Artykuł przeglądowy *Review*

Rethinking horse domestication in North America: New insights through modern scientific breakthroughs

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Summary

The evolving research methods and tools, along with the archived historical data, shed new light on the domestication process and origin of horses in North America. According to previous theories, horses became extinct in that region, and their current presence could only be attributed to the colonization by conquistadors. Contrary to these speculations, genetic data, primarily from well-preserved dental and jaw structures, indicate that the evolution of horses was of a polyphyletic nature. Traditional oral accounts, which challenge reports from the first European settlers, are now carefully analysed. This article is a synthetic analysis of literature concerning the domestication process of horses. It suggests that the thesis about the reintroduction of horses to both Americas may be flawed and needs revision. It presents a completely new picture of the direction of equid migration, beyond the already known overland route through the Land Bridge of Beringia. Additionally, it reveals possible new human-horse relationships associated with the domestication and expansion of only certain lineages of this species. This opens the possibility of a new interpretation of historical data and suggests new research areas.

Keywords: archaeozoology, horse domestication, hippology, natural history

After decades of research into the domestication process of horses and their relationship with humans, there are still many unresolved issues. However, in recent years, there have been important revisions of the views of various researchers on this subject. These changes are influenced not only by the increasingly common use of genetic research, but also by the careful consideration of the oral traditions of indigenous inhabitants.

Evolution and extinction of horses in North America

It is well established that Equidae evolved in North America and subsequently migrated across the land bridge of the Bering Strait to Eurasia (19, 30). This opened up great opportunities for expansion for them. It is believed that by the end of the Holocene, horses in the Americas had become extinct. Therefore, their contact with humans was not sufficient to precisely determine the nature of the human-horse relationship (31). The extinction of horses was probably the result of climate change, a shorter growing season, and human pressure during the Younger Dryas (26). In addition, during this period, constituting the late glacial climatic phase, many members of the megafauna became extinct.

New insights and evidence

There are well-preserved traces of contact between humans and equines, including *Hippidon principal* (Lund, 1846), and *Equus neogeus* (Lund, 1840) (26). The presence of the horses in the Clovis culture is confirmed by archaeological evidence dating back to 14,000 BCE (14). Additionally, evidence of their presence extends to 12,700 BCE in Alberta, Canada (6). This discovery is noteworthy as it suggests the possibility of alternative migration routes for these animals beyond the Bering Strait. Until recently, the prevailing believed was that horses were reintroduced to the American continent only in the 15th century as a result of Spanish colonization, spreading among indigenous

peoples due to the Pueblo Revolt of 1680 AD (11, 12, 28). To date, there is no evidence indicating that the Viking colonization of Greenland and Newfoundland or Viking expeditions to the American continent, had any impact on the presence of horses there (28). In recent times, a perspective has emerged suggesting that horses did not go extinct on this continent, but survived and interacted with humans. This view is supported by the accounts of indigenous people belonging to the Dakota, Cheyenne, Choctaw, Ojibwa, and Navajo nations (9). Some authors, however, do not rule out the possibility of previously unknown contacts in ancient times between America and those continents where horses were present (28). This is a breakthrough in understanding contacts between ancient populations of people, which would probably translate into their relationships with domestic animals. Notably, Ake Hultkrantz recorded that the Shoshones (Shosones) believed that their ancestors possessed horses long before the arrival of the Spaniards (13). Similarly, Ewers noted that the Blackfoot tribe (Siksika) did not associate the presence of horses with settlers; instead, they held their own theories about the origin of horses. This theory finds support in new finds, including a petroglyph from Alto de Pitis, Peru, depicting a rider on a horse (dated 3,000-1,000 BCE), a geoglyph from the Mojave Desert near Blythe, Southeast California (dated to c. 900 AD), split-twig figurines from Stanton's Cave in New Mexico depicting horses and petroglyphs, pictographs, geolyphs, and figurines, carvings of horses from Mayan temples in Yucatan (dated to 1000-2000 BCE) (9, 10). The presence of horse reliefs in Mayan temples in Central America provides new insights into how indigenous people responded to horses, as described by the Spaniards. In this context, horses were not entirely foreign to them; rather, they held significance in their collective memory, religion, and culture, and these animals made a reappearance. Recent results of genetic studies, elemental isotope analysis, and carbon-14 dating unequivocally confirm that horses owned by the indigenous inhabitants of New Mexico were present before Spanish colonization and before any European set foot on the American continent (10, 28). It has been established that these horses were genetically related to Iberian horses. However, analysis of the isotopes of carbon, oxygen and strontium showed that the animals came from New Mexico, not from Europe. Moreover, their connection to North American horses from the Pleistocene epoch was excluded. Thus, it was demonstrated that horses with genetic traits of modern Eurasian domesticated horses were present prior to the Spanish colonization of North America (28). It is noteworthy that the Spaniards did not extensively explore the interior of the North American continent, but rather remained on its periphery. Therefore, their knowledge about distant nations was limited (12). These findings challenge claims regarding the extinction of horses in North America and raise the possibility that they were present on the continent before the arrival of the Spaniards.

