Dividing the number of skulls or skeletons found in MMBS by three (3), dependent upon the number of mammoth people at the site, may result in a very approximate estimate of the number of years occupied. Mezhyrich was occupied for 50 years (old count) or 36.3 years (new count) under this divisor.

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The Mid-Dnieper basin was depopulated for 5,000 to 6,000 years, from 25/24 kyr cal BP to 20/19 kyr cal BP (Chabai et al., 2020), due to cold climactic conditions, including a Heinrich event at around 23,000-21,000 ya. Structure 4 at Mezhyrich was precisely dated recently to 18,248 to 17,764 years ago. (Chu, et al., 2025). Mezinian Culture probably abandoned the Middle Dnieper River Basin after the abrupt arrival of Heinrich Event 1, about 17,000 ya.

We find the periodic abandonment of MMBS sites after decades of occupation, which would not always meet the more stringent definitions of sedentism (Dow & Reed, 2015), followed by re-occupation of the general riverine niche after additional years, decades, centuries or millennia. If knowledge of the River Paradigm was lost, it could be re-created based on its clear advantages over nomadic hunting, known to both Neanderthals and AMH. Abrupt climate change probably drove abandonment at multiple sites. The onset of warmer temperatures drove mammoth herds northward, and one of the last mega-sites was Berelekh, on the Arctic Ocean. (Shipman, 2014: Table 1).

Bands may have re-located to a more favorable site, perhaps downriver by rafts or boats. One explanation for mega-site abandonment in the absence of abrupt climate change could be that controlling mammoth matriarchs and other game avoided hunted kilometers of river, changed migration routes, found water outside of those rivers, or learned better to avoid the risks of Paleolithic hunting. River volume decrease, tied to climate change, might have played a role. Fortunately, the mammoth hunters left incised eyewitness accounts (Paleolithic blueprints or process charts) on museum-quality Paleolithic ivory.

## 7.0 Conclusion

Only the River Paradigm explains the productivity of the efficient and successful organized sedentary mammoth hunters who constructed multi-purpose mammoth-bone structures (MMBS) in Central and Eastern Europe during the Upper Paleolithic. Each element, phase, and artifact relied upon to support the River Paradigm meets the preponderance of the evidence standard, not the slower, narrower, and more burdensome scientific method applied to artifacts and limited numbers of variables. The many elements, artifacts, data, and phases fit precisely into the dynamic subsistence system, and the exact fit and functionality verify the scientific validity of the riverine system. Systems analysis shows how organized mammoth hunters used optimal methods as determined by the riverine environment and how the same system could not have been used on land. As a production line, the MNI for mammoths proves effectiveness and efficiency in output, the production of smoked or dried meat packages, pemmican, or stored rendered fat, and in addition building materials and a wealth of useful objects. The Mezinian Culture, along with other cultures within the long-lasting River Paradigm, was dynamic both physically—through river transport and processing of carcasses—and culturally, as shown by their high achievements and exceptional artifacts.

The River Paradigm disposes of theories advocating scavenging, finding frozen dead mammoths in a herd, *in situ* killing of herds, the undue significance of bone collecting or finding, and that mammoth hunters sought bone graveyards in order to construct their dwellings. Those speculations constitute the badges of complete systemic failure. The many efficiencies of the River

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Paradigm contrast starkly with the failure modes of land-based models. The River Paradigm justifies moving successful mammoth hunters out of the ranks of scavengers and nomads and placing them squarely within the ranks of brilliant early sedentary cultures, for which there is abundant material evidence in artifacts, dwellings, tools, production of food, clothes, and art.

It has been said that "there are no eyewitness accounts of the distant past" (Haynes, 1991:259), but the ivory process charts are eyewitness explanations memorialized in ivory, illustrating mundane features of the Mezinian Culture in a Paleolithic blueprint. Eyewitnesses illustrated on ivory what they saw: mammoth carcasses in rivers tied up below mega-sites, a flap of thick mammoth hide and subcutaneous fat held back by cords or bones to provide butchery access, loose bones and tusks from butchery, paths and steps from rivers up to settlements of MMBS, structures of different types, smokehouses, fat-rendering stations, bone beds, elevated meat/fat caches, and to the author's interpretation, dog kennels, raw and smoked meat packages, and curved ivory tusks serving to support elevated meat/fat caches both horizontally and vertically. The eyewitnesses recorded their subsistence system on ivory, and their accounts agree with the terrain, physical facts, logistics, data, artifacts, needs of Paleolithic people in an Ice Age, and dynamic processes.

Iakovleva (2016) observed that the "palaeoeconomy of the Mezinian is based on intensive and systematic mammoth exploitation." Their successful system was the River Paradigm, harvesting large numbers of mammoths. Mezinian mammoth people were relatively well-dressed (Iakovleva, 2016) and took large numbers of fur-bearers (Soffer, 1985:400). Soffer found that the number of wolves taken in the Middle Dnieper River Basin exceeded the utilitarian needs of those sites. (Soffer, 1985:320).

