The analysis of Betula pollen season in Poland in 2019

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Abstract:
The aim of this study was to compare *Betula* pollen seasons in 2019 in 12 cities located in different regions of Poland. Pollen monitoring was conducted in Bialystok, Bydgoszcz, Cracow, Lublin, Olsztyn, Opole, Piotrkow Trybunalski, Sosnowiec, Szczecin, Warsaw, Wroclaw, and Zielona Gora. Airborne pollen was monitored by the volumetric method using Burkard or Lanzoni pollen samplers. Pollen season length was determined by the 98% method. The pollen season start date was recorded earliest in Wroclaw and Zielona Gora, and latest in Bialystok. The highest *Betula* pollen concentration values were found in Lublin, whereas the lowest ones in Bialystok. In most of the cities, the maximum daily *Betula* pollen concentration was recorded on April 19th or 20th. Exceptionally, in Wroclaw the peak value occurred on April 8th, while in Bialystok as late as April 29th. The annual pollen sum reached the highest values in Warsaw and the lowest ones in Bialystok. The highest risk of allergy in people sensitive to the pollen of this taxon was found in Bydgoszcz, Zielona Gora, Szczecin, Opole, and Warsaw.

Key words: aeroallergens, pollen concentration, risk of allergy, birch, 2019

The range of trees of the genus *Betula* is limited to the Northern Hemisphere where they are predominantly found in the temperate and cold zones. In Poland *B. pendula* and *B. pubescens* are the most common [1]. *Betula* pollen grains are recorded across almost the whole of Europe, from Scandinavia to central Spain and Italy. The highest pollen concentrations of this taxon are reported in the Boreal region, among others in Latvia, Finland, and Poland. The average seasonal pollen index (SPI) for *Betula* calculated based on data from several hundred pollen monitoring sites in Europe reached a value 32 708 [2]. On the other hand, the total annual birch pollen sums, calculated as means from five years (2001–2005) for six Polish cities (Cracow, Lublin, Poznan, Szczecin, Sosnowiec, and Rzeszow) were 4665–14 551. The highest average values were recorded in Lublin, where during this period the maximum annual count was found in 2003 and it was 34 134 pollen grains [3].

Betula pollen dispersion is most frequently considered at the regional scale of about 100 or 120 km [4, 5]. However, we need to take into account the fact

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that only the fraction of emitted pollen remains as the „regional component" [6]. *Betula* pollen grains are easily carried by air currents for large distances due to their small size, which is 19–22 µm [7]. Long-range transport of *Betula* pollen from East to West Europe and in the opposite direction has been recorded many times. Skjøth et al. [8] report about episodes of *Betula* pollen transport from Poland and Germany to Denmark. Pollen from Russia has been recorded in Finland [9], while pollen from Latvia, Sweden, Denmark, Belarus, Ukraine, Moldova, Germany, and Poland has been found in Lithuania [10].

Betula pollen allergens are one of the most common causes of pollen allergy in Poland [4]. Research demonstrates that in Poland 28% of patients exhibit sensitization to birch pollen [11]. Because it has been found that there is a linear statistically significant relationship between airborne pollen concentration and clinical allergy symptoms [12], it is very important to continually monitor the pollen content in the aerosol at many monitoring sites.

Aim

The aim of this study was to compare birch pollen seasons in 2019 in selected cities of Poland.

Material and method

In 2019 monitoring of airborne birch pollen was carried out in Bialystok, Bydgoszcz, Cracow, Lublin, Olsztyn, Opole, Piotrkow Trybunalski, Sosnowiec, Szczecin, Warsaw, Wroclaw, and Zielona Gora. Airborne pollen concentrations were investigated by the volumetric method using Burkard or Lanzoni pollen samplers. Microscopic observations were performed on slides obtained in a 7-day cycle with assessment of 24-hour periods. Pollen concentrations were expressed as the number of pollen grains in 1 m^3 of air per day (P/m^3). Season start and end dates, maximum pollen concentrations, and annual pollen sums were determined. The length of birch pollen seasons was determined by the 98% method. The start and end of the season were defined as the date when 1% and 99% of the seasonal cumulative pollen count was trapped, respectively. The number of days on which the threshold values were recorded, at which the first allergy symptoms occur in people sensitized to birch pollen (20 P/m^3) and symptoms in all allergic patients (75 P/m^3) [13], was calculated for each of the cities. The study results are presented in graphs and shown in a table (figs 1–6, tab. 1).

