

Pollen concentrations in central Italy (Ascoli Piceno and Perugia)

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SUMMARY. Air-borne pollen grains were collected using Hirst volumetric spore traps in both Ascoli Piceno and Perugia during the March-November 1983 period. Similar types of pollens were recorded in both towns. In Perugia, higher total amounts of Cupressaceae/Taxaceae pollens were recorded in March and of *Quercus*, Gramineae, Urticaceae and Oleaceae in May-June. However, the pollen concentration in the Ascoli Piceno atmosphere was higher in the August-October period owing to the pollen of the «summer weeds».

RIASSUNTO. I granuli di polline aerodiffusi sono stati campionati con trappole volumetriche tipo Hirst sia in Ascoli Piceno che in Perugia durante il periodo marzo-novembre 1983. In entrambe le città sono stati rilevati tipi di polline simili. In Perugia sono state registrate concentrazioni di polline in atmosfera più elevate rispetto ad Ascoli Piceno in marzo per la pollinazione di Cupressaceae/Taxaceae e in maggio-giugno per la pollinazione di *Quercus*, Gramineae, Urticaceae e Oleaceae. In Ascoli Piceno, invece, la concentrazione di polline in atmosfera è stata più elevata di Perugia nel periodo agosto-ottobre per la pollinazione delle «erbe estive».

Key words: Aerobiology, central Italy, Pollen census.

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INTRODUCTION

Comparative studies on the pollen content in the atmosphere of different areas have been carried out by researchers in Europe (Fucker-ieder, 1976; Stix *et al.*, 1977; Michel *et al.*, 1979; Spieksma *et al.*, 1980; Van Campo and Quet, 1982; Lejoly-Gabriel and Leuschner, 1983) and in Italy (Caramiello Lomagno *et al.*,

1984; Romano *et al.*, 1986). Within the framework of aeropalynological research carried out in several areas of central Italy (Mincigrucci *et al.*, 1982; Frenguelli *et al.*, 1983; Romano *et al.*, 1983a, b; Nardi *et al.*, 1983, 1984) a census was taken of the different types of pollen present in the atmosphere of Ascoli Piceno and Perugia during the March-November 1983 period.

THE STUDY AREA

The two towns are approximately 100 km apart as the crow flies (Fig. 1).

Ascoli Piceno (42°51' N; 13°34' E; 136 m above sea level) lies in the valley of the River Tronto about 25 km from the coast of the central basin of the Adriatic. Relative humidity during the year is about 70% and the average annual rainfall 700 mm; average summer and winter temperatures are 24° and 6°C respectively, with an annual average of 14.9°C. The prevailing winds in the area come from the South-West and North-East. Ascoli Piceno has a typically sub-Mediterranean climate.

Perugia (43°63' N; 12°23' E; 493 m above sea level) is a hill town overlooking the central valley of the River Tevere, between Lake Trasimeno and the Tyrrhenian side of the Marches-Umbrian Apennines. High levels of the relative humidity are always registered, with an annual average of 70%. Average annual rainfall is 900 mm; average summer and winter temperature are 23° and 4°C respectively, with an annual average of 12.9°C. The prevailing winds in the town come from the North-East and South-West. North-Easterly winds are prevalent during the autumn-winter, whereas the winds come from the South-West in the spring and summer. Perugia has a sub-continental climate.

MATERIALS AND METHODS

The pollen was collected by 7-day recording volumetric traps (Hirst, 1952, 1972). The pollen concentration in the atmosphere is expressed in terms of the number of pollen grains per cubic meter of air (p/m^3). The methods used are described in previous paper (Frenguelli *et al.*, 1981). In Ascoli Piceno the trap was positioned ESE of the town 10 m above ground level on the roof of a cottage approximately 2 km from the town centre. In Perugia the trap was positioned approximately 20 m above ground level on the roof of the Faculty of Agricultural Science of Perugia University.

While the meteorological data in Ascoli Piceno were recorded by the SIAP Bologna S 2000 Meteorological Station, in Perugia they were kindly supplied by the Institute of Ecology of the Faculty of Agricultural Science of Perugia University. In both towns, the meteorological data were plotted as 5-day mean. Daily pollen concentrations were also noted and reported on a 5-day mean basis. Identification of the pollen grains was based on a comparison with reference slides of the Palynotheca of the Institute of Plant Biology of Perugia University and photographs which appear in Hyde and Adams (1958), Faegri and Iversen (1964) and Erdtman (1952, 1969). The nomenclature of the families, genera and