During the Pleistocene, horses were among the most common animals in Eurasia (5). The interaction between humans and horses in the Pleistocene and Holocene was based on hunting. Given its size, the horse served as a valuable source of meat, skins, bones, and fat (15, 22, 32). Hunting horses played a crucial role in the lives of hunter-gatherers communities, necessitating effective organizational strategies. It is noteworthy that horses were a common motif in rock art and bone carvings, which undoubtedly served as a source of inspiration for people (27). The existence of cultural and religious connections with horses during this period cannot be dismissed, and these ties may have influenced later eras (20).

Horse domestication occurred relatively late compared to the domestication of other animal species. Despite the great interest of science in this topic, its circumstances still remain unclear. It is assumed that it took place in the Eurasian steppes (30).

Until recently, it was a unanimous consensus that horse domestication took place in northern Kazakhstan, and the first, or one of the first, to domesticate horses was the Botai culture (around 4,000,000 BCE) (21, 23). These conclusions were derived from the examination of animal remains at archaeological sites and the presence of horse milk lipids on vessel walls. The horses' teeth bore traces of the possible use of a bit (7, 23). However, these conclusions were not universally accepted. Some authors believed that horses were simply harvested in large numbers and kept, or even ridden, but not bred. It was also pointed out that horse dressage is not synonymous with horse breeding. It merely suggests that horses had been tamed (16, 28). Many researchers did not consider the traces of bits on horses' teeth in their studies, nor did they account for the presence of horse milk residues on vessels. This assertion is supported by noting comparable dental changes observed in the teeth of wild horses from the Pleistocene epoch in North America. Moreover, the interpretation of specific traces as milk residues has been considered evidence of horse meat consumption. In addition, they indicated the presence of horse milk residues on the teeth of people from the Bronze Age living in the Caspian-Pontic steppe, which serves as direct evidence of horse meat consumption (28, 33). The age distribution of the kept horse herd was also discussed, which made it possible to analyze the model of animal use.

Another location proposed as a potential site of horse domestication is the Sredny Stog shepherd culture (romanized as Seredn'ostohivs'ka kul'tura) from the Copper Age in Deriivki, Ukraine (4500-3500 BCE) (1, 2, 29). This is supported by numerous remains of horses discovered there and the traces of a bit on the

teeth of one of them. However, later studies using the carbon-14 dating method showed that the only horse with changes in the teeth came from the Iron Age and therefore could not have any relation with the early domestication of horses (4).

