

# The oak pollen concentration in the air of selected cities in Poland in 2018

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**Abstract:** This paper contains an analysis of oak pollen seasons in selected cities of Poland in 2018. Sampling sites were located in the following cities: Białystok, Bydgoszcz, Cracow, Drawsko Pomorskie, Lublin, Olsztyn, Opole, Piotrków Trybunalski, Sosnowiec, Szczecin, Warsaw, Wrocław and Zielona Góra.

The volumetric method was applied using the Burkard or Lanzoni trap. The pollen season was determined by the 98% method. The season started earliest in Sosnowiec (April 14<sup>th</sup>). The mean duration of the pollen season was 33 days. The highest pollen concentration (713 P/m<sup>3</sup>) was observed in Wrocław (April 19<sup>th</sup>). The peak values were recorded between April 19<sup>th</sup> and May 1<sup>st</sup> in the different cities.

**Key words:** aeroallergens, pollen concentration, oak (*Quercus*), 2018

The oak (*Quercus*) genus belongs to the family Fagaceae and it comprises about 600 species that are found almost exclusively in the Northern Hemisphere [1]. In Poland only 3 species grow in the wild: pedunculate oak (*Quercus robur* L.), sessile oak (*Quercus petraea* [Matt.] Liebl.), and pubescent oak (*Quercus pubescens* Willd.), as well as a hybrid of the former two species (*Quercus* × *rosacea* Bechst.)

[1, 2]. Due to their longevity, up to 1000 years and more, *Q. robur* and *Q. petraea* often constitute the core of forest stands. Ornamental varieties of the above mentioned species, with various leaf forms and colors, are also used in park planting. The northern red oak (*Q. rubra* L.) is the most frequently planted species of foreign origin (from Northern America); it grows faster than other oaks and is very resistant to frost

and air pollution [1]. In total, about 40 oak species are grown in Poland, among which the most important ones are mentioned above [2, 3].

Oak pollen grains are among 12 most allergenic pollen types [4]. Rapiejko [5] reports that for most sensitized patients, clinical symptoms are visible during exposure to a concentration of ca. 80 oak pollen grains in 1 m<sup>3</sup> of air.

According to Burge [6], in the case of *Quercus* pollen grains the threshold value is a concentration of 16 pollen grains in 1 m<sup>3</sup> of air, at which clinical symptoms occur in many sensitized patients exposed to this concentration, while for most sensitized patients clinical symptoms are visible during exposure to a concentration of 91 pollen grains in 1 m<sup>3</sup> of air.

**Aim**

The aim of the study was to compare the oak pollen season in 13 monitoring sites in Poland: Białystok, Bydgoszcz, Cracow, Drawsko Pomorskie, Lublin, Olsztyn, Opole, Piotrkow Trybunalski, Sosnowiec, Szczecin, Warsaw, Wrocław and Zielona Gora.

**Material and method**

Measurement of the concentration of oak pollen grains in atmospheric air was performed by the volumetric method using Burkard or Lanzoni pollen samplers. 24-hour periods were analyzed in microscopic slides. The pollen season duration was determined by the 98% method. Pollen season start and end dates, pollen grains sum during the season expressed by the SPI (Seasonal Pollen Index), maximum pollen con-

centration, peak date and number of days with the oak pollen concentration exceeding the threshold value at which the consecutive allergy symptoms develop (according to Burge) [6] were determined.

**Results and discussion**

In 2018 the oak pollen season started in the studied cities between April 12<sup>th</sup> and April 21<sup>st</sup>, earliest in Sosnowiec (tab. 1). In 6 cities, the onset of the season occurred 6–16 days later than in 2017, while in 5 cities at dates similar to those in the previous year [7]. The average duration of the oak pollen season at the investigated monitoring sites was 33 days in 2018 (tab. 1), while in 2017 it was 44 days [7]. In 2018 the end of the oak pollen season occurred between May 13<sup>th</sup> and May 26<sup>th</sup>. The highest seasonal pollen count (SPI) for oak was recorded in Lublin, followed by Wrocław (tab. 1). The next values of this parameter, very similar, were observed in Warsaw and Piotrkow Trybunalski, followed by Opole, Zielona Gora and Olsztyn. The least oak pollen was observed in Białystok (tab. 1). The average SPI in 2018 was 1816 pollen grains, whereas in 2017 it was 1363 [7].

