

COMPARISON OF TWO AEROBIOLOGICAL STATIONS DATA IN ZONGULDAK

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ABSTRACT. In this study, data from two Durham sampler placed at different altitude in Zonguldak city (Incivez station, 60m) center and near Kozlu district, (Kozlu station, 190m) was compared by using different statistical approaches. Spearman's rank correlation test and the Kolmogorov-Smirnov test were used for comparing data and its distribution. Mann-Whitney U test was used for comparison of groups. It was seen that pollen of arboreal taxa were dominant in Incivez station than Kozlu station. With it was observed differences in pollen of non-arboreal taxa especially in Solanum pollen between station in the result of correlation test and the comparing of distribution. Besides that some differences were also found in pollen of members of some Fagales order between stations in the result of comparison of groups. Although the differences determined between station in this study was higher than other studies in the literature, degree of this was not higher enough considering hilly topography of Zonguldak city.

1. INTRODUCTION

The relationship between pollen and allergy is a well-defined phenomenon. Similarly there is a close relationship between pollen concentration in the atmosphere and vegetation of study area. Pollen dispersion is affected by many factors such as meteorological and geographical factor. Therefore it was reported that a significant differences between pollen concentrations over years in many aerobiological stations [1]. While in many cases, pollen concentration tended to be higher due to global climate changes [2], sometimes pollen concentration getting lower because of urbanization [3]. In any case, aerobiological studies is very valuable for monitoring allergenic pollen and spore types. Therefore in many part of world pollen and spore monitoring studies have been done for long time. Early studies focused on determining of pollen and spore concentrations of city centers. Whereas recent studies have focused on placed where tourism activities is high. On the other hand, it was shown that pollen concentration obtained has been highly affected by the place of sampler. Xiao et. al showed that the number of pollen trapped and its concentration were decreasing with increasing height [4]. Actually

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investigation of relationship between pollen concentration and height of places which sampler placed is not newly topic. Raynor *et al.* emphasized that concentration of *Ambrosia* pollen showed great variation from day to day in slides from samplers which placed at 5 levels (1.5 to 108m) [5]. The differences in pollen profile associated with height of site on which sampler were even obtained in the lower heights. Data from six different rotorod samplers that were placed one meter spaced revealed that pollen of herb/shrub were dominant at lower heights [6].

The geographical properties of place in which aerobiological station is placed is also important for collecting airborne especially transported pollen. It was shown that Zonguldak city center is protected from pollen and allergen transported from the south of Zonguldak by hills that lay behind Zonguldak [7]. Therefore, data of two aerobiological stations in Zonguldak were compared using different statistical approach in this study, in order to demonstrate of effect of elevation changes.

2. MATERIALS AND METHODS

2.1. Study area

Zonguldak which places in Western Black Sea region of Turkey is mainly characterized by vegetation mainly composed of deciduous forests. It was reported that broad-leafed trees such as *Fagus orientalis* (Oriental Beech), *Quercus* (Oak), *Carpinus betulus* (Hornbeam), *C. orientalis* (Oriental Beam), *Castanea sativa* (Chestnut), *Platanus orientalis* (Oriental Plane), *Tilia tomentosa* (Silver Lime), *Alnus glutinosa* (Common Alder), *Corylus colurna* (Turkish Hazel) and *Ostrya carpinifolia* (Hop Hornbeam) are dominant in Zonguldak [8]. So vegetation of Zonguldak are considered a Mediterranean, Euxin vegetation. Climate of Zonguldak is oceanic and average annual rainfall is 1040.5 mm and annual average temperature is 13.6 °C from data obtained from the Turkish State Meteorological Service.

2.2. Pollen Sampling

In this study, data from two aerobiological stations which is equipped with a gravimetric Durham sampler were used. One of them was placed on the roof of an office in Zonguldak Bulent Ecevit University

campus (Incivez station). The other was placed on the roof of civilian building in Kozlu district (Kozlu station). Both sampler were placed approximately at height of

10m. Air distance between samplers was about 2.5km. Elevation of Incivez and Kozlu stations was about 90 and 160m respectively (Figure 1). The slides were changed weekly during 2003 and then were covered with glycerine-gelatine mixed with safranin, before microscopic analysis. Pollen concentrations were obtained by full area counting of slides and converting pollen/cm².