Results

In most of the cities, the birch pollen season in 2019 started in the first or second week of April (tab. 1). The earliest pollen season start was recorded in Wroclaw and Zielona Gora (April 3rd), whereas the latest one in Bialystok (April 18th). The end of the birch pollen season was observed between May 1st and May 10th (tab. 1). Maximum daily pollen concentra-

Table 1. *Characteristics of Betula pollen season in 2019.*

Site	Pollen season period by the 98% method	Peak value [P/m^3]	Peak date	Days number with concentration above threshold		Annual pollen sum
				20 P/m^3	75 P/m^3	
Bialystok	18.04–10.05	1033	29.04	20	15	7591
Bydgoszcz	8.04–6.05	2980	20.04	36	29	23 538
Cracow	5.04–1.05	2911	20.04	27	21	17 107
Lublin	9.04–2.05	6292	19.04	29	21	27 727
Olsztyn	9.04–6.05	3198	20.04	30	23	23 747
Opole	4.04–1.05	2897	19.04	30	26	21 296
Piotrkow Trybunalski	4.04–3.05	3974	19.04	32	25	29 596
Sosnowiec	8.04–2.05	1894	19.04	23	20	10 460
Szczecin	4.04–3.05	1971	20.04	32	27	18 139
Warsaw	7.04–2.05	4637	19.04	34	26	32 163
Wroclaw	3.04–1.05	2923	8.04	30	25	22 343
Zielona Gora	3.04–1.05	3268	19.04	34	27	27 256