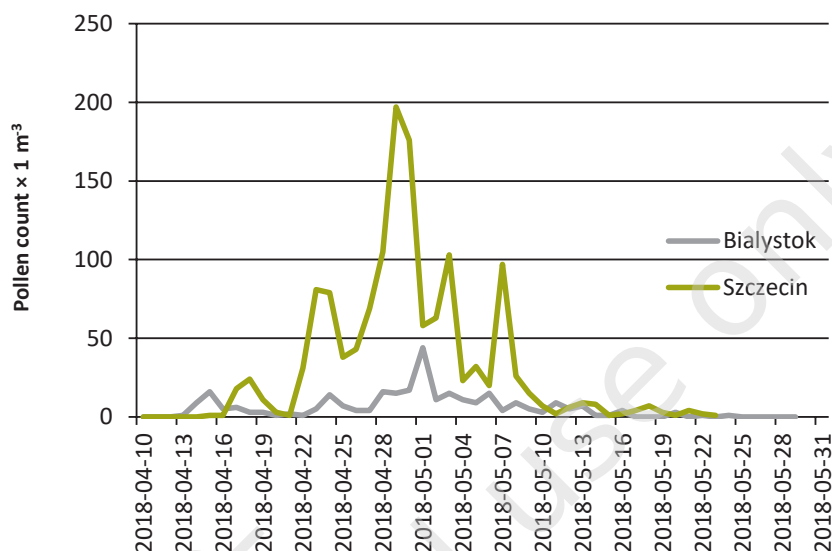
The pattern of oak pollen seasons in the individual cities is illustrated by curves characterized by the presence of several peaks, which indicates that flowering and pollen shed of different oak taxa occurred at different times (figs 1–6). Because flowering of the most frequently found oak species in Poland, the pedunculate oak, occurs about 2 weeks earlier than that of the sessile oak [3, 8], in the graphs this corresponds to the first peak, which is most often higher than the next peaks (figs 2, 3, 5, 6). The multiple peak curves