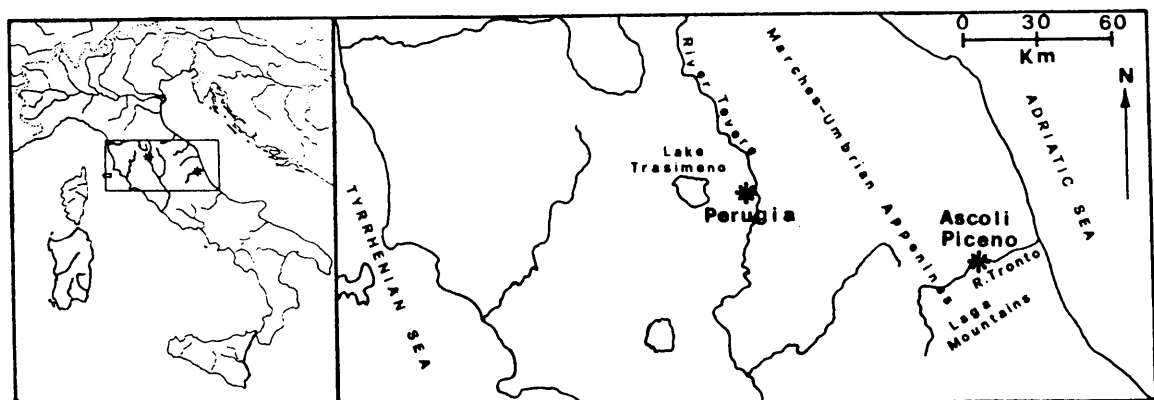


Figure 1. Study area.

species may be found in Tutin *et al.*, (1964-1980).

RESULTS AND DISCUSSION

During the period in question in 1983, a total of 64 different types of pollens belonging to 40 families were identified in the Ascoli Piceno atmosphere and 70 different types of pollens belonging to 45 families were recorded in Perugia. The pollens recorded in Ascoli Piceno totalled 18026 p/m^3 and in Perugia amounted to 26106 p/m^3 (Tab. I). The census in Ascoli Piceno differs from that in Perugia owing to the absence of Aquifoliaceae, Buxaceae, Caprifoliaceae, *Acacia*, Rosaceae, Simaroubaceae pollens and to the presence of Labiatae pollens. Herbaceous plants (53.706%) account for the greater part of the pollens collected in Ascoli Piceno. This is due to the prevailing winds which come from the North-East which corresponds to the Adriatic and to the widest part of the River Tronto basin. In this area, the absence of woods, the large number of towns and wide-spread agriculture encourage the growth of herbaceous plants on the walls and on the waste-lands, the pollens of which are responsible for a notable increase in air-borne pollen in Ascoli Piceno. In Perugia, arboreal plants account for the highest percentage (64.142%) of pollens recorded. This is due to the geographical location of the town; owing to its high position, Perugia is an easy target for winds from any direction. In addition, the green belt surrounding the town is made up, for the most part, of deciduous woods of *Quercion pubescenti-petraeae* and *Orno-Ostryon* and of hard-wood evergreens of *Quercetum ilicis*; arboreal plants such as *Olea*, *Castanea*, *Cupressus*, *Pinus* and *Cedrus*, which are of interest from an agricultural science viewpoint and are greatly valued for ornamental purposes, dominate the anthropical vegetation.

Fig. 2 shows the 5-day mean of the total daily pollen concentration per m^3 of air, together with the 5-day mean of rainfall, tempe-

perature, relative humidity, wind speed and sunshine. The highest percentages of pollens were found in the atmosphere of the two towns in the mid-March to mid-June period. However, the trends differ substantially. A fairly even trend of air-borne pollen concentration was observed in Ascoli Piceno, where the level peaks to a maximum of 204 p/m^3 in April and subsequently decreases gradually. Conversely, the trend in Perugia is somewhat uneven and, after an initial period (March-June) when there is an abundance of air-borne pollens, with peaks around mid-March and at the end of May, the level suddenly begins to fall. The levels of pollen in the atmosphere in March, May and June are much higher in Perugia than they are in Ascoli Piceno. In March this is due to the Cupressaceae/Taxaceae pollens and in May and June to the pollens of *Quercus*, Gramineae, Urticaceae and Oleaceae. Higher percentages of pollen in the atmosphere in Ascoli Piceno in August, September and October can be attributed to the pollens of *Artemisia*, Chenopodiaceae, Gramineae, Urticaceae, Plantaginaceae and *Mercurialis*. Slight differences were noted between the two towns with respect to the pollens content during April, July and November and are due to the different types of vegetation in the two areas, differences in climate in 1983 and, aboveall, to the topographical location of the towns and the positioning of the traps. Perugia is built on a hill and the trap was positioned in the town centre; Ascoli Piceno lies in a valley and the trap was positioned just on the outskirts and ESE of the town.

With regard to the meteorological data, a marked similarity can be noted between the two stations as far as average temperatures and sunshine are concerned. However, rainfall, relative humidity and wind speeds differ considerably.

The correlation between the 5-day mean pollen content per m^3 of air and the time when the phenomenon was observed is shown in Fig. 3 by means of a highly significant ($P = 0.01$)

Table 1. Comparison of the total pollen and the percentage of all the families recorded in the atmosphere of Ascoli Piceno and Perugia during the March-November 1983 period.