Figure 1. *Birch pollen concentration in Bialystok and Olsztyn in 2019.*

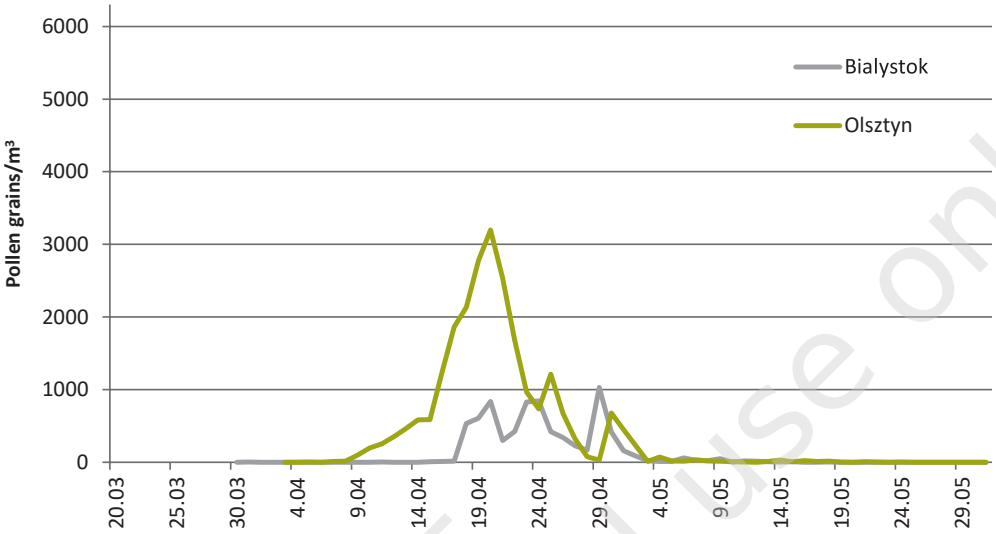


Figure 2. *Birch pollen concentration in Cracow and Lublin in 2019.*

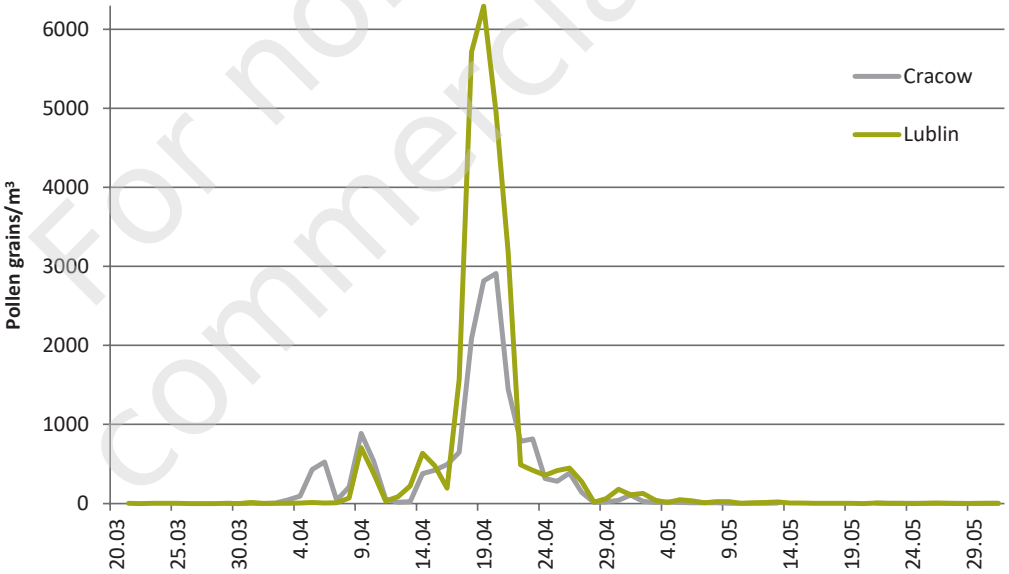


Figure 3. *Birch pollen concentration in Piotrkow Trybunalski and Warsaw in 2019.*

