

Yew and juniper pollen season in the air of Poland selected cities in 2022

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Abstract:

The allergenic content of the atmosphere varies according to climate, geography and vegetation. The work compares the yew and juniper pollen seasons in Białystok, Bydgoszcz, Cracow, Piotrków Trybunalski, Szczecin, Sosnowiec, Warsaw, Wrocław and Lublin in 2022. The investigations were carried out using the volumetric method (Hirst type pollen sampler). Seasonal pollen index (SPI) was estimated as the sum of daily average pollen concentrations in the given season. The yew pollination is observed mainly in February and March, while juniper pollination is observed mainly in March and April. Due to the morphological similarity of the pollen grains of both taxa, the pollen seasons of yew and juniper are considered together. The pollen season of yew/juniper started first in Szczecin, on the February 14th. At the latest, a pollen season ended in Bydgoszcz, April 18th; while the pollen season lasted 2 days shorter in Białystok, Szczecin, Sosnowiec, Warsaw and Lublin. Only in Cracow and Wrocław the season ended exceptionally early, already at the end of March. The differences of pollen seasons duration were considerable, from 36 to 62 days. The highest airborne concentration of 460 pollen grains/m³ was noted in Wrocław on the March 13th. The maximum values of seasonal pollen count occurred between the March 13th and 24th. The highest yew and juniper pollen allergen hazard occurred in 2022 in Sosnowiec, Piotrków Trybunalski, Lublin and Wrocław. On the other hand, in Białystok and Szczecin the risk of yew and juniper allergens was exceptionally low.

Key words: allergens, pollen count, yew (*Taxus baccata*), juniper (*Juniperus* sp.), 2022

Introduction

It is considered highly probable that the climate in Europe will indeed change over the next century, magnifying the current regional differences. This is likely to be the result of global warming, as shown by

numerous climatological data. As confirmation of this phenomenon, we observe an increase in air temperature near the earth's surface and above the oceans, with a simultaneous decrease in temperature in the stratosphere; declining sea ice range in the Arctic and Antarctica; an

increase in air humidity, changes in the habits of migrating species, and above all the shifting of tree ranges towards the poles and earlier flowering of plants. The phenomenon of early flowering is observed in the following years of yew, juniper and other *Cupressaceae*, as flowering and pollinating species in late winter and early spring [1].

Another facet controlling northerly migration is the need for migrating species to be able to compete with resident species. For example, Zhu et al. [2] working in eastern N. America suggest that as climate warms, seedlings of yew should precede adult trees in the north (as the range expands) and the other way round in the south as range contracts due to loss of competitive advantage it had under cooler conditions. The shift of the yew range to the north also means an increase in the pollen concentration of this taxon in the newly inhabited areas.

The growing trend in the incidence of allergic diseases is observed in industrialized areas. Such phenomenon may be related not only to air pollution, poor quality food, changes in lifestyle, but also to an actual increase in airborne quantities of allergenic pollen as a probable effect of global warming. However, pollen allergens from yew plants is considered a minor offender in allergenicity. Despite this Japanese research proved there were significant reactions among skin-tested patients for yew pollen allergens, while cross-reactions with food were not apparent up to now for this plant group [3].

Juniper is the only native genus representing the *Cupressaceae* family growing in central Europe. This species is able to colonise poor habitats such as sandy wasteland, dunes and heath sites. *J. communis* is a pioneer species. It is found in abandoned fields and pastures, where it plays an essential role in the process of secondary succession. In Poland the main season for juniper pollen production is in April [4].

In Poland *Taxus baccata* L. is a rare species and is under protection. Yew does not tolerate frosty areas and is sensitive to wide fluctuations of temperatures, droughts and to desiccation by winter winds. It tolerates air pollution well and even withstands toxic industrial emissions. Yew is a wind-pollinated species, flowering rather abundantly. Investigations into the rate of fall of its pollen grains in still air suggest that they can remain airborne for a relatively long time. Studies of surface samples coming from a transect placed under a male specimen of *Taxus baccata* reveal that the majority of its pollen grains fall directly under the tree. Only a few have been recorded beyond the extent of its crown [5].

The threshold value for clinical symptoms for yew and juniper pollen grains in Europe, for the many of sensitised patients is visible during exposure to the concentration of 16 pollen grains in 1 m³ of air, while the clinical symptoms for the most of sensitised patients are visible during exposure to the concentration of 91 pollen grains in 1 m³ of air [6].