	ASCOLI PICENO		PERUGIA	
	n°	%	n°	%
Aceraceae	8	0.044	13	0.050
Anacardiaceae	5	0.027	27	0.104
Aquifoliaceae	-	-	3	0.011
Araliaceae	31	0.172	16	0.061
Betulaceae: <i>Alnus</i>	119	0.660	127	0.486
Buxaceae	-	-	9	0.034
Caprifoliaceae	-	-	2	0.008
Corylaceae	1918	10.640	1115	4.271
Cupressaceae/Taxaceae	2055	11.400	6973	26.710
Ericaceae	29	0.160	66	0.253
Fagaceae	1683	9.337	5030	19.267
Hippocastanaceae	4	0.022	11	0.042
Juglandaceae	30	0.167	26	0.100
Lauraceae	1	0.005	1	0.004
Leguminosae: <i>Acacia</i>	-	-	1	0.004
Moraceae	21	0.117	38	0.146
Myrtaceae	18	0.100	22	0.084
Oleaceae	1281	7.107	2549	9.764
Pinaceae	140	0.777	309	1.184
Platanaceae	128	0.710	60	0.230
Rosaceae	-	-	4	0.015
Salicaceae	415	2.302	255	0.977
Simaroubaceae	-	-	1	0.004
Tiliaceae	6	0.034	1	0.004
Ulmaceae	167	0.927	83	0.318
Vitaceae	2	0.011	3	0.011
TOTAL POLLEN OF TREES AND SHRUBS	8061	44.719	16745	64.142
Boraginaceae	11	0.061	9	0.034
Cannabaceae	50	0.277	43	0.165
Caryophyllaceae	1	0.005	3	0.011
Cheno-Amaranthaceae	626	3.473	214	0.820
Compositae Liguliflorae	48	0.266	12	0.046
" Tubuliflorae	631	3.501	129	0.494
Cruciferae	56	0.311	37	0.142
Cyperaceae	14	0.078	26	0.100
Euphorbiaceae: <i>Mercurialis</i>	857	4.754	320	1.226
Gramineae	2335	12.953	2813	10.775
Juncaceae	1	0.005	1	0.004
Labiatae	3	0.017	-	-
Leguminosae	72	0.399	84	0.322
Liliaceae	24	0.133	8	0.031
Papaveraceae	111	0.616	43	0.165
Plantaginaceae	401	2.225	209	0.800
Polygonaceae	56	0.311	76	0.291
Ranunculaceae	5	0.028	4	0.015
Rosaceae: <i>Sanguisorba</i>	-	-	4	0.015
Rubiaceae	42	0.233	65	0.249
Typhaceae	11	0.061	14	0.054
Umbelliferae	151	0.838	77	0.295
Urticaceae	4175	23.161	4820	18.463
TOTAL POLLEN OF HERBS AND WEEDS	9681	53.706	9011	34.517
MISCELLANEA	284	1.575	350	1.341
TOTAL POLLEN	18026	100.000	26106	100.000

