

Northern conifers youngest of the species

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Dramatic shifts in the planet's climate and geography over millions of years changed the course of evolutionary history for conifer trees, according to a Yale paper in the *Proceedings of the National Academy of Sciences*.

Yale researchers examined the [fossil record](#) and [genetic makeup](#) of 489 out of more than 600 living conifer species and discovered that while most conifers belong to ancient lineages, most Northern Hemisphere species, including the majority of pines and spruces, appeared within the past 5 million years.

They argue that the migration of tree species and the contraction and expansion of their ranges in response to [glacial cycles](#) led to isolated populations and the formation of new species, especially in mountainous environments where conifer diversity is high.

"Extreme [climatic shifts](#) through time may have favored the replacement of older lineages with those better adapted to cooler and drier conditions," said Andrew Leslie, the study's co-author and a Yale postdoctoral associate, "resulting in high turnover rates and the disproportionate loss of ancient lineages."

The researchers also found that the lineages of existing conifers in the [Southern Hemisphere](#) are millions of years older than their counterparts in the Northern Hemisphere, and believe it is owing to fragmented ranges and mild, wetter habitats that favored their survival.

"The [evolutionary history](#) of conifers reflects a complex set of environmental interactions," said Peter Crane, a co-author, professor of botany and dean of the Yale School of Forestry & Environmental Studies. "Nevertheless, we found large-scale and consistent differences between the diversification of southern and northern conifer clades."

The majority of existing conifer species belongs to lineages that diversified during the Cenozoic Era, over 65 million years. Conifers such as firs, hemlocks, larches, pines, spruces (Pinaceae family), junipers and cypresses (Cupressoideae) are found across the [Northern Hemisphere](#), whereas evergreens in the Araucariaceae and Podocarpaceae families and Callitroideae subfamily are found primarily in Argentina, Australia, New Guinea and New Zealand.

Michael Donoghue, a co-author of the study and Sterling Professor of Ecology and Evolutionary Biology, said temperate rainforests and broadleaf evergreen forests were common before the Pleistocene Epoch, which spanned 2.5 million years and ended 11,000 years ago, and are still present in New Zealand and in parts of Australia and South America.

"These now-fragmented habitats are among those in which older conifer lineages adapted to warmer or wetter climates and have survived at high diversity," he said. "The evolutionary histories of organisms are shaped by many factors, but this study suggests that global-scale geographic features can leave an unexpected imprint in the way in which groups evolve and diversify."

More information: The study, "Hemisphere-scale Differences in Conifer Evolutionary Dynamics," can be viewed at www.pnas.org/content/early/201...621109.full.pdf+html

Provided by Yale University

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