Genetic research has been conclusive, showing that neither the horses of the Botai culture nor those of the Sredny Stog culture or the Yamnaya tribe culture were the ancestors of modern domestic horses. Interestingly, the horses of the Botai and Deriivka cultures were genetically related to Przewalski's horses (Takhi) (24). These may have been early attempts to domesticate horses, but they did not result in a wide-ranging expansion of these animal populations. This strongly supports the theory of polytopic horse domestication. It suggests that there were numerous attempts to domesticate horses, but only a few genetic lines have been successful in achieving expansion. According to archived genetic sequences, modern horses (Fig. 1) are descended from horses of the DOM2 genetic line, and their homeland is the Pontic-Caspian steppe (South-Eastern Europe) (18). The rapid expansion of the DOM2 horse lineage appears to have been driven not only by the needs of local societies, but also by broader socio-economic factors and the militarization of horse riding (22, 24). The spread of horses was related to the simultaneous expansion of bronze metallurgy and Indo-European languages. It was also associated with the spread of pastoral cultures (3), particularly among groups capable of harnessing horses to chariots. War chariots were drawn by horses and served a purely military purpose. The use of these war chariots marked a significant offensive revolution that had a direct impact on global power dynamics.

Fig. 1. The use of modern draft horses, 2019 (Canada, North America). Source: the A. Tomańska's archive

A study by Librado et al. (18) raises doubts about the idea that the spread of DOM2 lineage horses was related to the expansion of Yamnaia herdsmen. The expansion of these horses occurred much later, around 2200-2000 BCE, when they reached Anatolia, the lower Danube region, Bohemia, and Central Asia. From there, they extended their presence to Western Europe and Mongolia, eventually supplanting local horse populations around 1500-1000 BCE. Techniques of horseback riding and the combat use of chariots first emerged in the Trans-Ural Sintashta culture. This expansion appears to have had a military character, motivated by competition for grazing land. Another model for the spread of horses of the DOM2 lineage involves Anatolia, the Levant, and the Carpathian Basin. Horses arrived in these regions through trade along with specialists in horse breeding and chariot construction.

We possess detailed documentation of the horse-related activities of the Indo-European peoples. Historical records indicate that the Indo-Europeans found developed civilizations coexisting with horses in the Middle East (including Anatolia, Syropalestine, and Mesopotamia). The remarkable history of humans alongside horses can be vividly reconstructed throughout the annals of the history. It often shows the unique significance of the bond between people and these animals. In ancient Mitanni (Northern Mesopotamia and Syria), chariot warriors were a special caste referred to as "maryannu" (the word etymologically related to the Old Indian noun "márya", meaning boy) (17, 25). The earliest written sources regarding horses come from the city of Ur (Mesopotamia, c. 2100 BCE). They refer to the horse as "a donkey from the mountains" because it was brought there from Iran and eastern Anatolia (17). Horses are presented in the Standard of Ur, a monument of Sumerian art deposited in the local royal tomb. Its war page shows Mesopotamia's military elites in horse chariots (Fig. 2). Based on historical data, a map depicting the spread and development of domesticated horses was created (Fig. 3).

Summary and future prospects

The domestication of the horse continues to be of interest to many scientists. Thanks to the continuous development of research methods, knowledge about the history of Equidae is increasingly comprehensive. Nevertheless, many unknowns remain, offering entirely new and intriguing avenues for research based on the intricate synthesis of the increasing pool of data.