**Table 1.** Characteristics of oak pollen season in 2018.

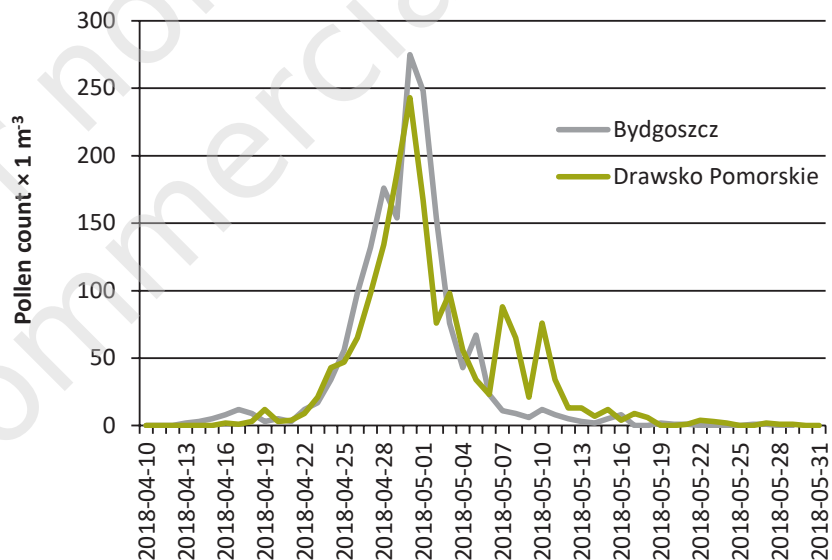
Features of pollen season	Białystok	Bydgoszcz	Cracow	Drawsko Pomorskie	Lublin	Olsztyn	Opole	Piotrkow Trybunalski	Sosnowiec	Szczecin	Warsaw	Wrocław	Zielona Gora
Duration of pollen season (number of days)	14.04–22.05 (39)	16.04–16.05 (31)	18.04–14.05 (27)	19.04–22.05 (34)	20.04–17.05 (28)	17.04–18.05 (32)	16.04–26.05 (41)	19.04–19.05 (31)	12.04–20.05 (39)	17.04–18.05 (32)	21.04–19.05 (29)	15.04–13.05 (29)	15.04–19.05 (35)
Seasonal Pollen Index	285	1674	1794	1673	4488	2137	2181	2865	930	1359	2728	3808	2120
Peak value and peak date	44 (1.05)	275 (30.04)	396 (21.04)	243 (30.04)	581 (22.04)	275 (25.04)	354 (21.04)	287 (29.04)	207 (21.04)	197 (29.04)	378 (25.04)	713 (19.04)	342 (25.04)
Days ≥ 16 P/m <sup>3</sup> * [4]	4	7	10	13	10	9	8	6	12	14	8	12	10
Days ≥ 91 P/m <sup>3</sup> ** [4]	0	7	6	6	14	9	8	14	3	5	12	9	8

\* Symptoms present in many patients.  
\*\* Symptoms present in most patients.

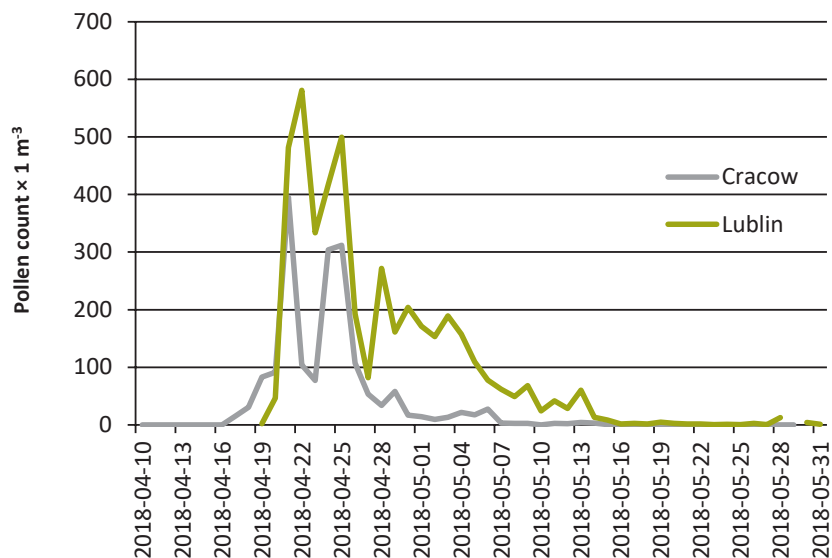
**Figure 1.** Oak pollen count in Białystok and Szczecin in 2018.