It is well known from aeropalino logical studies that *T. baccata* pollen showed morphological similarity to *Cupressaceae* pollen. The *Cupressaceae* family produces spheroidal, pseudoporate, anemophilous pollen grains that are small. *Taxaceae* and *Taxodiaceae* species, which are similar from a pollen morphology point of view, have also been included in the *Cupressaceae* pollen type in aerobiological studies [7].

Aim

The aim of the study was to compare the yew and juniper pollen concentrations in the air of Białystok, Bydgoszcz, Cracow, Sosnowiec, Piotrkow Trybunalski, Szczecin, Warsaw, Wrocław and Lublin in 2022, to the indication of the highest risk of pollen allergens in individual cities.

Material and method

Measurements of aeroplankton were carried out in the selected cities of Poland: Białystok, Bydgoszcz, Cracow, Sosnowiec, Piotrkow Trybunalski, Szczecin, Warsaw, Wrocław and Lublin in 2022. Measurements were performed by the volumetric method. The used devices, which are recommended by the IAA (International Association for Aerobiology), collect air samples (Burkard and Lanzoni as the Hirst type pollen sampler) in volumes corresponding to average human respiratory parameters.

The duration of the pollen season was determined by the 98% method [8], assuming that the onset and end of the season were days with recorded 1% and 99% of the annual total of pollen grains, respectively. Due to the morphological similarity of the pollen grains of yew and juniper, the pollen seasons of both taxa are considered together.

The total pollen count over this period was expressed by the SPI (seasonal pollen index).

In order to determine the risk of pollen allergens yew and juniper, the number of days was determined in which concentrations of pollen of the *Cupressaceae* family exceed the threshold values of consecutive allergy symptoms' development (tab. 1) [6].

Table 1. Characteristics of yew and juniper pollen season in 2022.

Features of pollen season/ city	Bialystok	Szczecin	Cracow	Sosnowiec	Piotrkow Trybunalski	Bydgoszcz	Warsaw	Wroclaw	Lublin
Duration of pollen season (number of days)	25 II–16 IV (51)	14 II–16 IV (62)	22 II–29 III (36)	18 II–16 IV (58)	23 II–15 IV (52)	24 II–18 IV (54)	24 II–16 IV (52)	17 II–24 III (36)	6 III–16 IV (42)
Seasonal pollen index (SPI) – total	195	335	2026	2803	2899	950	3274	2258	3004
Peak value and peak date	37 (23 III)	35 (13 III)	296 (15 III)	254 (22 III)	267 (15 III)	113 (21 III)	367 (24 III)	460 (13 III)	444 (23 III)
Days ≥ 16 g/m ³ [4]*	2	4	20	29	28	15	13	21	25
Days ≥ 91 g/m ³ [4]**	0	0	8	12	12	2	6	7	10

*Symptoms present in many patients; ** symptoms present in most patients.

Results and discussion

In Poland, yew and juniper pollination periods usually differ: the yew blooms about 3 weeks earlier than juniper. The concentration of pollen of the analyzed plants decreases markedly at the beginning of April, because yew pollination period usually ends, and in the air mainly pollen of juniper and other *Cupressaceae* occurs. The beginning of the juniper pollen season is marked in figures 1–5 with a blue arrow. Due to the morphological similarity of the pollen grains of both taxa, the pollen seasons of yew and juniper are considered together.

In different regions of the world, the pollen season of yew and juniper is recorded in different months of the year. Additionally, climate change influences the shifting of the ranges of these trees to the north, which is associated with the occurrence of new allergens in areas where they have not been recorded so far [1]. In Hokkaido, *Taxus cuspidata* (Japanese yew) usually started its flowering early April or mid-April approximately 2 weeks before the beginning of birch flowering [9]. In Mediterranean countries, the *Cupressaceae* pollen season starts in January and lasts until March [10]. In Oklahoma, Texas, and New Mexico

juniper pollen is a major allergen. While the bulk of pollen may be released in rural areas, large amounts of pollen can be transported to urban areas. Major juniper species in the region include: *Juniperus ashei*, *J. virginiana*, *J. pinchotii*, and *J. monosperma*. Pollen release is virtually continuous, beginning in late September with *J. pinchotii* and ending in May with *J. monosperma* [11]. Over many years of research in Poland, *Cupressaceae* pollen was recorded in the air from the beginning of March to the first days of May [12].

In 2022 yew/juniper pollen season started between February 14th and April 6th and lasted until mid-April. In 2007 the *Taxus/Juniperus* pollen season in most Polish cities started the earliest at the beginning of March in Wroclaw [13], i.e. 2 weeks later than in Szczecin in 2022 (tab. 1, fig. 1–5). Comparison of the onset of pollen season in Polish cities in 2009 [14] and 2022 showed a tendency towards acceleration of the beginning of the season in 2019 by about 2 weeks.

