

# WILL THE GLOBAL CLIMATE CHANGE-INDUCED CHANGES IN THE STRUCTURE OF OUR FORESTS BRING ABOUT A SIGNIFICANT CHANGE IN THE REPRESENTATION OF ALLERGENIC TREE SPECIES?

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## Abstract

The dominant negative effect of forests, or forest trees not only for recreation in forests and their surroundings but also for the health of the population is caused by pollen allergies of some trees. In the territory of Central Europe, it is mainly hornbeam (*Carpinus betulus*), birches (*Betula sp.*), and alders, especially common alder (*Alnus glutinosa*). Climate development scenarios published by the International Panel on Climate Change (IPCC) until the year 2100 indicate that with the trend of increasing air temperature, there will be a significant change in the habitat conditions of our forests and thus probably also a change in their structure. It can be assumed that a change in the structure of forests will mean, among other things, an increase in the proportion of deciduous trees. The article indicates the possible development of the representation of allergenic tree species on the territory of the Czech Republic and the influence of this development on the recreational and health-hygienic potential of forests in the near future.

**Keywords:** Allergic tree species, recreational forest function, health-hygienic forest function

## Introduction

Climate development scenarios published by the International Panel on Climate Change (IPCC, 2021) until the year 2100 indicate that with the trend of increasing air temperature, there will be a significant change in the habitat conditions of our forests and thus probably also a change in their structure. This change will extend the growing season, which will cause long-term stress to forest trees. This stress will lead not only to functional changes in forests, such as their hydrological shift (Kupec et al., 2021), affecting their water use efficiency (Kupec et al., 2018), but also to a change in the distribution of altitudinal forests zones (AFZ) and drought (e.g. Vahalík, 2012).

In this context, significant changes can also be expected in the woody composition of forests and non-forest tree vegetation. In view of the expected increase in the proportion of lower AFZs, an increase in the proportion of woody species that are bound to these AFZs can also be expected. Because the main allergenic trees in the Czech Republic are hornbeam (*Carpinus betulus*), birches (*Betula sp.*), and alders, especially common alder (*Alnus glutinosa*), i.e. trees of lower AFZ, an increase in the proportion of these tree species can also be expected. This can negatively affect the allergen load of vacationers in the forests and the landscape as such.

## Material and methods

IPCC has published several scenarios of the changes in surface temperature until the year 2100 (IPCC, 2021), see Figure 1. Excluding the most extreme ones there is a real expectation of the surface temperature increment between 1.4 to 4.4°C until the year 2100 in Central Europe.

Current forests in the Czech Republic consist of a mix of coniferous and broadleaf tree species with slightly prevailing coniferous ones. The proportion of allergenic tree species is low in general (see Table 1 – allergenic tree species in bold).

The results presented below were obtained by modeling the changes in AFZ proportions due to changes in the average surface temperature by 1 - 3°C according to Vahalík (2012). In connection with this, conclusions were formulated for forecasting the likely spread of allergenic wood species. Valid calculation is done for the hornbeam.

Source: Summary Report on the Sixth Assessment Report of the Intergovernmental Panel on Climate Change

<b>Jehličnany</b>	<b>57,8</b>	<b>Listnáče</b>	<b>42,2</b>		
Smrk ztepilý	43,1	Buk lesní	10,5	Olše	<b>2,4</b>
Jedle bělokorá	0,9	Duby	8,2	Břízy	<b>4,2</b>
Borovice lesní	9,6	Habr obecný	<b>2,4</b>	Ostatní list. tvrdé	3,9
Modřín evropský	3,2	Javory	4,1	Ostatní list. měkké	4,9
Ostatní jehličnaté	0,9	Jasany	1,6		

Notes:	<b><i>Jehličnany</i></b>	<b><i>Coniferous</i></b>	<b><i>Listnáce</i></b>	<b><i>Broadleaf</i></b>
	Smrk ztepilý	Norway spruce	Buk lesní	Beech
	Jedle bělokorá	White fir	Duby	Oaks
	Borovice lesní	Scotch pine	Habr obecný	Hornbeam
	Modřín evrop.	European larch	Javory	Maples
	Ostatní jehl.	Other coniferous	Jasany	Ash trees
		Olše		Alders
		Břízy		Birches
	Ostatní list. tvrdé/měkké			Other broadleaves hardwoods/softwoods

- Extension of the growing season by about 3 to 4 weeks
- Mild winters (less snow, the ground does not freeze, or only a little)
- Reduced dormancy (winter rest)
- Prolongation of physiological activity in the season
- Extending the time of transpiration in the season
- Loss of available water in the soil
- Long-term stress of forest trees

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Tab. 2: Model changes in the proportion of altitudinal forest zones in CR according to different GCCH scenarios with special regard to lowland and lower upland AFZ

