Following Late Pleistocene horse migration toward our sustainable future

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The horse originated in North America around four million years ago. As changing sea levels created land bridges between continents, the horse traveled into Eurasia. A team of 57 international researchers – including 18 Indigenous scientists from the Lakota, sqilx^{w} (suknaqin/Okanagan Nation), Blackfoot, Dene' (Athabascan) and Iñupiaq Nations – reveal that inter-continental exchange of horse populations occurred in both directions on multiple occasions. This back-and-forth migration pattern continued as recently as the last Glacial period, between 50,000 and 19,000 years ago. By combining cutting-edge ancient DNA and isotope analyses with traditional Indigenous scientific knowledge systems, this global study reveals new insights into how climate change affected megaherbivore species in the Late Pleistocene. The publication of "*Sustainability insights from late Pleistocene climate change and horse migration patterns*" released in *Science* on May 15th 2025, carries important lessons for biodiversity conservation in the face of today's ongoing climate and ecosystem shifts.

Role of the Horse:
Horses have played an integral role in shaping the world views and scientific systems of many Indigenous Peoples globally. Their behavior, ecological roles, and ability to adapt and move great distances have offered profound lessons to Indigenous communities who have caretaken vast territories in the Americas for more than 20,000 years. *"We understand the Horse Nation to be a keystone species that, together with the other life forms with which it shares relationality, brings balance to the ecosystem,"* says Chief Harold Left Heron, a traditional Lakota scientist, knowledge keeper and leader from the Lakota Nation. *"Multiple scientific systems respectfully joined together in this study to offer critical knowledge that can be applied by each of us today in our respective communities around the world to preserve all life."*

The Medicine Man Trail:
Dene' (Athabascan) traditional knowledge speaks of The Medicine Man Trail – a vital corridor that connected the American and Eurasian continents for many thousands of years. Along this trail, horses, like all life, traveled freely, inter-mixing, contributing, reinforcing and learning from the natural systems that shaped their journey. *"This knowledge is held in our songs, stories and in the sciences and lifeways we carry. Singing the song of life ensures that the world is balanced and life can diversify and continue in a good way,"* adds Wilson Justin, an Upper Ahtna/Upper Tanana Dene' (Athabascan) Elder and knowledge keeper of the Alth'setnay clan.

Genomic Research:
Today, the frozen soils of Alaska, Yukon and Siberia preserve a remarkable archive of fossilized bones from ancient megaherbivores, including horses. *"DNA preserves best in cold environments,"* explains Dr Ludovic Orlando, director of the Centre for Anthropobiology and Genomics of Toulouse, a joint multi-disciplinary research centre supported by the French National Center for Scientific Research (CNRS) and University of Toulouse, France. *"In this study we harnessed the full power of the latest generation of DNA sequencing instruments, and Lakota scientific genomic principles, to uncover a more complete diversity of horse lineages that existed in these regions during the Late Pleistocene,"* he adds.

Over nearly 15 years, his research team has sequenced the genomes of horses ranging in age from a few centuries to nearly one million years old. Previous work has illuminated aspects of horse domestication, and revealed details regarding ways in which they spread across the globe with human societies. This new study, however, sequences the genomes of 68 Late Pleistocene

horse specimens from both the American and Eurasian continents, includes expert co-authors representative of the territories from which the samples derive, and delves deeper into intercontinental horse migrations, focusing on movements up to and during the Last Glacial Maximum, between 26,000 and 19,000 years ago.

Horses Connect Continents:
"Our work shows that, in North America alone, there was one distinct horse lineage south of the ice sheets, another across Alaska and the Yukon—and even a third at the westernmost edge of Alaska," says Dr. Yvette Running Horse Collin, a Lakota scientist and director of Taku Skan Skan Wasakliyapi: Global Institute for Traditional Science (GIFTS), who led the genome sequencing laboratory work for this study and helped to ensure all Indigenous scientific protocols were applied and followed. *"However, the natural migration patterns of our Horse Nation relatives show us clearly that today's geographic country boundaries and accompanying paleontological labels do not accurately define or capture the actual experience of the horse."*

The above noted third horse lineage found in North America was genetically traced back to Eurasia. It represents the easternmost spread of a horse population native to the Ural Mountains, one that extended across the Arctic and entered North America as sea levels dropped and a landmass connected Siberia to Alaska. The study shows that this land bridge was crossed many times from Eurasia to America by horses between 50,000 and 19,000 years ago. Intriguingly, it also reveals that horses traveled the opposite direction during earlier time periods, following coastal routes southward along the Pacific, reaching as far as northeastern China—and eventually leaving enduring genetic traces as far west as Anatolia and the Iberian Peninsula well into the Holocene.

The team also analyzed a horse population that lived in the Yukon during the post-glacial warming period, as melting ice sheets gave rise to new environmental conditions. *"These horses lived within the Ice-Free Corridor at a time when the landscape was transitioning from steppe-tundra to a much wetter ecosystem,"* says Clément Bataille, professor at the University of Ottawa, who coordinated the carbon and nitrogen isotope analyses. This shift proved less favorable to horse populations and their necessary ecosystems, leading to a significant demographic decline.

Findings and Next steps:
Jane Stelkia is an Elder for the sqilxʷ (suknaqin/Okanagan Nation), which is based on her People's traditional lands in Canada. She is a keeper of traditional science surrounding Snklc'askaxa, the Horse Nation, and she confirms her People's experience with the Medicine Man Trail and their ability to overcome great environmental and historical adversity together with and alongside the horse. *"In this study, Snklc'askaxa is offering us medicine by reminding us of the path all life takes together to survive and thrive as life moves and changes," she says. "It is time that we come together, again, to help life find the openings and points to cross and move safely."*

These findings underscore the importance of maintaining ecological corridors that support continuous movement between habitats. Such pathways appear essential for preserving the biodiversity of megafauna and their dependent and interrelated life forms—not only in the rapidly warming Arctic, but globally—as the world faces a severe biodiversity crisis.

Long-term Scientific Study:
"We did this study with our allies from other nations in order to show the world the importance of movement in sustaining life," says Chief Joe American Horse, a traditional leader and

knowledge keeper for the Lakota Nation. He references “yutaŋ’kil,” the Lakota scientific concept that was brought forward by Chief Left Heron in this article to help today’s scientific and conservation community understand life’s behavior during these times of great environmental change. *“This concept means that life never moves alone, but follows its ecosystem – life must move to survive. We are implementing the findings of this paper in He’Sapa, our sacred Black Hills in conjunction with many leading scientific institutions, headquartered from the Black Hills Wild Horse Sanctuary.”*

More information, including a copy of the paper, can be found online at the *Science* press package at https://www.eurekalert.org/press/scipak/

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Picture captions:
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BlackHillsWildHorseSanctuary-5.jpg
Wild horses running free at the Black Hills Wild Horse Sanctuary in South Dakota, USA. © Black Hills Wild Horse Sanctuary.

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C'wyelx (Thomas Pierre), with an Okanagan Nation horse. © Little Pine Productions.

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