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One year of airborne pollen sampling in Mar Del Plata (Argentina)

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A continuous aeropalynological survey of the atmosphere of Mar del Plata was carried out from December 1992 to November 1993 using a Burkard volumetric spore trap. Ten-day averages were calculated for 28 relevant taxa, selected on the basis of their relative high concentration in the air. The total annual concentration (Cupressaceae pollen excluded) was 84,445 grains/m³, with 42% of total appearing during September and October. The pollen spectrum largely reflects urban anemophilous vegetation, which is characterised by naturally occurring herbs and by ornamental shrub and tree species. A qualitative analysis shows two major pollen seasons related to the atmospheric dominance of either arboreal or non arboreal pollen.

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Pollinosis is a common allergenic disease affecting almost 15% of the human population around the world. Most human exposures are to pollen types, which occur in the air at relatively high concentrations. In practice, this means that pollinosis is mostly caused by plants that depend on the wind for cross-fertilisation (Driessen & Derksen 1989). Knowledge of the abundance of allergenic pollen types and their pollination season is useful to allergologists, who can correlate hay fever symptoms with the presence of allergenic pollen in the atmosphere (Romano & Castellano 1992). Furthermore, pollen calendars are important for studies of phenology, ecology, pollination biology, etc. (Rizzi Longo & Cristofolini 1987).

A few atmospheric pollen surveys have been carried out in different cities of Argentina using gravimetric techniques (Cuadrado 1978, 1979; Rabino 1983, Borromei & Quattrocchio 1990, García de Albano 1991, Majas et al. 1992). Hirst type samplers (1952) were not used in Argentina until 1987 when continuous volumetric studies started in the city of Mar del Plata (Pérez 1991, Latorre 1993, Bianchi 1994).

To establish a preliminary pollen calendar, we investigated the most important pollen types and their seasonal trends, with regard to both flowering period and the meteorological parameters influencing anthesis and dispersion.

Environmental characteristics

The city of Mar del Plata (38°03 S; 57°33 W) extends over 12 km along the shore of the Atlantic Ocean (Fig. 1). Its topography is characterized by the presence of several flat hills ranging 20–50 meters above sea level. Between these, the most densely populated sector of the city is situated reaching nearly 800,000 inhabitants at all. The climate, according to Thornthwaite's classification (Burgos & Vidal 1951) is mesothermal, subhumid-humid. Annual mean pre-

cipitation is 884 mm and monthly mean temperatures range from 8.7°C to 19.7°C in July and January, respectively.

There are two important green spaces placed north and southwest of the urbanised area. Exotic taxa (mainly *Pinus* and *Eucalyptus* species) are the principal constituents of these.

Urban pollen sources are cultivated trees used for ornamental purposes and naturally occurring herbs. Trees are present along streets and avenues, and in numerous parks and gardens in the surroundings of the city. The most abundant species are: *Prunus ceracifera* var. *athropurpurea*, *Lagerstroemia indica*, *Ulmus pumila*, *Fraxinus* spp., *Populus*

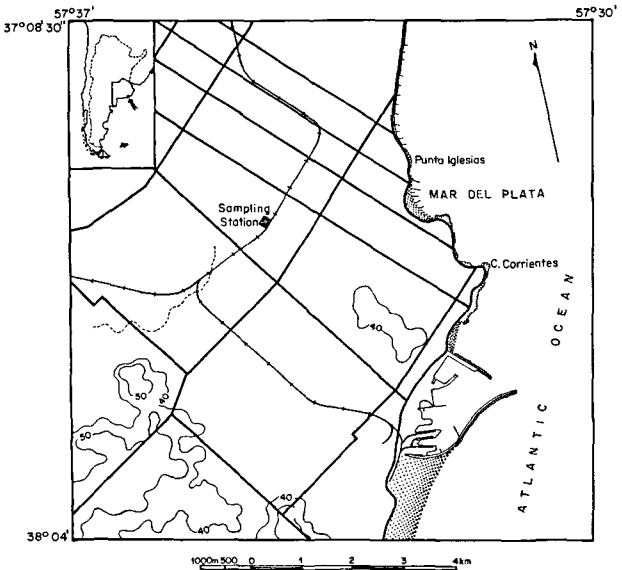


Fig. 1. Map of the city of Mar del Plata and location of the sampling station.

spp., *Platanus acerifolia*, *Robinia pseudo-acacia*, *Tilia cordata*, *Ligustrum* spp., *Cupressus* spp., and *Acer negundo*. Herbaceous vegetation is characterised mainly by taxa such as: Poaceae, Brassicaceae, *Conium maculatum*, *Chenopodium* spp. and Asteraceae.