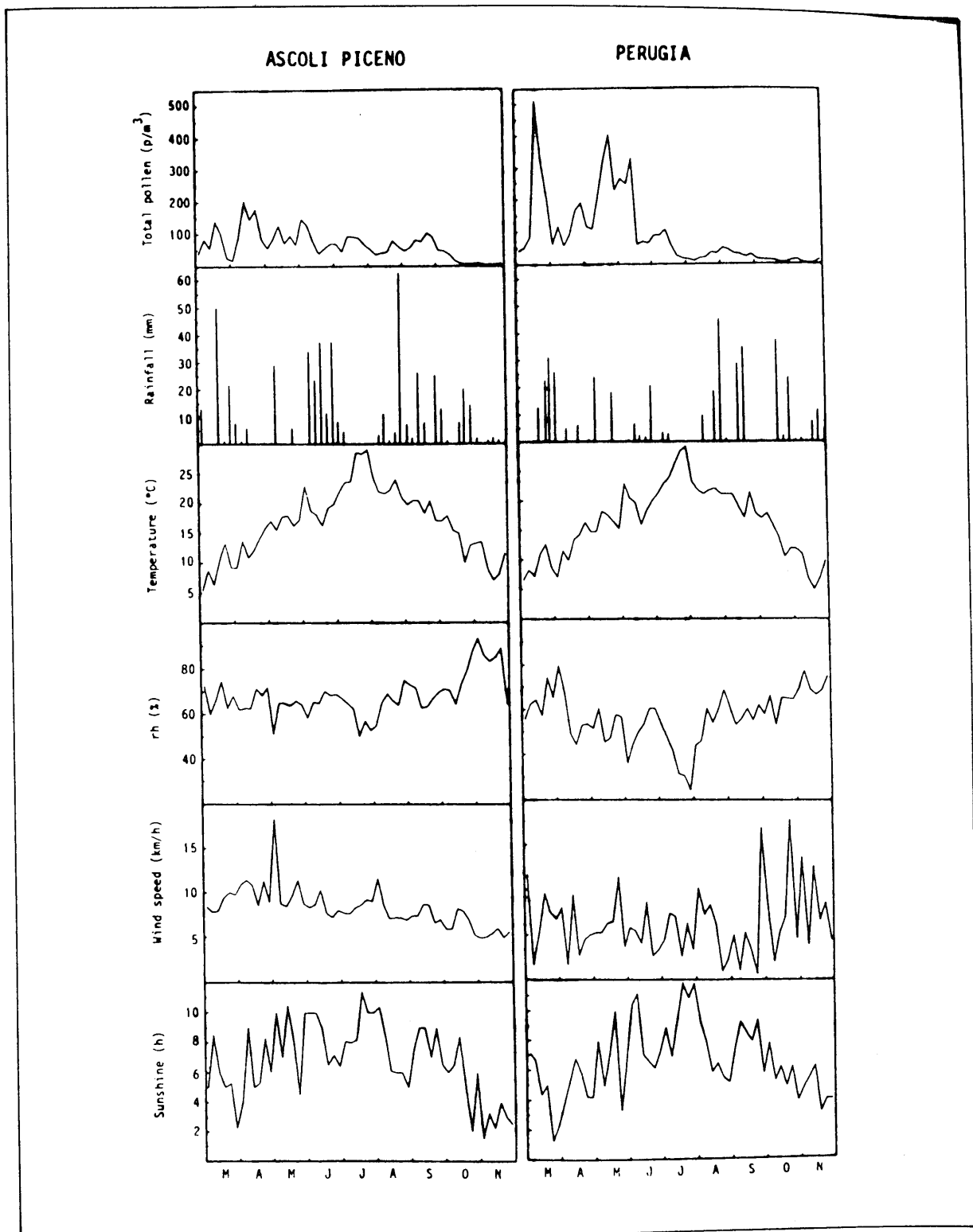


Figure 2. 5-day mean of the total daily pollen concentration per m^3 of air, together with the 5-day mean of the meteorological data.