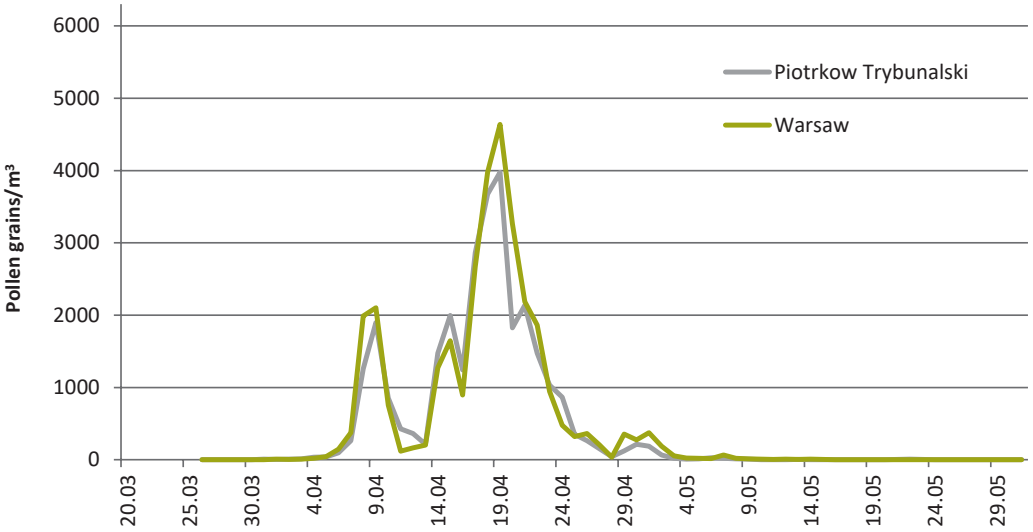


Figure 4. *Birch pollen concentration in Bydgoszcz and Sosnowiec in 2019.*

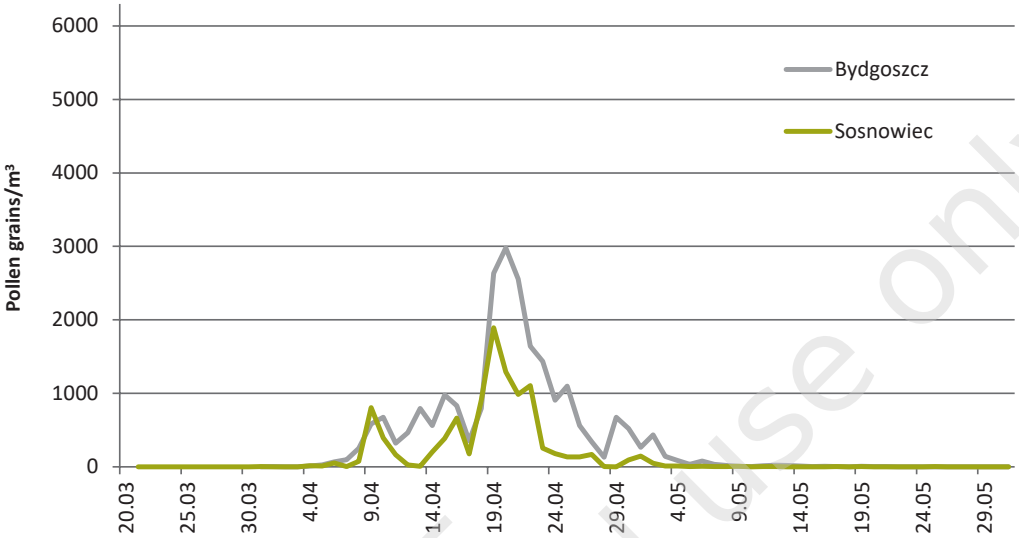


Figure 5. *Birch pollen concentration in Opole and Zielona Gora in 2019.*

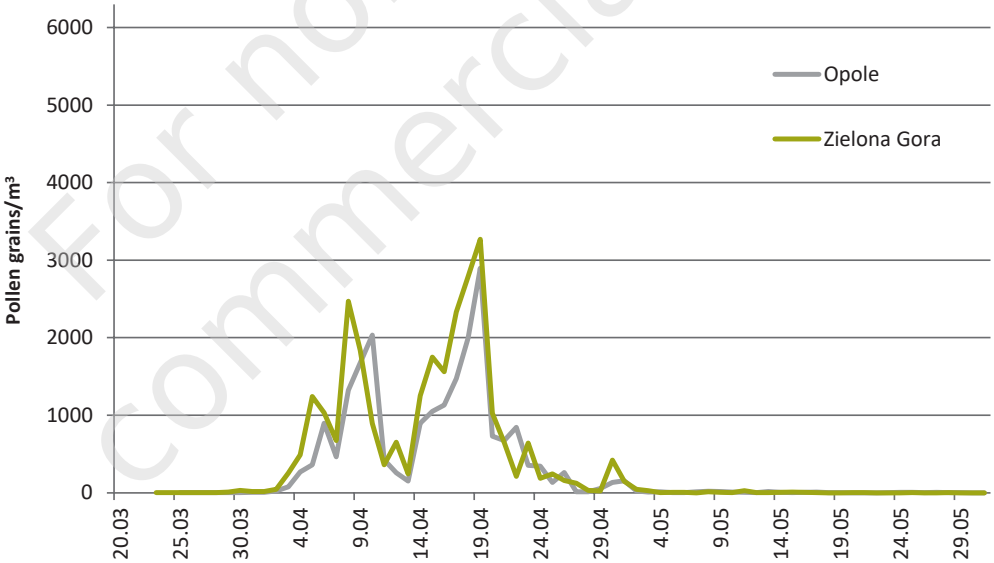
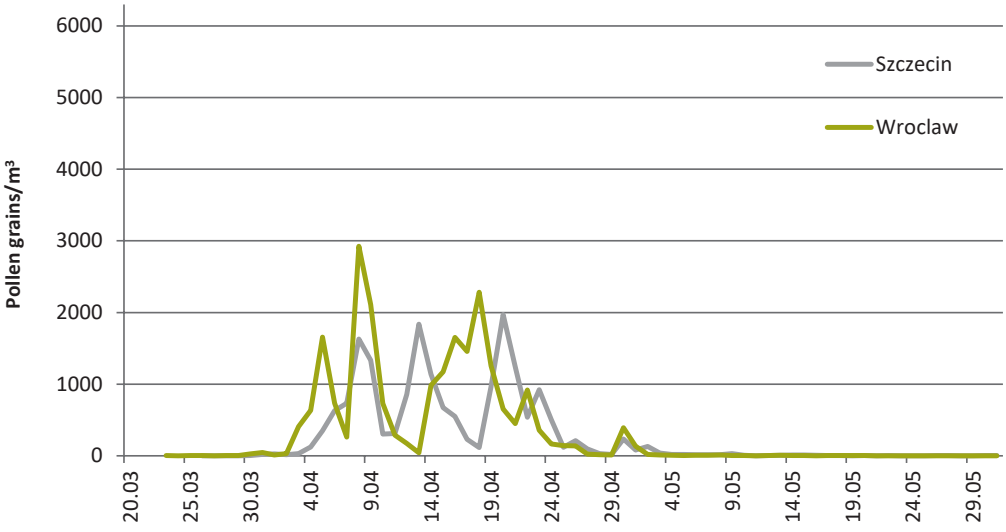