MATERIAL AND METHODS

Pollen sampling was performed using a seven-day Burkard spore trap. The sampler is placed about 15 m above ground level, on a terrace of a building of the University of Mar del Plata in the centre of the city and far from the highest constructions.

The sampling period lasted from December 1992 to November 1993. The last 5 days of November were lost because of a mechanical failure of the trap.

Slides were prepared according to standard methods (Käpylä 1989). Pollen identification was performed with the aid of a reference collection containing non acetolyzed pollen grains collected from the local flora, together with the following reference literature (Kapp 1969, Heusser 1971, Basset et al. 1978, Markgraf & D'Antoni 1978, Moore & Webb 1978, Moore et al. 1991). *Casuarina* and *Corylus* were difficult to distinguish so they were grouped in a *Casuarina/Corylus*-type.

Twelve transverse traverses, corresponding to every second hour of sampling, were analysed at a magnification of 200X (Käpylä & Penttinen 1981). Daily pollen concentrations were obtained by summing the counts, and expressing the results as grains per cubic meter of air.

Three ten-day averages were calculated for each month to construct the pollen calendar. The onset and end of the pollen season for each taxon were considered as the first and last day on which pollen concentration reaches at least 1 grain/m³ of air (Cadman 1990).

Hourly data of wind speed, air temperature and relative humidity, were obtained with a semiautomatic meteorological station located near the pollen trap. Monthly averages for these variables were computed. Rainfall data were obtained from the Servicio Meteorológico Nacional.

RESULTS

The total pollen concentration registered during the sampling period was 330,762 grains/m³. The counts include over 75 different pollen types (45 arboreal and 30 herbaceous) which are shown below.

The most significant input to the pollen spectrum was that of Cupressaceae (74% of total counts). Several trees, growing in the surrounding parks, were considered to be the main pollen source. The pollination season of this plant reaches a peak in August, with 96% of the total counts registered in that month. This taxon was not included in further analyses. Thus, total pollen concentration was reduced to 84,445 grains/m³ (TP). Sixty per cent of TP arises from arboreal vegetation.

The general trend shows an increase in pollen counts from the end of the winter reaching a maximum in early spring. 42% of TP was recorded in September and October. In summer, pollen concentration starts to decrease due to the scarcity of flowering plants. Noticeable is the very small number of grains observed from autumn until early winter, with a minimum occurring in June (Fig. 2).

Pollen seasonality during 1993

An arbitrary limit has been set for the construction of the pollen calendar (Fig. 3). Only those taxa that accounted for at least 0.5% of TP were included. It is felt that sporadically

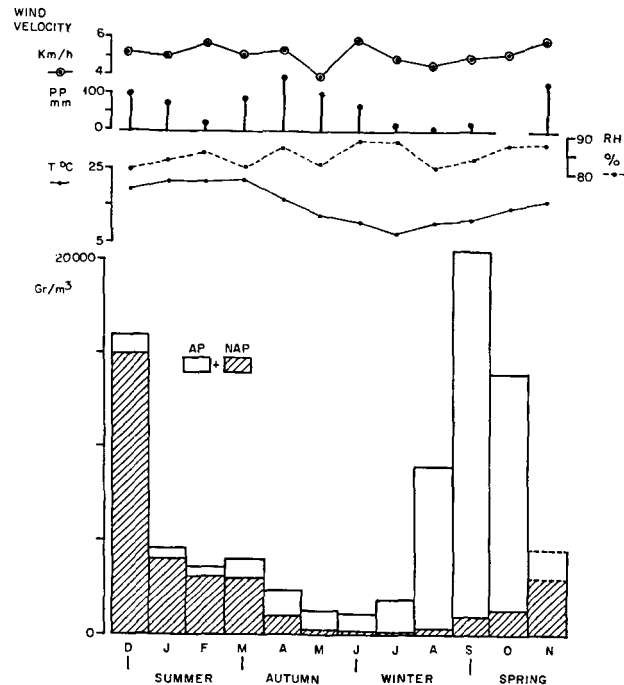


Fig. 2. Average pollen concentration and meteorological parameters during the sampling period.

occurring pollen contribute little or nothing to the cause of pollinosis and may therefore be disregarded.

