Restoring the Arctic Landscape to a Time When Mammoths Roamed Could Protect Thawing Permafrost | Opinion

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By Marc Macias-Fauria

The permanently frozen soil of the Arctic, known as permafrost, is a powder keg for climate change. Thawing of the permafrost would release enormous quantities of greenhouse gases—carbon dioxide and methane—into the atmosphere. The amount of carbon contained in Arctic soils, which has accumulated over tens of thousands of years, is larger than that in all living vegetation including rainforests. Current global warming is set to destabilize these soils, releasing carbon and causing further climate change, in a feedback loop that will make a bad situation even worse.

I have been studying Arctic vegetation responses to climate and environmental change for over a decade. At large scales—over large regions and continents—science generally understands changes in vegetation as a consequence of changing physical conditions. For example, a warmer Arctic will favour certain plant species over others. Only rarely are animals thought to play a large enough role to drive vegetation dynamics and composition over extensive areas.

In the early 1990s, Russian scientist Sergey Zimov led a ground-breaking publication. In it, he proposed that the giant mammals of the ice age, including the woolly mammoth, woolly rhinoceros, horse, bison and musk ox, had such an effect on northern ecosystems that their presence created and maintained a whole biome dominated by grass and forbs, known as the mammoth steppe.

Zimov and colleagues hypothesized that the current wet, shrub and moss-dominated tundra is largely a consequence of the demise of these ice age giants.

That means that the Arctic, often seen as the very essence of wilderness in popular imagination, could be considered a degraded ecosystem. But why is this of any interest beyond academic discussions?

First, Zimov's work suggests that if we were to repopulate Arctic lands with large mammals, we could revert the current situation and turn the tundra back into grasslands. As much as 42 percent of the Arctic has been deemed susceptible to such animal-mediated vegetation shifts. Whereas many may dream of seeing mammoths roaming Siberia, for the time being the animals employed in this ecological engineering experiment would be the extant ones—most notably bison and horse but also reindeer and musk ox.

Second, the mammoth steppe was a much more productive ecosystem than the current tundra. It sustained animal densities comparable to current African game reserves and, crucially, it enabled a set of processes that result in cooler soils and thus better preservation of the permafrost.

Grasslands enhance the Earth's surface reflectivity compared to shrub and tree-covered terrain, which means that more of the sun's incoming energy bounces back to space and does not remain in the ecosystem. The deep root systems of grasses and forbs increase the amount of carbon captured and stored deeper in the soil. By trampling on snow in search of winter forage, animals enable the penetration of cold winter temperatures deeper in soils, which would otherwise be protected by a thick blanket of snow and tall vegetation. Altogether, these changes would stabilize or delay permafrost melt.

Pleistocene Park is a family-run experiment, established by Sergey Zimov in the 1990s. It is currently run by his son Nikita in the far north-eastern corner of the Sakha Republic in Siberia, to put these ideas to test. With limited resources, the park has succeeded in enabling a vegetation shift mediated by the activity of large mammals. Preliminary temperature measurements show animal-affected soils are more than 2 degrees Celsius cooler and capture and store more carbon.

Restoring the mammoth steppe with large animals is an example of a 'natural climate solution' for the Arctic. Natural climate solutions involve improved land management and ecological restoration practices that avoid emissions and/or increase carbon sequestration.

Could this be done on a large scale? In recent research with colleagues at the Environmental Change Institute, University of Oxford, and Nikita Zimov at the Northeast Science Station, Russian Academy of Sciences, we explored the feasibility of Arctic rewilding on a large scale. We found that this kind of initiative could be economically viable in a carbon market, and that time is ripe for a large-scale experimental phase. We costed the project at $114 million over ten years—not a large number given the potential implications for the stewardship of our planet.

However, it's important to remember that the Arctic is not empty. It is and has been inhabited and managed by people for thousands of years. Seeing it as a wilderness results in a large part from a biased perspective of those of us not living there. The options we present and discuss require not only a very thorough monitoring of their impacts on the Earth's systems, but most importantly the willingness of local communities to engage with them.

To date, it is difficult to call global management of the global warming crisis anything other than a failure. The next decades, partly as a result of our inaction over the past ones, are crucial to mitigate climate warming. It is time to embrace innovative and proactive new experiments.

By doing nothing, we have embarked on the largest and boldest of all geo-engineering experiments in human history: that of modifying the atmospheric chemical composition and increasing greenhouse concentrations to levels never experienced by our species. In the Arctic, which is already changing rapidly, taking no action is a conscious decision that enables large, often irreversible changes to occur.

Our study highlights that land use options in the Arctic are at least as important for the mitigation of climate change as other land use options such as reforestation that receive much more attention.

It is now time for large new experiments at the interface of science and practice. Rewilding the Arctic to preserve the permafrost stands out as one of the most exciting and potentially cost-effective amongst them. Who's up for the challenge?

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