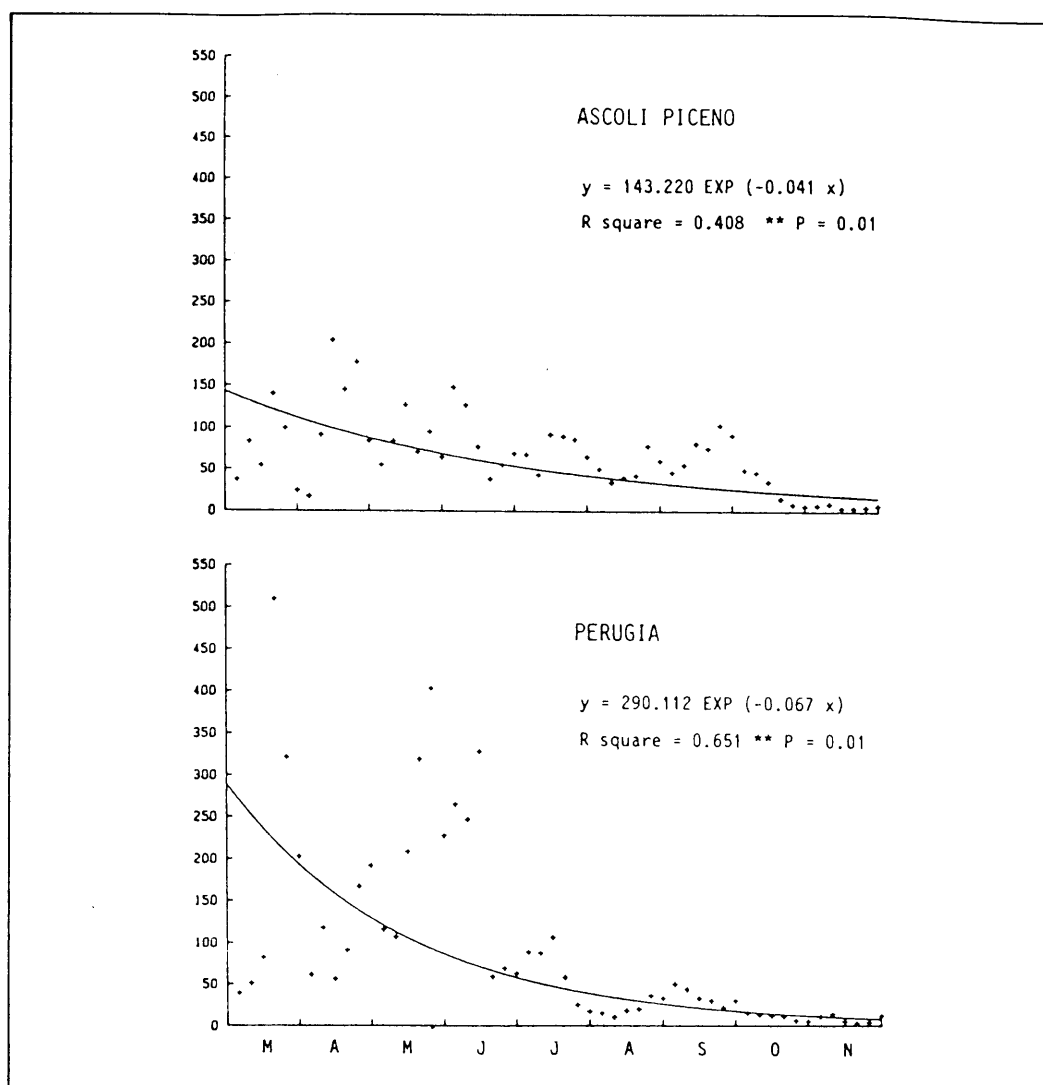


Figure 3. Correlation between the 5-day mean pollen content per m^3 of air and the time when the phenomenon was observed.

exponential curve in both towns. Throughout the period in question, there is a gradual decrease in Ascoli Piceno and a sharp fall in Perugia.

Fig. 4 shows the frequency of the 5-day mean content of pollen per m^3 of air in the two towns. In both stations, fairly low levels were recorded with the greatest frequency; there is a certain similarity in the subsequent frequencies recorded, up to a level of 200 p/m^3 . Level in excess of 200 p/m^3 were only recorded with a certain frequency in Perugia, but not

on a regular basis.

The total quantities and respective percentages of those taxa which in the air-spores of at least one of the towns were in excess of 1% are detailed in Fig. 5. Cupressaceae/Taxaceae and Corylaceae, together with the genera *Cupressus*, *Taxus* and *Corylus*, respectively, commence pollination before March which explains why the levels of the total quantities shown in this figure are lower than those recorded throughout the entire year. Cupressaceae/Taxaceae, *Quercus*,