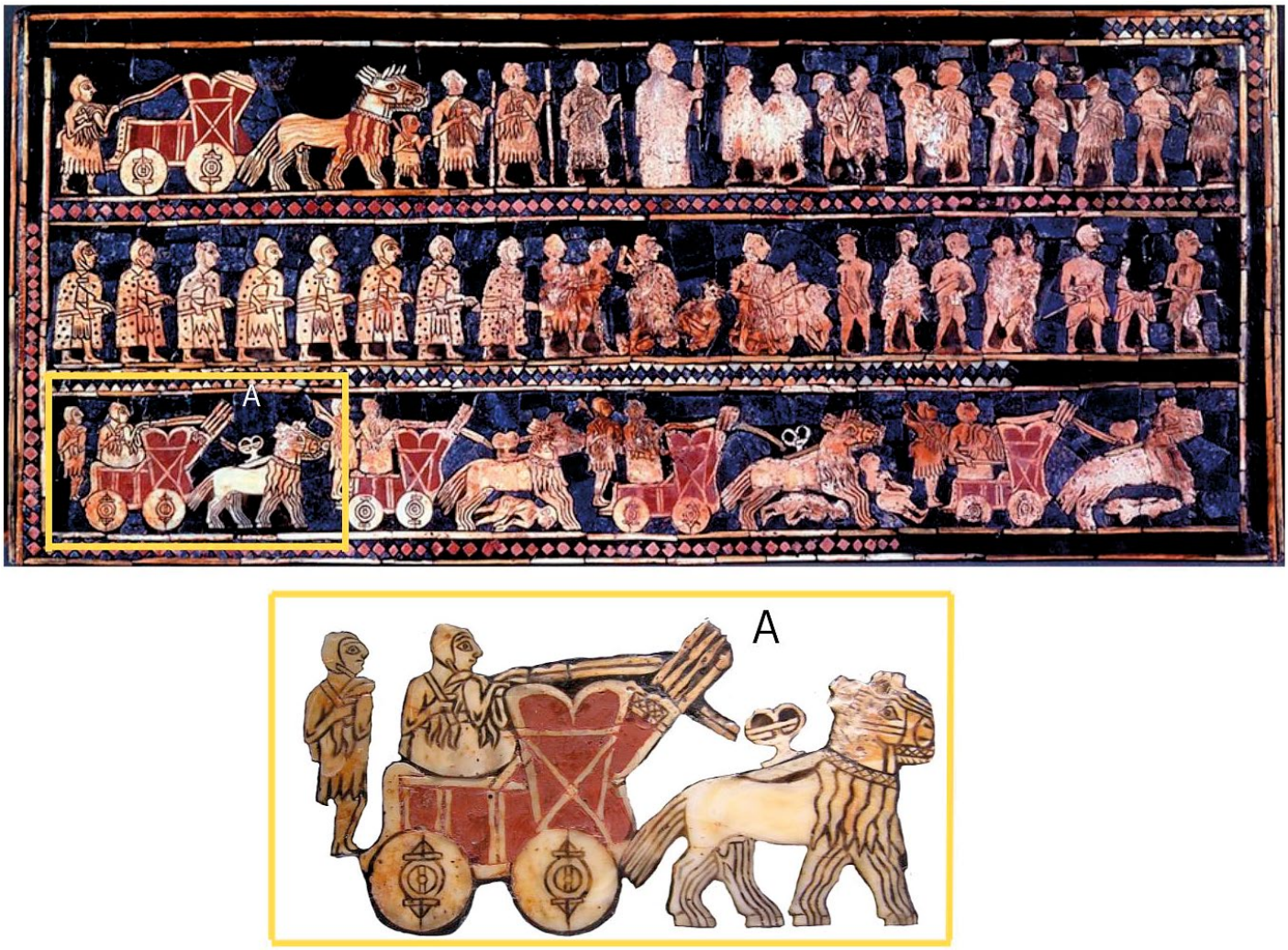

Fig. 2. The war side of the Standard of Ur (Mesopotamia) displaying figural scenes (A). Source: "Royal Standard of Ur" – Mosaic With Sumer Images, Source: public domain

Fig. 3. Charting the Historical Dissemination and Evolution of Domestic Horses: A Geographic Overview. Source: A. Tomańska