The airborne pollen patterns of each taxon show marked seasonality; although Poaceae, Pinaceae, Myrtaceae,

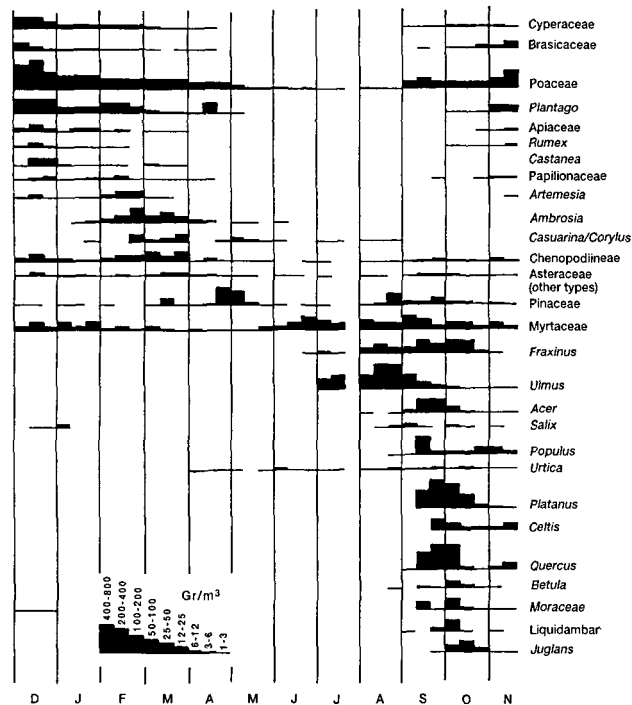


Fig. 3. Pollen calendar for the most important taxa (Cupressaceae pollen excluded) collected in the Mar del Plata atmosphere. Ten-day means of the daily pollen concentrations are illustrated.