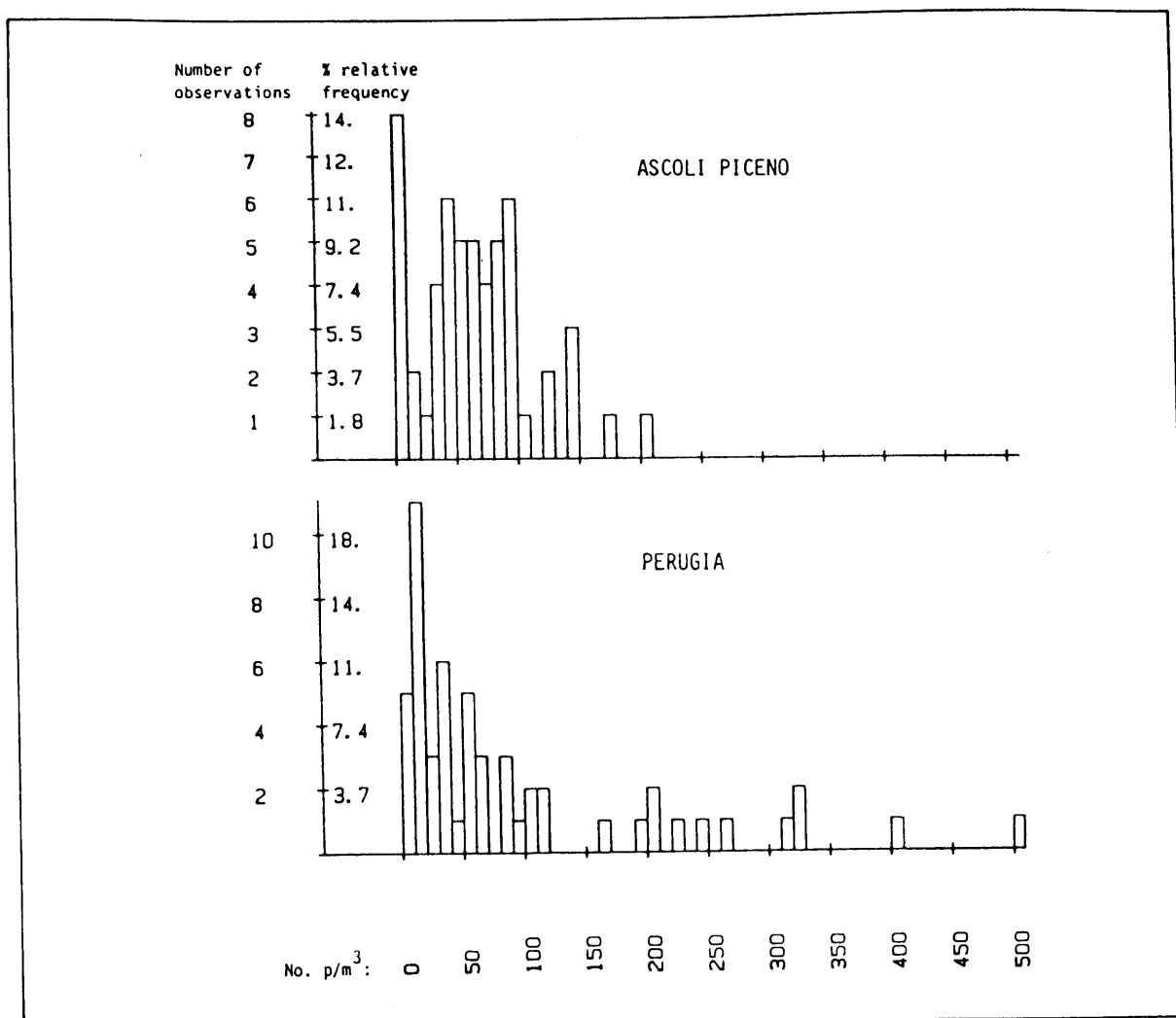


Figure 4. Frequency of the 5-day mean content of pollen per m³ of air in the two towns.

Oleaceae, Corylaceae, among the arboreal plants, and Urticaceae, Gramineae, among the herbaceous plants, account for the highest percentages of pollens counted in both towns. In Ascoli Piceno, the arboreal taxa with the highest pollen content were Cupressaceae/Taxaceae (11.4%), followed by Corylaceae (10.64%), Oleaceae (7.107%) and *Quercus* (6.019%). This is due to the specific type of autochthon vegetation found on the mountains sides which rise above the River Tronto valley in which the town lies (with the Laga Mountains to the South-South-West and the Sibillini Mountains in the West)

and to the winds which blow down from these mountains and along the Tronto Valley towards the Adriatic. The slopes are mainly covered with *Orno-Ostryon*, *Quercion pubescenti-petraeae* and *Fagion* alliances. Conversely, in Perugia, Cupressaceae/Taxaceae account for the highest pollen content (26.71%), followed by *Quercus* (17.54%) Oleaceae (9.764%) and Corylaceae (4.271%) owing to the type of vegetation already described. Of the remaining arboreal taxa in Perugia, Pinaceae (1.184%) are found in greater percentages, while *Castanea* (2.879%), *Salix* (1.209%) and *Populus* (1.093%) are present in larger quan-