References

1. *Anthony D., Telegin D. Y., Brown D.*: The origin of horseback riding. JSTOR, SciAm 1991, 94-101.
2. *Anthony D. W.*: Bridling horse power: The domestication of the horse, [in:] Olsen S. L. (ed.): Horses Through Time. Boulder: Roberts Rinehart Publishers 1996, 57-82.
3. *Anthony D. W.*: The horse, the wheel, and language: How Bronze-Age Riders from the Eurasian steppes shaped the modern world. Princeton University Press 2007, 1-568.
4. *Anthony D. W., Brown D. R.*: Eneolithic horse exploitation in the Eurasian steppes: diet, ritual and riding, [in:] Witcher R. (ed.): Antiquity. A Review of World Archaeology 2000, 74 (283), 75-86.
5. *Bendrey R.*: From wild horse to domestic horses: A European perspective. World Archaeol. 2012, 44 (1), 135-157.
6. *Brink J., Barron-Ortiz Ch., Loftis K., Speakman R. J.*: Pleiostocene horse and possible human association in central Alberta, 12,700 years ago. Can. J. Archeol. 2017, 41, 79-96.
7. *Brown D., Anthony D.*: Bit wear, horseback riding and the Botai Site in Kazachstan. J. Archeol. Sci. 1998, 25 (4), 331-347.
8. *Choyke A. M., Bartosiewicz L.*: Osseous projectile points from the Swiss Neolithic: taphonomy, typology and function, [in:] Roksandiü M. (ed.): Violent interactions in the Mesolithic. Evidence and meaning. British Archaeological Reports International Series. Oxford: Archaeopress 2004, 1237, 75-88.
9. *Collin Y. H. R.*: The relationship between the indigenous people of the Americas and the horse: deconstructing a Eurocentric myth, A Dissertation for the Degree of Doctor of Philosophy. University of Alaska Fairbanks 2017, 1-211.
10. *Downer C. C.*: The horse and Burro as Positively Contributing Returned Natives in North America. Am. J. Life Sci. 2014, 2 (1), 5-23.
11. *Ewers J. C.*: The Horse in Blackfoot Indian Culture. Smithsonian Institution Bureau of American Ethnology Bulletin 159. United States Government Printing Office. Washington 1955, 1-374.
12. *Gwynne S. C.*: Empire of the Summer Moon. Little Brown Book Group. New York 2007, 1-496.
13. *Hultkrantz Å.*: Shoshoni Indians on the Plains. An Appraisal of the Documentary Evidence. JSCA, Z. Ethnol. 1968, 93, 49-72.
14. *Kooyman B., Newman M. E., Cluney Ch., Lobb M., Tolman S., McNeil P., Hills L. V.*: Identification of Horse Exploitation by Clovis Hunters Based on Protein Analysis. Am. Antiq. 2001, 66 (4), 686-691.
15. *Kyselý R., Peške L.*: New discoveries change existing views on the domestication of the horse and specify its role in human prehistory and history – a review. Archeol. Rozhl. 2022, 74 (3), 299-345.
16. *Levine M. A.*: Botai and the Origins of Horse Domestication. J. Anthropol. Archaeol. 1999, 18 (1), 29-78.
17. *Lewis S., Llewellyn-Jones L.*: The Culture of Animals in Antiquity. A Sourcebook with Commentaries. Routledge, London and New York 2020, 1-778.