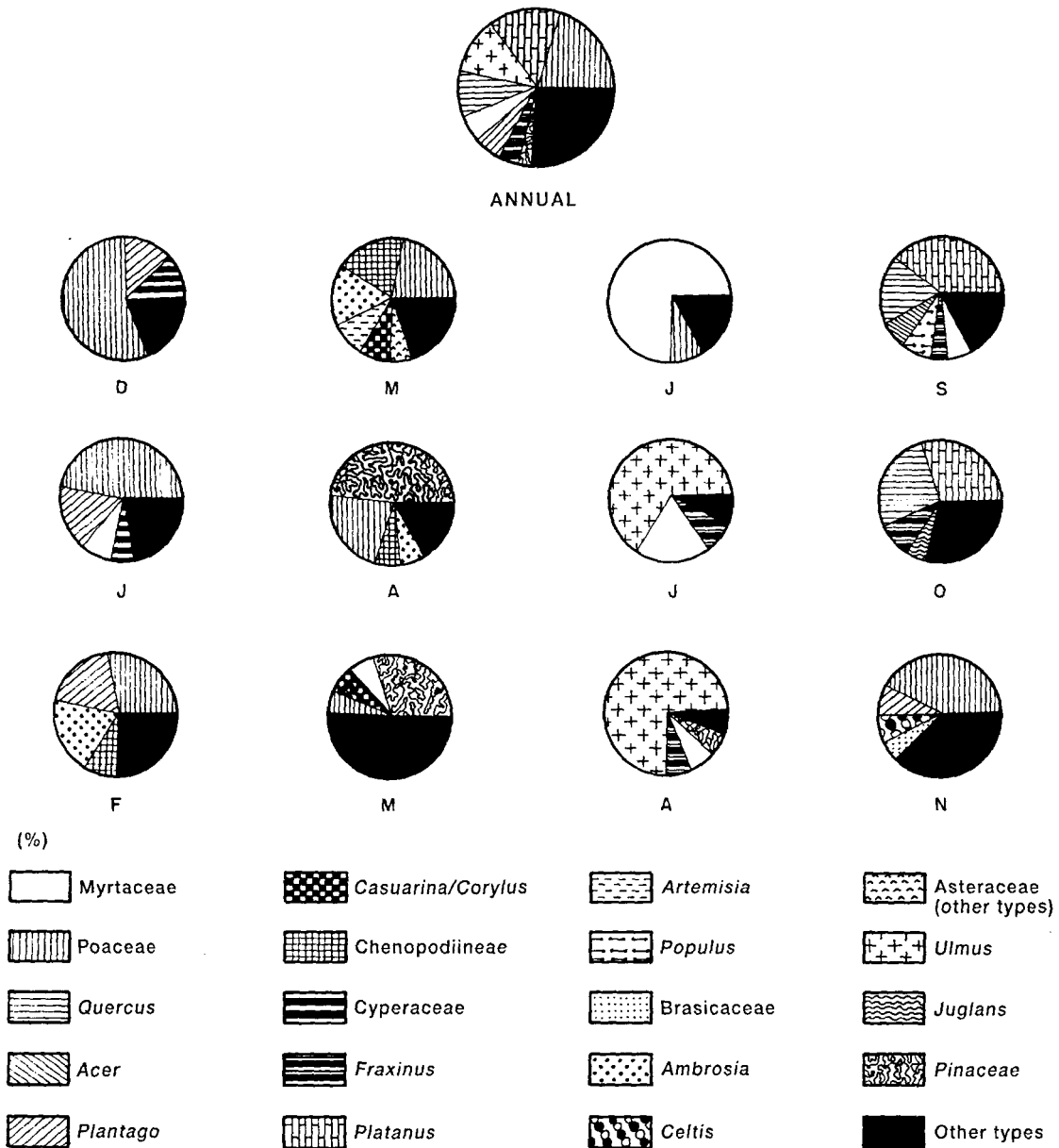


Fig. 4. Relative variation in pollen composition throughout the year. Pollen types attaining more than 5% of monthly total counts are included.

Chenopodiaceae-Amaranthaceae and Asteraceae are present in the air throughout the year. This continuous pollen emission is due to the presence of different species that flower at different times.

The airborne pollen spectrum of Mar del Plata could be divided into two main periods (Figs. 2 and 3), which are characterised by the following features:

Non-arboreal pollen (NAP) predominance. – This period extends from November to April, with a maximum concentration in December. NAP reaches 84% of TP.

Arboreal pollen (AP) predominance. – This period lasts from May to October with a maximum concentration in September. Arboreal pollen during this period forms 93% of TP.

The high concentration of NAP is correlated with mean monthly temperatures (Spearman $R=0.87$, $p=0.0003$), while that of AP is negatively correlated (Spearman $R=-0.61$, $p=0.04$). Relative humidity and wind speed are reasonably uniform throughout the year. Neither of these variables nor precipitation were significantly correlated with the aeropalynological data.

Pollen diversity

A noticeable change in monthly pollen composition was observed during the sampling period (Fig. 4). Only those taxa accounting for more than 5% of the total monthly counts were analysed for each month.

74% of TP was represented by only 8 taxa, so these were considered representative of the pollen spectrum. In decreasing order of importance they are: Poaceae, *Platanus*, *Ulmus*, *Quercus*, Myrtaceae, *Plantago*, *Fraxinus* and Pinaceae.

From December to March, the pollen spectrum, was composed of Poaceae, Cyperaceae, *Plantago*, Chenopodiaceae-Amaranthaceae and *Ambrosia*.

Poaceae dominate the pollen spectrum of Mar del Plata. The presence of this pollen type is consistently important reaching 2,209 grains/m³ in December. Although its main pollen season occurs when temperatures are at the highest, Poaceae is caught throughout the year.

Ambrosia has been studied separately, because of the allergenic relevance of this genus (at least in the Northern Hemisphere). Although its pollen season is relatively short, concentrations reach high levels in February and March.

Pollen concentrations of Pinaceae, Myrtaceae and *Ulmus* occurred successively during the autumn and winter.

The contribution of Pinaceae to the airborne pollen spectrum was noticeable. There are two main pollen seasons due to the consecutive flowering of *Cedrus* (*C. atlantica* in March and *C. deodara* in April-May) and *Pinus* spp (in August-September).

Myrtaceae pollen characterises the autumn and winter seasons but it is present almost all the year due to the pollination of *Callistemon* and several *Eucalyptus* species. *E. globulus* is the most important pollen source of the genus.

During late winter, *Ulmus* reached the highest count of any other tree pollen.