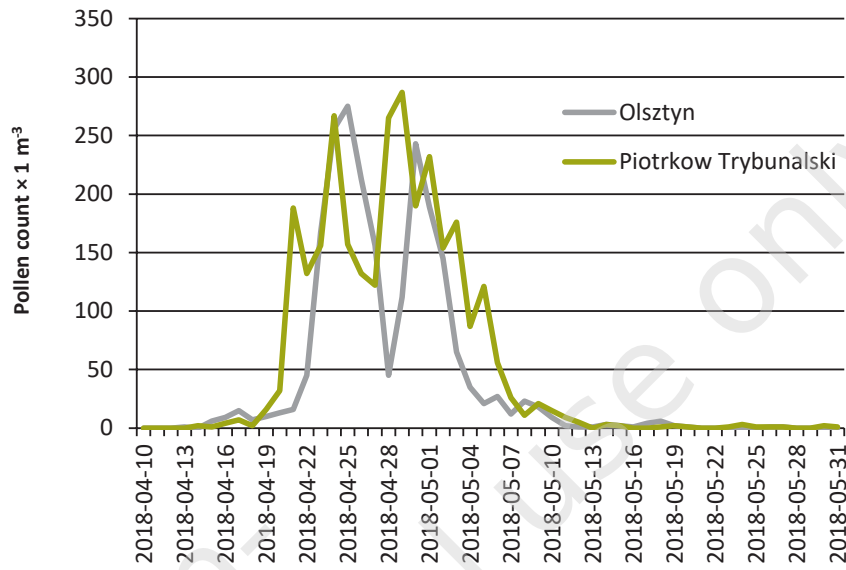
**Figure 2.** Oak pollen count in Bydgoszcz and Drawsko Pomorskie in 2018.



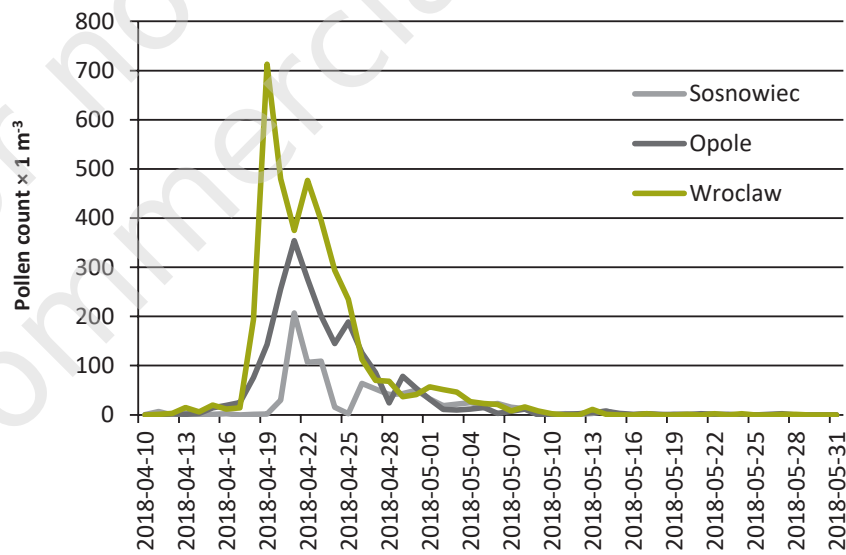
**Figure 3.** Oak pollen count in Cracow and Lublin in 2018.



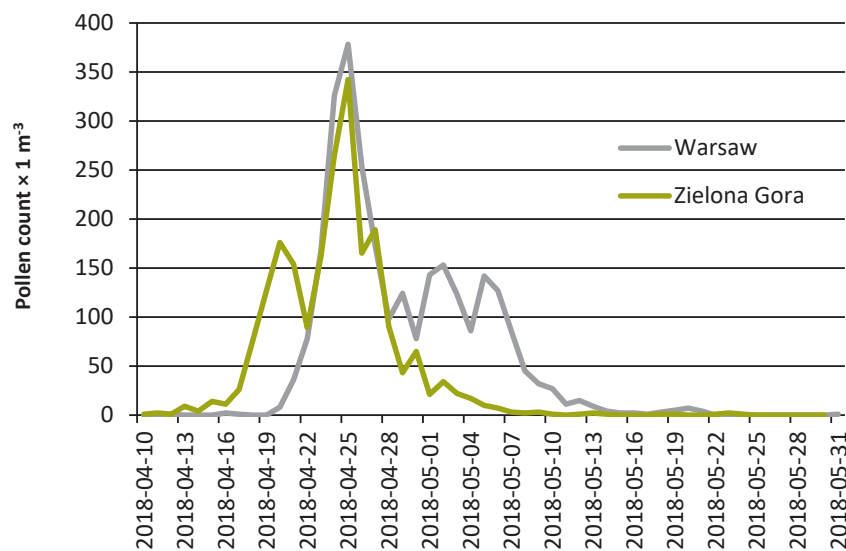
**Figure 4.** Oak pollen count in Olsztyn and Piotrkow Trybunalski in 2018.