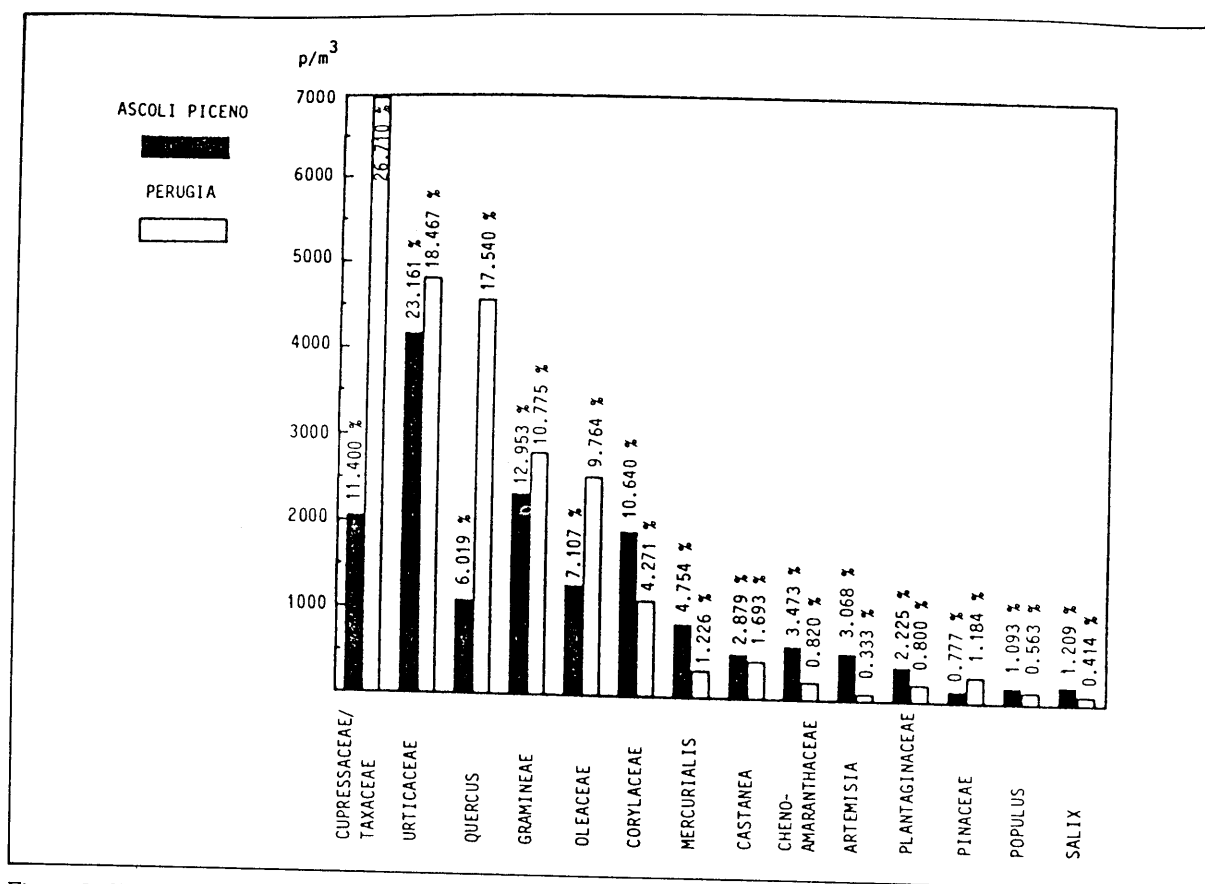


Figure 5. Total quantities and respective percentages of those taxa which in the atmosphere of at least one of the towns were in excess of 1%.

ties in the Ascoli Piceno atmosphere. It should be mentioned that chestnuts are grown on a wide scale along the River Tronto valley and that the riparial vegetation, though patchy, is characterised by woods of *Alno-Ulmion* above the town and of *Alno-Padion* and *Salicion albae* below. Among the herbaceous taxa in Ascoli Piceno, the pollens of *Mercurialis*, *Cheno-Amaranthaceae*, *Artemisia* and *Plantaginaceae* are of significance and globally account for 13.52%, whereas in Perugia these amount to the relatively low level of 3.179%.

Figs. 6 and 7 show the seasonal trend of the pollen concentration of those taxa which are found in the greatest quantities in the atmosphere of both towns. Fig. 6 gives the periods of pollination of 11 arboreal taxa in chronolo-

gical order, based on the period of maximum pollination. It is clear that the period of initial and maximum pollination of these taxa take place earlier in Ascoli Piceno than in Perugia. The reason for the delay in pollination of *Castanea* in Ascoli Piceno can be attributed to the fact that this is cultivated at high altitudes and therefore flowers later. This genus, which is grown on the mountain slopes South-South-West of the town, is cultivated up to height of approximately 1500 m above sea level and the winds blowing down the mountain-sides transport the pollens downhill.

Fig. 7 gives the trend of the pollen concentration of the «summer-weeds». The two peaks recorded for *Artemisia* are due: in August to *A. vulgaris* and in September-October to *A.*