Figure 6. *Birch pollen concentration in Szczecin and Wroclaw in 2019.*



tions ranged between 1033 P/m^3 and 6292 P/m^3, with the highest ones recorded in Lublin and the lowest ones in Bialystok. Our study reveals that in most of the cities the dates of maximum pollen concentration occurred at a similar date, April 19th or 20th (tab. 1, figs 1–6). It was only in Wroclaw that the seasonal peak was observed on April 8th, while in Bialystok on April 29th. The risk of pollen allergy due to the persistence of pollen concentrations above 20 P/m^3 was highest in Bydgoszcz (36 days), followed by Zielona Gora and Warsaw (34 days), Piotrkow Trybunalski and Szczecin (32 days). A very high pollen concentration of this taxon (above 75 P/m^3) was recorded longest in Bydgoszcz (29 days), Zielona Gora and Szczecin (27 days), Opole and Warsaw (26 days). Pollen concentrations exceeding 75 P/m^3 occurred earliest (since April 3rd) in the south-western part of Poland (Zielona Gora, Wroclaw, Opole), and then in Szczecin and Cracow (since April 4th). High airborne pollen concentrations were recorded latest in eastern Poland: in Bialystok (since April 18th) as well as in Lublin and Olsztyn (since April 9th). The annual birch pollen sum was highest in Warsaw (32 163 pollen grains), whereas it was lowest in Bialystok (7591 pollen grains). A relatively high pollen count was also recorded in Piotrkow Trybunalski (29 596 pollen grains), Lublin (27 727 pollen grains), and Zielona Gora (27 256 pollen grains).

Discussion

The presented data show that there was high spatial variability in the *Betula* annual pollen sum (7591–32 163) in Poland in 2019, which had also been found in the previous years [14–16]. In 2019 birch pollen abundance reached relatively high values at individual monitoring sites. This is evidenced by the average annual *Betula* pollen sums for the years 2016, 2017 [15, 17], and 2019 calculated for six cities (Cracow, Lublin, Opole, Sosnowiec, Wroclaw, Zielona Gora), which are respectively 22 502, 8080, and 21 031.

Long-term research has produced results showing that Lublin is one of the cities where *Betula* pollen reaches the highest concentrations in Poland [3, 14]. The years 2016, 2014, and 2003 were particularly favorable for this taxon's pollen production in Lublin since the recorded annual counts were respectively 37 532, 34 631 and 34 134 [3, 17]. These values exceed the average pollen sum calculated for several hundred monitoring sites in Europe, which is 32 708 [2].

On the other hand, the average annual *Betula* pollen sum calculated for Lublin based on the 2001–2014 study period was 15 932 [14], which is a value almost twice lower than the annual birch pollen sum determined for this city in 2019 (27 727).

Wroclaw and Szczecin are the cities where the *Betula* pollen season started earliest in 2019 (April 3rd and April 4th, respectively). The average start dates of the birch pollen season in these cities calculated for the period 2001–2014 fell later, notably on April 10th, but at the same time it was the earliest pollen season start date for this taxon among eight Poland's cities compared [14].

At most monitoring sites, the number of days with the birch pollen concentration exceeding 75 P/m^3 ranged 20–29 in 2019, similarly as in the year 2016 which was also characterized by high birch pollen production and in which the number of such days was 23–28 [17].

Conclusions

In 2019 the birch pollen season started earliest in south-western Poland and latest in north-eastern Poland.

Pollen concentrations triggering allergic reactions in all pollen sensitive people occurred since April 3rd–9th, while only in Bialystok since April 18th.

The highest peak values were observed in Lublin, similarly as in the previous years.

The greatest risk of *Betula* pollen allergy, associated with the largest number of days on which more than 75 P/m^3 were recorded, was found in Bydgoszcz (29 days), Zielona Gora and Szczecin (27 days), Opole and Warsaw (26 days).

Birch pollen abundance in Poland in 2019 was at a relatively similar level to that recorded in 2016.

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