Pollen of *Fraxinus* is detected in the atmosphere from late winter to early spring. *F. excelsior* starts to flower in August, followed by other species with spring flowering such as *F. americana* and *F. excelsior* var. *aurea*. This accounts for the three principal peaks in the pollen curve (Fig. 3).

Spring is characterised by *Platanus* and *Quercus* pollen. *P. acerifolia* has a marked maximum between September and October. Deciduous oaks, mainly *Q. robur*, are also flowering during these months. Other taxa such as *Populus* and *Acer*, are important during this season because of their relative high density.

Taking into account the flowering seasons we suspect that the first period of the *Corylus/Casuarina* pollen curve (February-March) corresponds to *Casuarina*, and the second one to *Corylus* (April-August).

DISCUSSION

Although there are only a restricted number of dominant pollen types, the pollen spectrum of Mar del Plata shows a high level of diversity, due to the floristic complexity of the urban vegetation (Bianchi 1992). Plants with anemophilous pollination are the best represented.

There are two marked pollen seasons. One of them is characterised by herbaceous taxa, mainly grasses and weeds, and prevails from December to April coinciding with the highest temperatures of the year. The other is characterized by arboreal pollen and lasts from May to November. It is related to the relatively low temperatures occurring in late winter-early spring.

Herbaceous vegetation (grasses and weeds), Gymnosperms (*Cupressus* and *Pinus*) and Myrtaceae species, have long pollination periods. In contrast, most of the tree species have a different reproductive strategy, reaching high levels of pollen concentration for a short span of time.

Our results could potentially be of great interest to medical physicians since the anemophilous taxa, such as those presented in this pollen calendar, are the main sources of infections to the human respiratory tract, due to their abundant productivity and their good dispersion in air.

Further research of Mar del Plata aerobiota in relation to meteorological and phenological data is in progress. Results from these studies will lead to a more accurate interpretation of the structure and dynamics of the pollen cloud.

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LIST OF TAXA

Pollen types registered in Mar del Plata during the sampling period (December 1992–November 1993):

ANACARDIACEAE

Schinus

APIACEAE

ASTERACEAE

Ambrosia

Artemisia

Mutisia

Franseria type

Echinate

Fenestrate

BETULACEAE

Alnus glutinosa

Betula pendula

Corylus avellana

BOMBACACEAE

Chorisia speciosa

BORAGINACEAE

Echium plantagineum

BRASSICACEAE

CAPRIFOLIACEAE

Sambucus

Viburnum tinus

CARYOPHYLLACEAE

CONVOLVULACEAE

Dichondra

CUPRESSACEAE

CYPERACEAE

CHENOPODIACEAE

ELEAGNACEAE

Eleagnus

EPHEDRACEAE

Ephedra

EUPHORBIACEAE

Sapium

Ricinus communis

FABACEAE

Papilionaceae

Mimosaceae

Prosopis-type

Styphnolobium japonicum

FAGACEAE
Castanea sativa
Fagus
Nothofagus
Quercus ilex
Quercus robur
HAMAMELIDACEAE
Liquidambar sthiraciflua
HIPOCASTANACEAE
Aesculus hippocastanum
JUGLANDACEAE
Juglans regia
JUNCACEAE
LAMIACEAE
LAURACEAE
MONOCOTYLEDONEAE
MORACEAE
Maclura pomifera
Morus alba
MYOPORACEAE
Myoporum laetum
MYRTACEAE
NICTAGINACEAE
Bougainvillea
OLEACEAE
Fraxinus americana
Fraxinus excelsior
Olea europaea
OXALIDACEAE
Oxalis
PINACEAE
Cedrus
Pinus
PLANTAGINACEAE
Plantago
PLATANACEAE
Platanus acerifolia
ROACEAE
POLYGONACEAE
Rumex
Polygonum-type
PROTEACEAE
Grevillea robusta
Lomatia-type
ROSACEAE
Prunus
Rosa-type
Rosaceae-type
RUTACEAE
Citrus
SALICACEAE
Populus
Salix
SIMARUBIACEAE
Ailanthus altissima
SOLANACEAE
TILIACEAE
Tilia
TROPAEOLACEAE
Tropeolum
TYPHACEAE
Typha
ULMACEAE
Celtis
Ulmus
URTICACEAE
VERBENACEAE

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