2.3. Statistical Analysis

In order to compare pollen concentration from two aerobiological stations, it was followed the approach defined by Del Mar Trigo et al. [9]. Spearman rank-correlation test was used to determine correlation between stations. the Kolmogorov-Smirnov test was used for determine whether pollen concentration distributed normally or not, besides comparing distribution of weekly pollen concentration. The pollen distributions were also compared by using non-parametric Mann-Whitney U test. All tests was carried out using custom web interface prepared by a python Microframework Flask and SciPy python package [10].



FIGURE 1. Location of aerobiological stations.

3. RESULTS AND DISCUSSION

Total 45 taxa of which 25 of this are arboreal were identified. Annual pollen index was 3246.2 and 2941.6 for Incivez and Kozlu stations respectively from 45 taxa. While 52% of total pollen concentration in this study was obtained from the Incivez station, the rest was obtained from the Kozlu station. There was slight difference in percentages of pollen of arboreal plants between stations. 91% of total pollen concentration consisted of tree and shrub pollen in Incivez, whereas the rate was 86% in the Kozlu station (Figure 2).

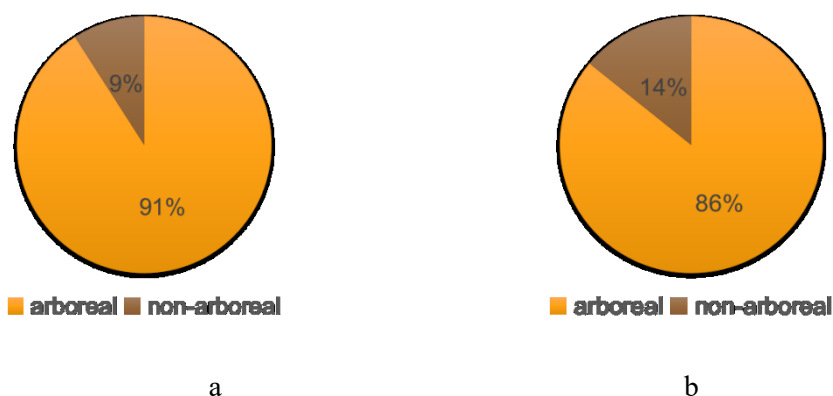


FIGURE 2. Distribution of arboreal and non-arboreal pollen according to stations. a. Incivez station, b. Kozlu station.

Top five arboreal taxa whose contribution of their pollen was highest to total pollen load in the atmosphere were Pinaceae, *Populus*, *Quercus*, *Corylus* and *Fagus* for in Incivez station and Pinaceae *Quercus*, *Betula*, *Corylus* and *Juglans* in Kozlu station. On the other hand, more similar pattern was determined for non-arboreal pollen (Table 1).

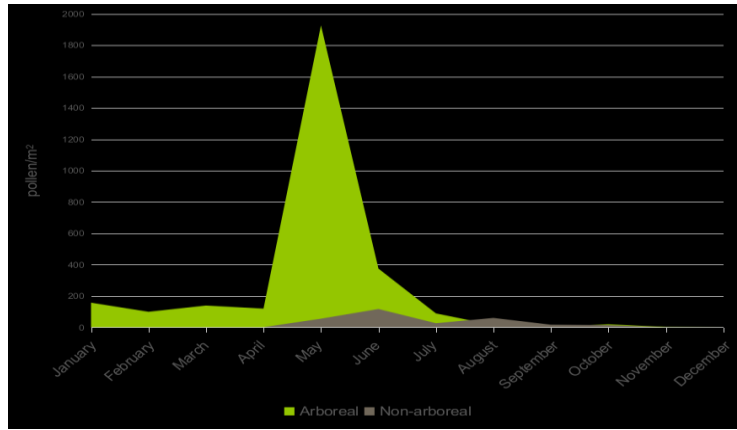
The month in which highest total and arboreal pollen concentration recorded was May in both stations. However while highest pollen concentration belonging to non-arboreal taxa was recorded in June in Incivez station, it was recorded in August in Kozlu station (Figure 3).

TABLE 1. Annual pollen indexes of top five arboreal and non-arboreal taxa in two stations.