18. *Librado P, Khan N., Fages A., Kusliy M. A., Suchan T., Tonasso-Calvière L., Schavinato S., Alioglu D., Fromientier A., Perdereau A., Aury J. M., Gaunitz C., Chauvey L., Seguin-Orlando A., Sarkissian C. Der, Southon J., Shapiro B., Tishkin A. A., Kovalev A. A., Alquraishi S., Alfarhan A. H., Al-Rasheid K. A. S., Seregély T., Klassen L., Iversen R., Bingon-Lau O., Bodu P., Olive M., Castel J. C., Boudadi-Maligne M., Alvarez N., Germonpré M., Moskal-del Hoyo M., Wilczyński J., Pospuła S., Lasota-Kuś A., Tunia K., Nowak M., Rannmäe E., Saarma U., Boeskorov G., Lõugas L., Kyselý R., Peške L., Bălăsescu A., Dumitrascu V., Dobrescu R., Gerber D., Kiss V., Szécsényi-Nagy A., Mende B. G., Gallina Z., Somogyi K., Kulcsár G., Gál E., Bendrey R., Allentoft M. E., Sirbu G., Dergachev V., Shephard H., Tomadini N., Grouard S., Kasparov A., Basilyan A. E., Anisimov M. A., Nikolskiy A., Pavlova E. Y., Pitulko V., Brem G., Wallner T., Magail J., Gantulga J. O., Bayarsaikhan J., Erdenebaatar D., Tabaldiev K., Mijiddorj E., Boldgiv B., Tsagaan T., Pruvost M., Olsen S., Makarewicz C. A., Lamas S. V., Canadell S. A., Nieto Espinet A., Pilar Iborra M., Garrido J. L., Rodríguez González E., Celestino S., Olària C., Arsaguaga J. L., Kotova N., Pryor A., Crabtree P., Zhumatayev R., Toleubaev A., Morgunova N. L., Kuznetsova T., Lordkipanize D., Marzullo M., Prato O., Bagnasco Gianni G., Tecchiati U., Clavel B., Lepetz S., Davoudi H., Mashkour M., Berezina N. Ya., Stockhammer P. W., Krause J., Haak W., Morales-Muñiz A., Bernecke N., Hofreiter M., Ludwig A., Graphodatsky A. S., Peters J., Kiryushin K. Yu., Iderkhangai T. O., Bokovenko N. A., Vasilev S. K., Seregin N. N., Chugunov K. V., Plasteeva N. A., Baryshinikov G. F., Petrova E., Sablin M., Ananyevskaya E., Logvin A., Shevina I., Logvin V., Kalieva S., Loman V., Kukushin I., Merz I., Merz V., Sakenov S., Varfolomeyer V., Usmanova E., Zaibert V., Arbuckle B., Belinskiy A. B., Kalmykov A., Reinhold S., Hansen S., Yudin A. I., Vybornov A. A., Epimakov A., Berezina N. S., Roslyakova N., Kosintsev P. A., Kuznetsov P. F., Anthony D., Kroonen G. J., Kristansen K., Wincker P., Outram A., Orlando L.*: The origins and spread of domestic horses from the Western Eurasian steppes. Nature 2021, 598, 634-640.
19. *MacFadden B. J.*: Fossil Horses – Evidence for Evolution. Science 2005, 37, 1728-1730.
20. *Makowiecki D., Chudziak W., Szczepanik P., Janeczek M., Pasicka E.*: Horses in the Early Medieval (10th-13th c.) Religious Rituals of Slavs in Polish Areas – An Archaeozoological, Archaeological and Historical Overview. Animals 2022, 12 (17), 2282.
21. *Olsen S. L., Zeder M. A.*: Early horse domestication on the Eurasian Steppe, [in:] Zeder M. A., Bradley D., Ernshwiller E., Smith B. D. (ed.): Documenting Domestication. New Genetic and Archaeological Paradigms. University of California Press, Berkeley 2006, 245-269.
22. *Outram A. K.*: Juggling with Indices: A Review of the Evidence and Interpretations Regarding Upper Palaeolithic Horse Skeletal Part Abundance, [in:] Olsen S. L., Grant S., Choyke A. M., Bartosiewicz L. (ed.): Horses and Humans: The Evolution of Human-Equine Relationships 2006, 49-60.
23. *Outram A. K., Stear N. A., Bendrey R., Olsen S., Kasparov A., Zaibert V., Thorpe N., Evershed R. P.*: The Earliest Horse Harnessing and Milking. Science 2009, 323, 1332-1335.
24. *Outram A. K., Stear N. A., Kasparov A., Usmanova E., Varfolomeev V., Evershed R. P.*: Horses for the dead: funerary foodways in Bronze Age Kazakhstan, [in:] Witcher R. (ed.): Antiquity. A Review of World Archeology 2023, 85, 116-128.
25. *Popko M.*: Huryci. PIW, Warszawa 2005, 1-205.
