ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

Arctic

How larches are conquering Siberia's high northern reaches

Reconstructing the development of Siberia's vast larch forests: Ranges of various larch species not chiefly determined by the climate

[29. November 2018] **Researchers from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research have for the first time reconstructed the historical development of the larch forests in northern Siberia over the past 9,000 years. This allowed them to identify, which factors determine the ranges of various larch species, and to gauge the forests' capacity for absorbing carbon dioxide – an aspect that is directly relevant with regard to potential shifts in the larches' ranges in the future. Their findings indicate that not air temperature alone determines whether or not the three Siberian larch species become dominant in a given region; the more important aspect is the biological competition between the species, and the question of which species settled there first. The new study will be released today in the journal "Scientific Reports".**

In Siberia, an area measuring over 2.6 million square kilometres – roughly seven times the size of Germany – is covered by larch forests, which have a significant influence on the Earth's climate. For one thing, the billions of trees there absorb and store massive quantities of carbon dioxide (CO_2) from the atmosphere. For another, they reduce the reflectivity of the Earth's surface; wherever trees grow, a far lower percentage of sunlight is reflected than in the largely snow-covered tundra.

Accordingly, the answer to the question of how the Siberian larch forests will influence the carbon cycle and the Earth's climate in the future also depends on whether or not they will spread farther to the north as a result of climate change (as expected), and if so, which species will become dominant. The fast-growing Siberian larch (*Larix sibirica*), for example, can absorb atmospheric CO_2 far more effectively than the slow-growing Dahurian larch (*Larix gmelinii*).

Expedition (Photo: Laura Epp)

DNA evidence reveals the forests' past

"Until recently, it was extremely difficult to make prognoses on the future of the Siberian larch forests because we knew so little about the historical spread of the respective larch species; with conventional methods, it's virtually impossible to tell the difference between the pollen and other remains left behind by the different species," explains first author Prof. Laura

Downloads

Contact

Science

Ulrike Herzschuh
+49(331)288-++49 (0) 331 288 2165
Ulrike.Herzschuh@awi.de

Stefan Kruse
+49(331)288-2218
Stefan.Kruse@awi.de

Press Office

Folke Mehrtens
+49(471)4831-2007
Folke.Mehrtens@awi.de

Prof. Dr. Laura Epp
University of Konstanz
+49(7531) 88-3391
laura.epp@uni-konstanz.de

Photos

Public media
Press media

Epp. In a recent project, she and her colleagues have for the first time successfully reconstructed the distribution and density of individual larch species in Siberia's forests along the Arctic tree line for the past 9,000 years. To do so, they employed a new method to extract ancient larch DNA from soil samples, taken from sediment cores gathered near two lakes on Russia's Taymyr Peninsula.

These genetic assets have allowed the experts to draw conclusions regarding which larch species grew in the immediate vicinity of the lakes, and in which century; how dense the forests were; and how the different species competed – an analysis that, until recently, would have only been possible to make in a handful of research labs worldwide.

Surprising findings from climate data comparisons

When the researchers compared this distribution dataset with the climate data for the respective time frame, they made a surprising discovery. Contrary to previous assumptions, it wasn't primarily the climate that determined the growth of the forests or their ratios of larch species; rather, the history of and competition between the larches were far more important factors. This insight turned the previous conjecture on a direct interdependency between climate and forest on its head...

"Our study shows that, with regard to future climate change, we can't simply assume that further warming will immediately cause certain tree species to disappear and others, which respond better to higher temperatures, to thrive," says co-author Prof. Ulrike Herzschuh, a paleo-ecologist at the AWI. "Instead, we have to bear in mind which species are already there, how they could hamper the spread of new species, and how the 'balance of power' would need to change in the long term, before the species now benefitting from climate change could actually gain the upper hand." In the past, Siberia's larch forests have consistently responded to climate changes with a delay of several hundreds or even thousands of years; the experts from the AWI research group "Polar Terrestrial Environmental Systems" now expect this trend to continue in the future.

They were able to confirm this time-delayed response by simulating forest development with the aid of a new model for larch populations. The AWI researchers now plan to further refine the model, so as to soon be capable of making detailed forecasts on the future spread and composition of Siberia's larch forests. Climate prognoses call for rising temperatures and increasing aridity in Siberian's high northern reaches. If that comes to pass, the larch forests are in for some major changes.

In addition to researchers from the AWI, experts from the Federal University in Yakutsk (Russia) and the University of Potsdam participated in the study.

Original publication

Laura S. Epp, Stefan Kruse, Nadja J. Kath, Kathleen R. Stoof-Leichsenring, Ralph Tiedemann, Luidmila A. Pestryakova & Ulrike Herzschuh. *Temporal and spatial patterns of mitochondrial haplotype and species distributions in Siberian larches inferred from ancient environmental DNA and modeling*, Scientific Reports, DOI:10.1038/s41598-018-35550-w

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG
HELMHOLTZ

Abo/Share

Subscribe to AWI press release RSS feed

The Institute

The Alfred Wegener Institute pursues research in the polar regions and the oceans of mid and high latitudes. As one of the 19 centres of the Helmholtz Association it coordinates polar research in Germany and provides ships like the research icebreaker Polarstern and stations for the international scientific community.

More information

Related news

» Siberian larch forests are still linked to the ice age