What facts are proposed by the River Paradigm, a model of riverine mammoth procurement?

- The three ivory process charts display overtly or through necessary inferences the River Paradigm, which operated productively through the five phases of the mammoth palaeoeconomy.
- MMBS people were sedentary.
- Mammoth-hunting territories were the kilometers of river terrain above settlements, which could be shaped and constructed to maximize mammoth acquisition, and within which hunters from the MMBS settlement set up temporary warm weather hunting outposts.
- The River Paradigm minimized close contact hunting of mammoths, by hunters firing or thrusting weapons from safe positions while maximizing the time mammoths were subject to atlatl, javelin, arrow, and spear attacks, with probable poisoned projectile tips, while dogs chased mammoths and kept them river-bound.
- Mammoth hunters prepared river segments to keep mammoths in the river and kill, wound, or trap mammoths with structures, channeling, hunting positions, and barriers.
- Scavenging and bone collecting were negligible compared to the productivity of the MMBS communities and the emphasis on nutrition.

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- Classification of sites into "kill sites," "fast-access scavenging" sites, and similar categories is no longer valid because those sites never existed.

By 40,000 years ago, European mammoth hunters had flutes made from bird bones and mammoth tusks. Later, they built a mammoth bone orchestra. The Pavlov Map is said to be the oldest map in the world. The Mezhyrich Process Chart similarly claims antiquity with contemporaneous ivories from Eliseevichi and Kyiv-Kirilovskaia. Mammoth hunters in Central Europe created the first known ceramic objects while those in Eastern Europe built the first documented elevated meat/fat caches. Mammoth hunters created the first known flowcharts or process charts and perhaps early management authority symbols. Sedentary mammoth hunters centralized meat processing, utilizing highly efficient water power in their production lines and operating the first wholly and vertically integrated production systems using water power. Dogs were likely first domesticated by Eurasian mammoth hunters who had ample meat and fat. Mammoth hunters probably created the first dogsleds along frozen rivers near their homes.

Pavlovian and Mezinian MMBS Cultures were among the first sedentary peoples in the world, preceding the Natufians. Organized sedentary mammoth hunters were pioneers in the production of warm fur clothing, the eyed needle, and woven cloth. (Gilligan et al., 2024; Gilligan, 2010). Long before Göbekli Tepe was built in Turkey, mammoth hunters pioneered architecture by designing solid, insulated multi-purpose buildings with clever inclusion and use of mammoth skulls, bones, mandibles, tusks, hides, and loess. They employed a precise northwest-southeast orientation to catch sunlight both in the morning and afternoon. Their thick-walled multi-purpose structures might have been used as smokehouses, fat-rendering stations, winter or all-year homes, storage spaces, workshops, or community gathering spaces.

Prehistory is the time before written records. The ivory process charts are written records, documents, pictographic illustrations of mundane objects and processes, Paleolithic blueprints. The ivories from Mezhyrich, Eliseevichi, and Kyiv-Kirilovskaia may represent the oldest pictographic writing system and oldest written records, perhaps the first history, predating cuneiform, the Kish Tablet, and Egyptian hieroglyphs by over 10,000 years. The ivory process charts may represent the literal dawn of history. They inform us how mammoth hunters over a wide region flourished under a common River Paradigm.

The Mezhyrich, Eliseevichi, and Kyiv-Kirilovskaia Process Charts provide evidence of the longest-lasting though not continuous successful highly organized subsistence system. This system was based on riverine hunting advantages, standardization of the five phases of the mammoth palaeoeconomy, water power, pyrotechnology, hunting dogs, meat and lipid processing, hunting weapon technology, probably poison, and elevated food storage. The model was employed in Central and Eastern Europe, starting with Neanderthals at Molodova I-Layer 4 before 44,000 years ago (Demay et al., 2012) and continuing for some 25,000 to 30,000 years, climate and mammoth herds permitting.

Sedentary mammoth hunters fit neither the typical nomadic style of subsistence nor the agriculturist sedentary mode. Instead, they pursued a distinct and advanced mode of subsistence

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conforming to the River Paradigm. Their nonconformance with both the predominant hunter-gatherer and sedentary agriculturalist profiles made them more difficult to understand and appreciate.

Mezinian Culture in the Middle Dnieper River Basin, and its cultural predecessors and contemporaries, remarkably created prosperity, sturdy warm multi-purpose structures, clothing, tools, containers, a standardized routine production process, art, and various advancements. Their ability to produce and maintain an abundant food supply demonstrates a high level of resourcefulness and planning.