26. *Prado J. L., Alberdi M. T.*: Fossil Horses of South America. Phylogeny, Systematics and Ecology. The Latin American Studies Book Series. Springer International Publishing AG, part of Springer Nature 2017, 1-16.
27. *Pruvost M., Bellone R., Benecke N., Sandoval-Castellanos E., Cieslak M., Kuznetsova T., Morales-Muñiz A., O'Connor T., Reissmann M., Hofreiter M., Ludwig A.*: Genotypes of predomestic horses match phenotypes painted in Paleolithic works of cave art. PNAS 2011, 108 (46), 18626-18630.
28. *Taylor W. T. T., Librado P., Tašunke Icu M. M., Gover C. S., Arterberry J., Luta Wi A., Nujipi A., Omniya T., Gonzalez M., Means B., High Crane S., Mažasu, Dull Knife B., Wiŋ W., Tecumseh Collin C., Ward C., Pasqual T. A., Chauvey L., Tonasso-Calviere L., Schiavinato S., Seguin-Orlando A., Fages A., Khan N., Sarkissian C. Der, Liu X., Wagner S., Ginondidoy Leonard B., Manzano B. L., O'Malley N., Leonard J. A., Bernáldez-Sánchez E., Barrey E., Charliquart L., Robbe E., Denoblet T., Gregsen K., Vershinina A. O., Weinstock J., Rajić Šikanjić P., Mashkour M., Shingiray I., Aury J. M., Perdereau A., Alquraishi S., Alfarhan A. H., Al-Rasheid K. A. S., Trbojević Vukićević T., Buric M., Sauer E., Lucas M., Brenner-Coltrain J., Bozell J. R., Thornhill C. A., Monagle V., Perri A., Newton C., Hall W. E., Conver J. L., Le Roux P., Buckser S. G., Gabe C., Bautista Belardi J., Barrón-Ortiz C. I., Hart I. A., Ryder C., Sponheimer M., Shapiro B., Southon J., Hibbs J., Faulkner C., Outram A., Patterson Rosa L., Palermo K., Solé M., William A., McCrory A., Lindgren G., Brooks S., Eché C., Donnadieu C., Bouchez O., Wincker P., Hodgins G., Trabert S., Bethke B., Roberts P., Jones E. L., Collin Y. H. R., Orlando L.*: Early dispersal of domestic horses into the Great Plains and northern Rockies. Science 2023, 379, 1316-1323.
29. *Telegin D. Y., Mallory J. P., Pyatkovskiy K.*: Dereivka: A Settlement Cemetery of Copper Age Horse Keepers on the Middle Dnieper, British Archaeological Reports. BAR International Series 287, British Archaeological Reports, Oxford 1986, 1-183.
30. *Warmuth V., Eriksson A., Bower M. A., Barker G., Barrett E., Hanks B. K., Li S., Lomitshavili D., Ochir-Gorayaeva M., Sizonov G. V., Soyonov V., Manica A.*: Reconstructing the origin and spread of horse domestication in the Eurasian steppe. Biol. 2012, 109 (21), 8202-8206.
31. *Webb S. D., Hemmings C. A.*: Last horses and first humans in North America, [in:] Olsen S. L., Grant S., Choyke A. M., Bartosiewicz L. (ed.): Horses and Humans: The Evolution of Human-Equine Relationships. BAR Publishing, International Series. Pensylvania, USA 2006, 11-23.
32. *Wilczyński J., Wojtal P., Robličkova M., Oliva M.*: Dolní Věstonice I (Pavlovian, the Czech Republic) – Results of zooarcheological studies of animal remains discovered on the campsite (excavation 1924-52). Quat. Int. 2015, 379, 58-70.
33. *Wilkin S., Miller A. V., Fernandes R., Spangler R., Taylor W. T.-T., Brown D. B., Reich D., Kennett D. J., Culleton B. J., Kunz L., Fortes C., Kitova A., Kuznetsov P., Epimakhov A., Zaibert V. F., Outram A. K., Kitov E., Kholkhov A., Anthony D., Boivin N.*: Dairying enabled Early Bronze Age Yamnaya steppe expansions. Nature 598, 2021, 629-633.

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