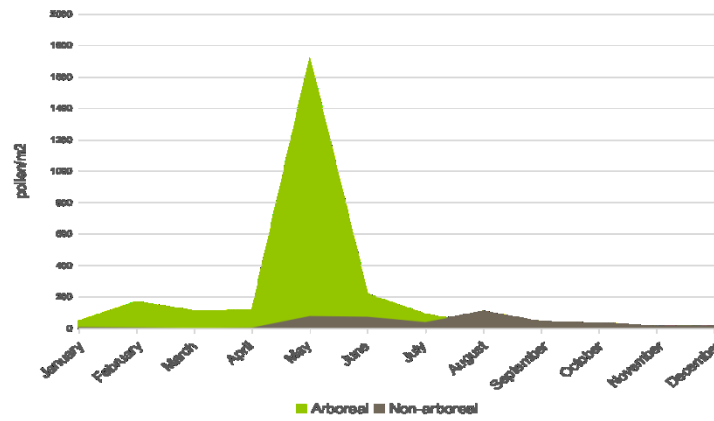
Arboreal taxa				Non-arboreal taxa			
Kozlu		Incivez		Kozlu		Incivez	
Pinaceae	763,92	Pinaceae	1128,41	Poaceae	107,66	Poaceae	149,41
<i>Quercus</i>	455,38	<i>Populus</i>	690,24	<i>Solanum</i>	83,18	<i>Ambrosia</i>	39,08
<i>Betula</i>	339,71	<i>Quercus</i>	211,99	Amaranth.	64,45	Urticaceae	28
<i>Corylus</i>	177,88	<i>Corylus</i>	156,91	<i>Ambrosia</i>	55,23	Amaranth.	24,84
<i>Juglans</i>	145,302	<i>Fagus</i>	96,65	Urticaceae	32,31	<i>Artemisia</i>	11,66

Selected results of correlation analysis of weekly pollen concentration from two stations was given in Table 2. It was found that Amaranthaceae, *Urtica* and *Fagus* pollen have the highest correlation coefficient between stations. On the other hand, there was a statistically differences pollen concentrations of *Solanum*, *Rumex*, *Typha* between stations at 95% confidence level (Table 2).

The Kolmogorov-Smirnov test was also done for the equality of continuous of pollen distribution. According to this test results, it has been found that *Solanum* (D=0.547, P<0.001) and total of nonarboreal taxa (D=0.321, P<0.001) pollen were different between stations. The last test for comparison of two stations was the group comparison with Mann-Whitney U test. In contrast to other tests used in the study, the result of this test indicates that some arboreal taxa such as *Juglans*, *Ostrya*, *Quercus* were different between stations. Solely *Solanum* pollen concentration among non-arboreal taxa was different. On the other hand total non-arboreal pollen were different. It is very interesting is that observation of differences in taxa belonging to Fagales that are characterized by having catkin.



a



b

FIGURE 3. Monthly variations of arboreal and non-arboreal pollen concentrations in İncivez (a) and Kozlu (b) stations.

TABLE 2. Results of Spearman's rank correlation analysis between stations with weekly data. Only results of three most correlated and uncorrelated taxa were given.

Taxa	Amaran.	Urtica	Fagus	Solanum	Rumex	Typha	Arboreal	Non-arboreal
Coeff.	0.927**	0.883	0.828**	0.22	0.251	0.154	0.904**	0.804**

** p<0.01

TABLE 3. Pollen types which statistically different between stations in the result of Mann-Whitney U test based on weekly pollen data.

	<i>Juglans</i>	<i>Ostrya</i>	<i>Quercus</i>	<i>Solanum</i>	non-arboreal
Statistic./P-value	1086.0/0.007	1193.0/0.044	1122.5/0.027	677.0/0.006	987.5/0.004

There are some studies about comparing pollen data between stations. Velasco-Jiménez *et al.* reported that there was no significant differences between two aerobiological stations which have about 9 km apart [11]. They found correlation between all studied pollen types. Although our results are consistent with this study, we found some differences between stations despite of lower distance between sampler than their study. This could be associated with height of sampler. They placed samplers approximately same height. On the other hand, while distance increases, it has been observed differences between stations even though samplers placed same height. Del Mar Trigo *et al.* indicated clear differences between stations where were placed apart 40 km at approximately same height [9]. Interestingly, they reported that *Quercus* and Poaceae were the pollen showed fewer differences. In contrast to our results indicates that differences in non-arboreal taxa more evident than arboreal taxa. Vegetation of the region that sampler placed could be primarily responsible for this difference. Kozlu is a district with garden houses. Although significant difference was observed between pollen and allergen concentration in one aerobiological station [7], such a difference was

not observed in pollen concentrations between stations. This can be interpreted that pollen and allergens have different aerodynamic.

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