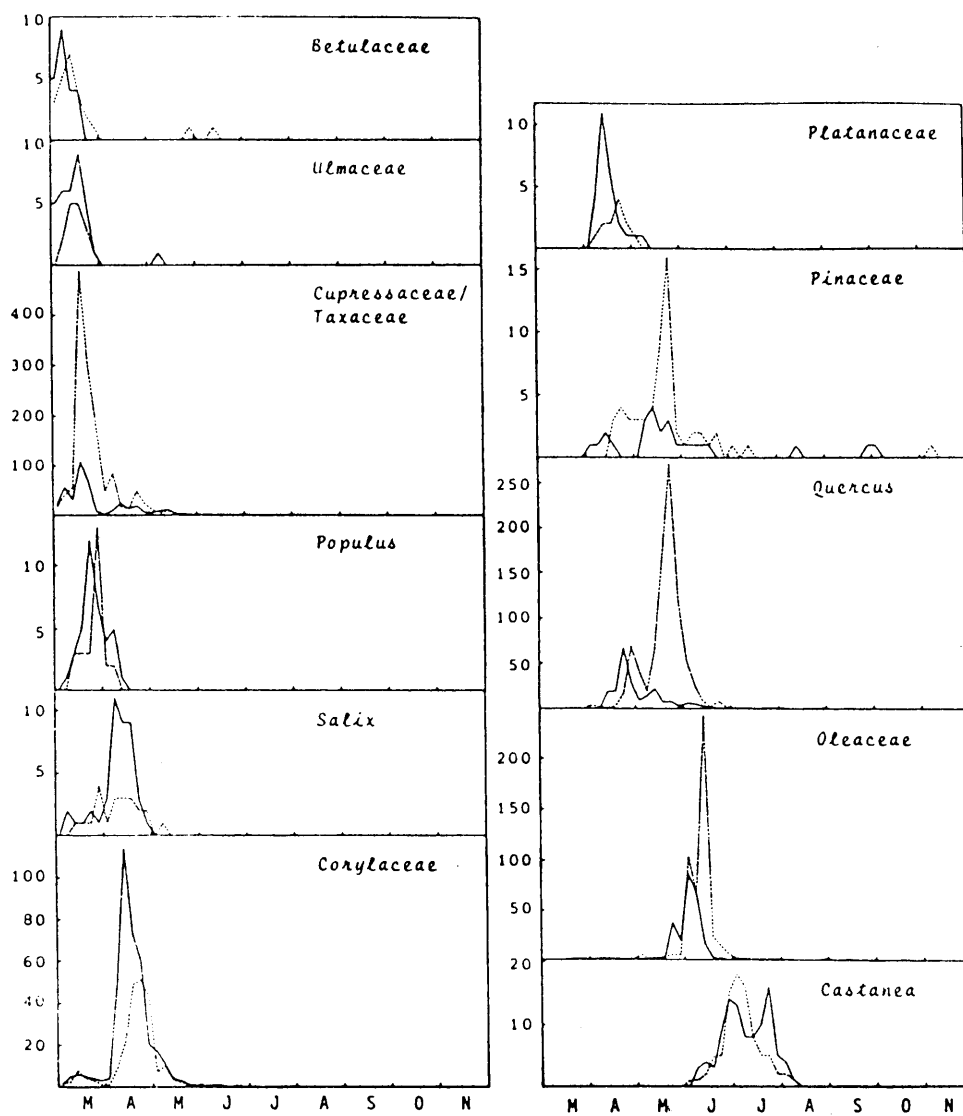


Figure 6. 5-day mean of the daily pollen concentration per m^3 of air of arboreal taxa. (----- = Perugia; — = Ascoli Piceno).

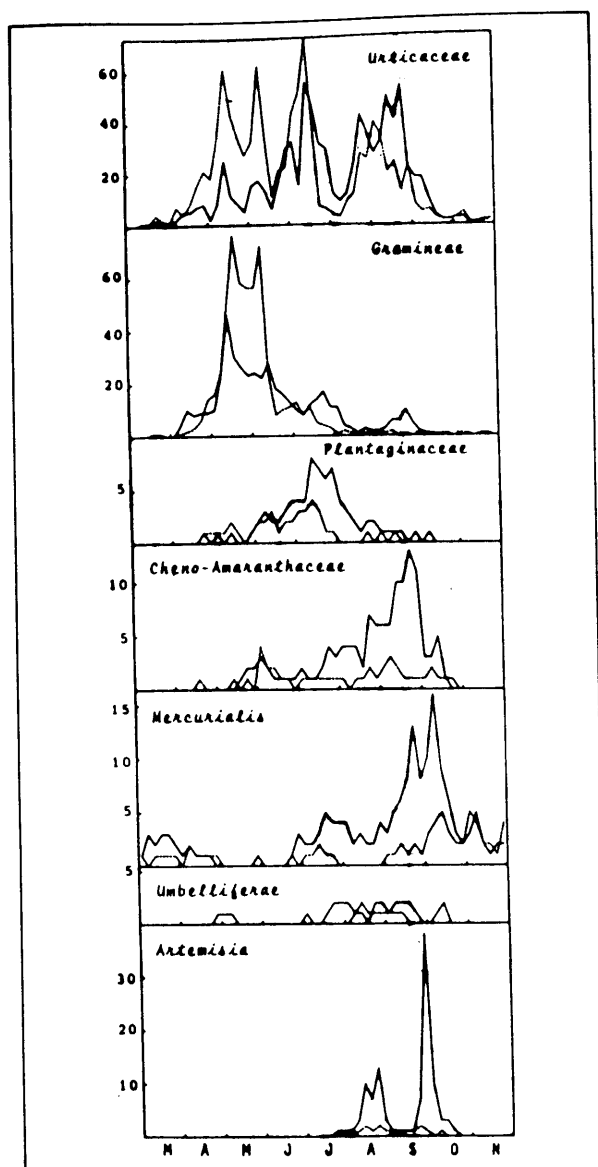


Figure 7. 5-day mean of the daily pollen concentration per m³ of air of herbaceous taxa. (----- = Perugia; — = Ascoli Piceno).

verlotorum.

The «summer weeds», while differing in quantity, show a similar trend in both the areas in question, even though the final period of pollination lasts longer in Ascoli Piceno.

CONCLUSIONS

Although the towns are not far apart, there are notable differences in the total amount of pollens collected, especially in the initial phase of the period under examination (March-June), due to the greater quantities of Cupressaceae/Taxaceae, *Quercus* and Oleaceae pollens present in the Perugia atmosphere which are found in abundance in the area surrounding the town. The different trends of pollen concentration in the atmosphere of the two towns can be attributed to the position of the traps and to climatic conditions. We intend continuing this comparative study in the future because the amounts air-borne pollen and the period of dispersal are subject to substantial variations over the years (Spieksma, 1983), especially as a consequence of varying climatic conditions (Stix, 1976; McDonald, 1979).

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