The maximum daily pollen count of yew/juniper was noted in 2022 in Wroclaw on March 13th (460 g/m³) (tab. 1, fig. 5) and the highest annual sum of *Taxus/Cupressaceae* pollen grains (SPI) was observed in

Figure 1. Yew and juniper pollen count in Bialystok and Szczecin in 2022. Blue arrow – estimated increase in pollen concentration at the beginning of April.

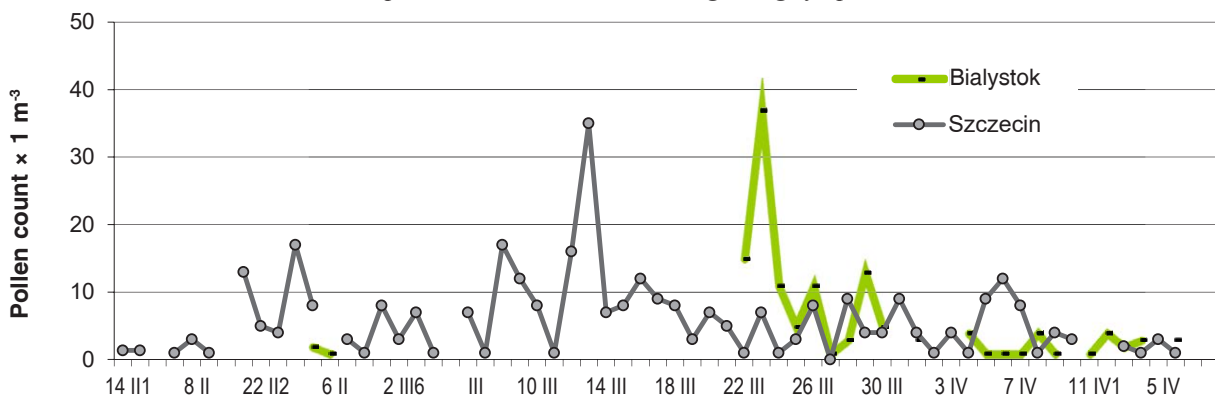


Figure 2. Yew and juniper pollen count in Cracow and Sosnowiec in 2022.

Blue arrow – estimated increase in pollen concentration only in Sosnowiec at the beginning of April.

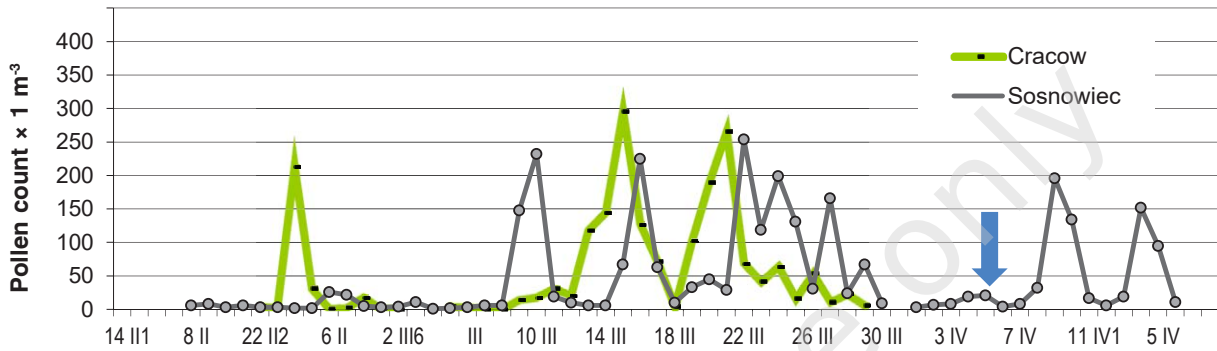


Figure 3. Yew and juniper pollen count in Piotrkow Trybunalski and Bydgoszcz in 2022.

Blue arrow – estimated increase in pollen concentration at the beginning of April.