Altitudinal forest zone	Proportion in forests in CR (%)				Proportion in landscape in CR (%)			
	Current	+ 1°C	+ 2°C	+ 3°C	Current	+ 1°C	+ 2°C	+ 3°C
1. Oak	8.3	11.3	24.9	32.9	12.5	17.0	37.5	49.5
2. Beech-oak	14.9	24.8	16.4	21.9	15.0	25.0	16.5	22.0
3. Oak-beech	18.4	20.2	19.9	12.9	30.0	33.0	32.5	21.0
4. Beech	5.7	4.6	2.1	1.4	16.0	13.0	6.0	4.0
5. Fir-beech	30.0	11.8	7.9	4.7	19.0	7.5	5.0	3.0
6. Spruce-beech	12.0	8.0	5.3	1.3	4.5	3.0	2.0	0.5
7. Beech-spruce	5.0	3.0	1.3	0.0	2.0	1.2	0.5	0.0
8. Spruce	1.7	0.7	0.0	0.0	0.7	0.3	0.0	0.0
9. Dwarf pine	0.3	0.0	0.0	0.0	0.3	0.0	0.0	0.0
<b>1 - 4 AFZ</b>	<b>47.3</b>	<b>61.0</b>	<b>63.4</b>	<b>69.0</b>	<b>73.5</b>	<b>88.0</b>	<b>92.5</b>	<b>96.5</b>
<b>Hornbeam (%)</b>	<b>1.3</b>	<b>1.7</b>	<b>1.7</b>	<b>1.9</b>	<b>2.4</b>	<b>2.9</b>	<b>3.0</b>	<b>3.2</b>

Table 2 shows the potential dramatic increment of lowland and lower upland AFZ proportions when specific climatic scenarios come true. In hand with the changes in the AFZ proportions will come an increment of the hornbeam proportion.

### Discussion and conclusion

Climate change will certainly cause fundamental changes in the composition of the forests of the Czech Republic, or in the distribution of tree species in general (but that is for another and longer lecture). These changes will not only be in the species composition but also in the spatial structure of the forests, including geographical changes in the distribution of altitudinal forest zones. Social changes will be reflected in this change, not only in connection with the effects of GCCH.

The prediction of the development of the representation of the main allergenic tree species in connection with the impacts of GCCH in Czech forests can be as follows:

- The concept of "natural forests" will be replaced by the concept of "adapted forests".
- The representation of birch in forests will not change in the long-term time scale (2.8%)
- The representation of alder (1.7%) will probably decrease due to the general drying out of forests, the prediction of 0.6% is realistic in a horizon of about 20 years.
- The representation of hornbeam (1.3%) will probably increase as a result of the application of adapted forests, changes in the scope of LVS and as a result of its resistance to the impacts of GKZ, the total proportion may be up to 3% in the next 20 years.
- A significant change in the composition of allergenic pollen can thus be expected in about 40 years.

Outside of lands purposed for the fulfillment of forest functions, the following can be expected:

- Significant increase in the proportion of hornbeams in the so-called scattered landscape greenery up to altitudes of around 450 m above sea level (5% maybe more).
- Preservation of the proportion of alder as especially the basic type of vegetation accompanying watercourses (2.4%).
- Reduction in the proportion of birch (4.2%).

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## Souhrn

Článek se zabývá potenciální změnou proporcí zastoupení alergenních dřevin jakžto driveru negativního vlivu lesů na rekreaci, resp. zdraví obyvatelstva obecně, v důsledku změny průměrných teplot jakžto důsledek klimatické změny.

Na území střední Evropy lze za významné alergenní dřeviny považovat především habr obecný (*Carpinus betulus*), břízu (*Betula sp.*) a olše, zejména olši lepkavou (*Alnus glutinosa*). Scénáře vývoje klimatu publikované Mezinárodním panelem pro změnu klimatu (IPCC) do roku 2100 naznačují, že s trendem zvyšování teploty vzduchu dojde k výrazné změně stanovištních podmínek našich lesů a tím pravděpodobně i ke změně jejich struktury. Lze předpokládat, že změna struktury lesů bude znamenat mimo jiné i zvýšení podílu listnáčů. Článek naznačuje možný vývoj zastoupení alergenních dřevin na území ČR a vliv tohoto vývoje na rekreační a zdravotně-hygienický potenciál lesů v blízké budoucnosti v tom smyslu, že koncept „přirozených lesů“ bude nahrazen konceptem „adaptovaných lesů“, zastoupení břízy v lesích se v dlouhodobém časovém měřítku nezmění (2,8%), zastoupení olše (1,7%) se pravděpodobně sníží v důsledku obecného vysychání lesů a zastoupení habru (1,3%) pravděpodobně vzroste v důsledku aplikace adaptovaných lesů, změny rozsahu LVS a v důsledku jeho odolnosti proti dopadům GKZ. Signifikanční změnu složení alergenních pylů z lesů (PUPFLu) lze očekávat za cca 40 let. Mimo pozemky určené k plnění funkcí lesa lze očekávat výrazný nárůst proporce habru v tzv. rozptýlené krajinné zeleni, a to až do nadmořských výšek kolem 450 m n. m. (5% možná více), zachování proporce olše jako zejména základního druhu vegetačních doprovodů vodních toků (2,4 %) a snížení proporce břízy (4,2 %).

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