**REGIONAL AND SPECIES FEATURES OF TREES' RESPONSE TO CLIMATE CHANGE IN THE FOREST - TUNDRA OF NORTHERN EURASIA**

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**Региональные и видовые особенности реакции деревьев на климатические изменения в лесотундре Северной ЕвразиИ**

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The forest - tundra ecotone of Northern Eurasia, stretching from the western borders of Russia to its far northeast, is undergoing significant transformations due to accelerated Arctic warming. This process, occurring at a rate nearly four times faster than the global average, drives shifts in the distribution, structure, and functioning of woody vegetation, impacting regional biodiversity and the carbon cycle. Changes are particularly pronounced in the continuous permafrost zone, where trees face extreme conditions such as a short growing season, low temperatures, and variable active layer depths. Understanding how different conifer species adapt to these conditions is crucial for assessing their resilience and predicting future ecological transformations.

The aim of this study was to investigate the regional and species - specific responses of radial tree growth to climatic factors along a latitudinal gradient in the forest - tundra. We sought to identify differences in tree sensitivity to temperature and precipitation and to evaluate how these variations might influence their distribution and competitive interactions under warming conditions. The analysis spanned the period from 1966 to 2021, enabling the tracking of long - term trends.

The study focused on four conifer species: *Pinus sylvestris*, *Larix sibirica*, *Larix gmelinii*, and *Larix cajanderi*. Samples were collected from five sites within the continuous permafrost zone: Apatity (**APA**, Kola Peninsula) for *P. sylvestris*; Polar Urals (**PUR**) for *L. sibirica*; Khatanga (**KHA**) for *L. gmelinii*; and Chokurdakh (**CHO**) and Bilibino (**BIL**) for *L. cajanderi*. A total of 137 trees were sampled using a 5 - mm increment borer at a height of 1.3 m. Radial growth was measured with CooRecorder, chronologies were constructed using ARSTAN, and correlation analyses were performed with monthly temperature and precipitation data from nearby weather stations (Kandalaksha, Salekhard, Khatanga, Chokurdakh, Ostrovnoye). Temporal dynamics were assessed using 25 - year sliding correlations.

The results revealed distinct regional and species - specific responses to climate. At the western site **APA**, *P. sylvestris* exhibited a strong dependence on July temperatures (r = 0.41, *p <* 0.01), linked to milder climatic conditions, the absence of continuous permafrost, and a deeper active layer (1 - 2 m). In the central and eastern regions (**PUR**, **KHA**, **CHO**, **BIL**), larch species responded predominantly to June warmth, with the highest correlations at **PUR** (r = 0.54) and **KHA** (r = 0.43, *p <* 0.01), reflecting their adaptation to a short growing season and rapid foliage deployment. At **CHO** and **BIL**, the June effect was slightly weaker (r = 0.24 - 0.41), likely due to extreme continentality. Precipitation had a minor influence, though rare positive effects were noted at **APA** and **BIL**, possibly related to local hydrology. Sliding correlations indicated instability: at **CHO**, the temperature signal weakened after the 1980s (r < 0.20), while at **BIL** it strengthened (r = 0.55 by 2021), suggesting adaptive shifts.

The discussion highlights that species physiology shapes their climatic sensitivity. As an evergreen, *P. sylvestris* exploits a longer growing season, explaining its July response [1]. Deciduous larches depend on early summer, critical in permafrost conditions [2]. The weak precipitation effect aligns with sufficient snowmelt supply, though localized effects at **APA** and **BIL** hint at potential hydrological shifts with permafrost thaw. These differences underscore the diversity of adaptive strategies and the potential for shifts in species distribution.

The study concludes that the climatic responses of conifers in the forest - tundra vary by region and species: *P. sylvestris* is sensitive to July, while *Larix spp*. respond to June. This reflects their ecological niches and may lead to changes in competition and community structure with ongoing warming.

**Key words:** warming, coniferous species, permafrost, forest - tundra, radial growth.

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**References**

1. Vaganov E. A., Hughes M. K., Kirdyanov A. V. et al. Influence of snowfall and melt timing on tree growth in subarctic Eurasia // Nature. 1999. № 400. С. 149 - 151.
2. Kirdyanov, A.V., Prokushkin, A.S., Tabakova, M.A., 2013. Tree - ring growth of Gmelin larch under contrasting local conditions in the north of Central Siberia. Dendrochronologia, 114 - 119.
3. Overland, J.E., Wang, M., Walsh, J.E., Stroeve, J.C., 2019. Future Arctic climate changes: Adaptation and mitigation timescales. Earth’s Future 7, 111 - 123.