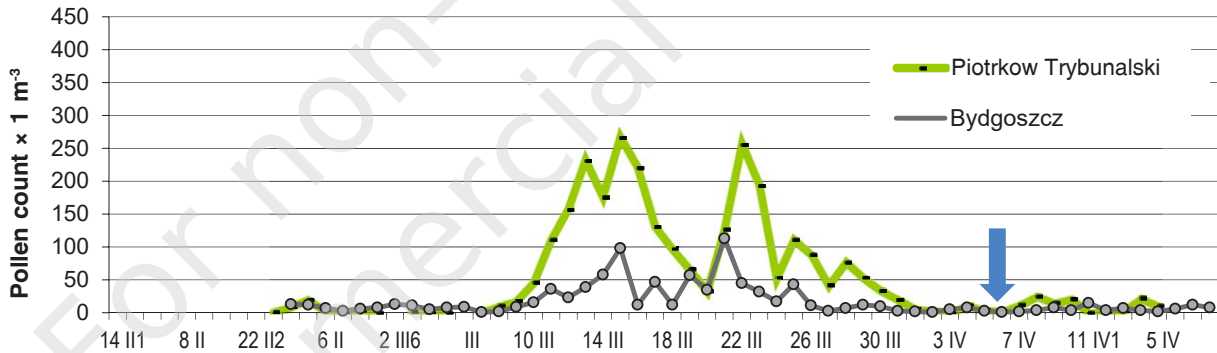


Figure 4. Yew and juniper pollen count in Warsaw in 2022.

Blue arrow – estimated increase in pollen concentration at the beginning of April.

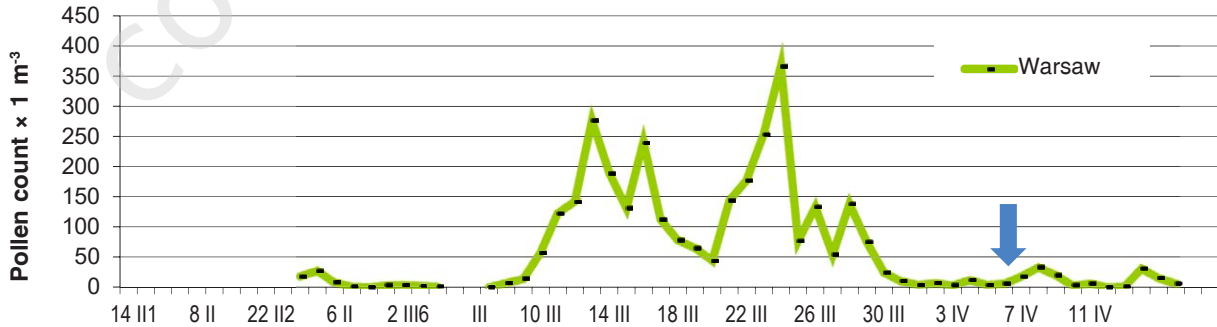
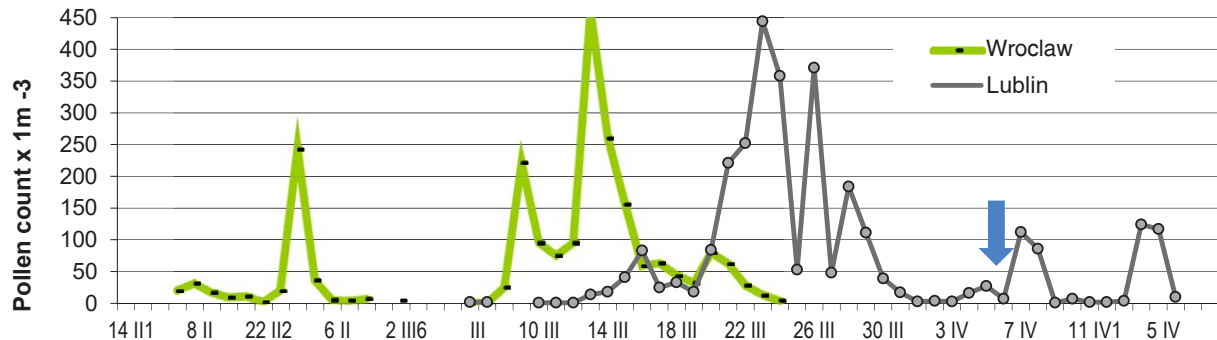


Figure 5. Yew and juniper pollen count in Wroclaw and Lublin in 2022.

Blue arrow – estimated increase in pollen concentration only in Lublin at the beginning of April.



Warsaw and Lublin; in other cities SPI value was much lower (the lowest value in Białystok SPI – 195). In 2007 the maximum daily concentration was observed March 13th in Szczecin [13], in 2009 [14] – March 31st also in Szczecin, whereas in 2020 the highest concentrations of this taxa pollen were recorded in Lublin and Wrocław [15].