The Mezinian settlement inhabitants in the Middle Dnieper River Basin and Kostenki-Borschevo sites were socially complex sedentary hunter-gatherers between 19,000 and 17,500 cal BP. Mezinian Culture displayed impressive technology and refinement in adornment as described by Iakovleva (2016), supported by the great number of woolly mammoths they harvested. Mezinian MMBS were the first to use mammoth skulls for their foundations (Iakovleva et al., 2012). Mammoth hunters over multiple millennia developed the first known family businesses, first production lines, and possibly the first ice skates, domesticated dogs, and dogsleds. Organized riverine mammoth hunters were producers, builders, innovators, and manufacturers, the most advanced hunter-gatherers. If we look carefully, we detect the earliest signs of modernity.

The River Paradigm answers the fundamental long-standing questions about the purpose and meaning of multi-purpose mammoth-bone structures (MMBS) and mega-sites. Within the vicissitudes of Ice Age climate, organized mammoth hunters in Central and Eastern Europe, and particularly the Mezinian Culture, were the most advanced people with the highest productive cultures during their times to live.

**Exhibit A**: Sequential System Model of Probable or Possible Detailed Production Activities within the River Paradigm
[with five (5) basic phases of mammoth palaeoeconomy marked **in red**]

Establishment of warm-weather hunting camps, chooms, upstream of base camp or settlement ===➔ probable preparation of riverbanks, removal of convenient steps for mammoths, blockage of some ravines, construction of hunting platforms, stands, barriers, narrow channels, obstructions, traps & ambush locations ===➔ mammoths (or other ungulates) observed (in or out of river) when sufficient water flowing in river ===➔ mammoths allowed to enter river or driven into river by humans or dogs ===➔ **mammoths hunted**, struck, constrained within rivers, pursued in flowing rivers for hours (or possibly days) by humans with superior terrain elevation, clear shots, and dogs ~~~ at some point, drums, fires, messengers, signals, or the arrival of hunted mammoths perhaps alerted upstream or downstream hunters and their dogs to the riverine hunt or downstream movement of hunted prey ~~~ or else the whole adult band, males and females, less children and their caretakers, hunted on designated days ===➔ **hunted mammoths killed in rivers**, possibly after kilometers of downstream movement with persistent attack by atlatl darts or spears, javelins, long straight spears with stone or ivory points, possibly hand-thrown stones,

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barriers & traps with underwater points or immobilizing structures, likely by or with poison on tips of projectiles, possibly bows & arrows, possibly heavy stones dropped from above, aided by dogs ~~~ some carcasses may have required pulling into rivers from floodplains, mudflats, or streambanks ===➔ whole mammoths, 100% of the relatively pristine carcass, **floated downstream via river to dock below settlement**, as depicted in ivory process charts ~~~ or sank underwater initially and rose to the surface after passage of time ~~~ or anchored underwater and stored in cold river water whole, for processing later ===➔ whole mammoths docked and secured to the riverbank belly-side up with ropes, cords, or long bones, and wood or bone walkways, docks, or platforms built to assist butchery and access to mammoth carcass, as depicted in ivory process charts ===➔ at dock, **mammoths butchered** with stone knives, microliths, axes, etc., as clearly depicted in Eliseevichi Process Chart ===➔ first tissues from mammoth belly likely given to domesticated dogs (or wolf-dogs or wolves assisting the hunt) as regular immediate operant conditioning ===➔ edible mammoth parts taken in baskets to smokehouses for fat-rendering, cold-smoking, or complete drying, as shown in Kyiv-Kirilovskaia Process Chart ~~~ some meat & fat was consumed raw, perhaps brains, or after roasting or other more immediate meal preparation ===➔ **cold-smoking**, **fat rendering**, **or full drying** of edible mammoth tissues ===➔ non-edible tissues taken to bone beds in ravines, work stations for bone, hide, organ, tusk, collagen, sinew/ligament, and ivory processing, utilization, artistic use, or tool-making ~~~ some bones used for fuel in smokehouses to slow combustion of wood fires ===➔ rendered fat and smoked or fully dried meat **stored in elevated meat/fat caches**, likely as pemmican with 50% meat/50% fat, the same percentages as edible mammoth parts, likely wrapped in sewn bison or other hides, the same method used by Native American Plains tribes ===➔ consumption of meat and fat when needed or desired ~~~ multiple uses for bones, hides, organs, ivory tusks, collagen & sinew/ligaments.

**Errata**. GLEISSNER, J.D., 2025. Explaining the Mammoth Economy, Smokehouses, and the Mezhyrich Map. *Glob J Arch & Anthropol*. 2025: 14(3): 555888. DOI: 10.19080/GJAA.2025.14.555888, mentioned 70 MMBS sites, and that should have been about 70 individual MMBS and far fewer mega-sites.

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**AI**. Artificial intelligence was used for clerical functions, only, including the improvement of grammar, sentence tense and structure, style, and verbosity in the English language. AI sped up the process of finding authorities, just as the internet or lengthy literature review generally does but played the role of clerical research assistant in this regard. AI provided no original or new ideas but helped confirm negatives opined by the author beforehand.

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