**Figure 5.** Oak pollen count in Sosnowiec, Opole and Wroclaw in 2018.



**Figure 6.** Oak pollen count in Warsaw and Zielona Gora in 2018.



illustrating the pattern of oak pollen seasons in some cities (Lublin, Szczecin, Warsaw) confirm the occurrence of several oak species in urban green spaces and at the outskirts of the cities, as reported by Puc et al. [7] for Szczecin, as well as by Adamiec and Trzaskowska [9] for Lublin.

The highest daily pollen count of *Quercus* was recorded in 2018 on April 19<sup>th</sup> in Wrocław, followed by Lublin on April 22<sup>nd</sup>, while the lowest value of this trait was found in Białystok on May 1<sup>st</sup> (tab. 1).

The highest *Quercus* pollen risk (above 91 P/m<sup>3</sup>/24 h) occurred in Lublin and Piotrków Trybunalski (14 days) as well as in Warsaw (12 days). In the other cities this value was 0–9 days (tab. 1). For most of the cities these are higher values than those recorded in 2017 [7].

### Conclusions

1. In 2018 the oak pollen season started in the second 10 days of April in most of the cities. The pollen season duration at the investigated monitoring sites was 27–41 days (on average 33 days).
2. In 2018 the average seasonal oak pollen count (SPI) for the investigated monitoring sites was 1816 pollen grains and was higher than the average in 2017. The highest SPI and peak value were found in Lublin and Wrocław.
3. The highest oak pollen allergen risk occurred in Lublin, Piotrków Trybunalski and Warsaw.

### References

1. Seneta W, Dolatowski J. *Dendrologia*. Wydawnictwo Naukowe PWN, Warszawa 2007.

2. Szwejkowska A, Szwejkowski J. *Słownik botaniczny*. Wiedza Powszechna, Warszawa 2003.
3. Rutkowski L. *Klucz do oznaczania roślin naczyniowych Polski niżowej*. Wyd. Naukowe PWN, Warszawa 2004.
4. Skjøth CA, Šikoparija B, Jäger S and EAN-Network. *Pollen sources*. In: Sofiev M, Bergmann K-Ch (eds). *Allergenic Pollen*. Springer, Dordrecht, Heidelberg, New York, London 2013.
5. Rapięko P. *Alergeny pyłku dębu*. *Alergoprofil* 2007, 3(3): 34–38.
6. Burge HA. *Monitoring for airborne allergens*. *Ann Allergy* 1992, 9: 9–21.
7. Puc M, Myszkowska D, Chłopek K et al. *Oak pollen in the air of Poland in 2017*. *Alergoprofil* 2017, 13(3): 124–128.
8. Rapięko P. *Alergeny pyłku roślin*. Medical Education, Warszawa 2012.
9. Adamiec P, Trzaskowska E. *Diagnoza stanu i walorów parków miejskich Lublina oraz wytyczne do ich kształtowania*. *Teka Kom Arch Urb Stud Krajobr – OL PAN* 2012, VIII/1: 7–18.

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Sulborska A: 30%; Weryszko-Chmielewska E: 5%; Piotrowska-Weryszko K: 5%; and other Authors: 3.1% each.

Conflict of interests:

The authors declare that they have no competing interests.

Ethics:

The contents presented in this paper are compatible with the rules of the Declaration of Helsinki, EU directives and standardized requirements for medical journals.

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