The highest yew/juniper pollen allergen hazard occurred (above 91 g/m³) in 2022 in Sosnowiec and Piotrków Trybunalski – 12 days. In other cities that value ranged from 0 to 10 days. The comparison of these taxa's pollen seasons in previous years revealed that in 2007 [13] 2009 [14] pollen concentrations were much lower. In contrast, the risk of pollen allergens in 2020 and risk in 2022 [15] were similar.

Conclusions

The risk of yew and juniper pollen allergens in most of the analyzed cities in 2022 was similar. Only in Białystok and Szczecin the exposure to allergens of these taxa was exceptionally low.

The maximum values of pollen concentrations occurred in most cities at a similar time: the first peak in mid-March and the second one after a week. In contrast, there was only one peak in Białystok at the end of March, and in Wrocław the first peak occurred at the end of February and the second one in mid-March.

Yew and juniper pollen season in most cities was above 40–50 days long (only in Cracow and in Wrocław – 36 days) and was characterized by extremely different total annual pollen SPI (from 195 to 3274).

The start of *Cupressaceae* pollen season in 2022 occurred in the middle of February and lasted till the middle of April; only in Cracow and Wrocław the pollen season ended earlier, at the end of March.

Pollen monitoring in relation to the *Cupressaceae* family, despite the low allergenicity of this pollen in Poland, is very important for people coming among others from the Mediterranean region.

References

1. Thomas PA, Garcia-Martí X. Response of European yews to climate change: a review. *Forest Systems* 2015.
2. Zhu K, Woodall CW, Clark JS. Failure to migrate: lack of tree range expansion in response to climate change. *Glob Change Biol.* 2012; 18: 1042-52. <http://doi.org/10.1111/j.1365-2486.2011.02571.x>.
3. Ziello Ch, Sparks TH, Estrella N et al. Changes to Airborne Pollen Counts across Europe. *Plos One.* 2012. <http://doi.org/10.1371>.
4. Szczepanek K. Pollen calendar for Cracow (southern Poland), 1982-1991. *Aerobiologia.* 1994; 10(1): 65-70.
5. Ralska-Jasiewiczowa M, Latalowa M, Wasylukowa K et al. (ed). Late Glacial and Holocene history of vegetation in Poland based on isopollen maps. *Polish Academy of Sciences* 2004, Cracow.
6. Burge HA. Monitoring for airborne allergens. *Ann Allergy.* 1992; 69: 9-21.
7. Vanhaelen M, Duchateau J, Vanhaelen-Fastré R et al. Taxanes in *Taxus baccata* pollen: cardiotoxicity and/or allergenicity? *Planta Med.* 2002; 68(1):36-40. <http://doi.org/10.1055/s-2002-19865>.
8. Emberlin J, Savage M, Woodman R. Annual variations in the concentrations of *Betula* pollen in the London area 1961–1990. *Grana.* 1993; 32: 359-63. <http://doi.org/10.1080/00173139309428965>.
9. Maguchi S, Fukuda S. *Taxus cuspidata* (Japanese yew) pollen nasal allergy. *Auris Nasus Larynx* 2001; 43-7. [http://doi.org/10.1016/S0385-8146\(01\)00062-1](http://doi.org/10.1016/S0385-8146(01)00062-1).
10. D'Amato G, Spiekma FThM, Bonini S (ed). *Allergenic Pollen and Pollinosis in Europe 1991*, Blackwell Scientific Publ.
11. Bunderson L, Luvall J, Water P et al. Juniper Pollen Hotspots in the Southwest. *J Allergy Clin Immunol.* 2013; 131: 2. <http://doi.org/10.1016/j.jaci.2012.12.954>.
12. Weryszko-Chmielewska E (ed). *Pylek roślin w aeroplanktonie różnych regionów Polski. Lublin, Wyd. Wydziału Farmaceutycznego Akademii Med.* 2006.
13. Kalinowska E, Lipiec A, Puc M et al. Analiza stężenia pyłku cisu/jałowca w wybranych miastach Polski w 2007 r. *Alergoprofil.* 2007; 3(3): 55-60.
14. Puc M, Myszkowska D, Lipiec A et al. Pylek cisa i jałowca w powietrzu wybranych miast Polski w roku 2009 r. Wpływ warunków pogodowych i zanieczyszczenia powietrza. *Alergoprofil.* 2009; 5(2): 38-43.
15. Dąbrowska-Zapart K, Chłopek K, Puc M et al. Yew and juniper pollen season in selected cities of Poland in 2020. *Alergoprofil.* 2020; 16(4): 10-4.

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