



A change from grass pollen induced allergy to tree pollen induced allergy: 30 years of pollen observation in Switzerland

Thomas Frei^{1*} & Ruth M. Leuschner²

¹Swiss Meteorological Institute, Zürich, Switzerland; ²Kantonsspital Basel, Basel, Switzerland

(*Author for correspondence, e-mail: thomas.frei@meteoschwiz.ch; fax: +41 12569278)

Received 15 December 1998; accepted in final form 17 May 2000

Key words: allergy, global change, long-term trends, rhinitis, tree pollen

Abstract

Pollen monitoring with a Hirst like pollen trap for 30 years in Basel, Switzerland allows understanding of the behaviour of the different plants producing allergenic pollens. It becomes evident that in this time period the different tree pollen like *Hazel* and *Birch* increased, whereas in the control, the observed amount of a herb pollen like *Artemisa* did not change. Moreover, it was observed that in the different trees flowering took place earlier namely at the beginning of the year. This was especially impressive for *Hazel*, where flowering was shifted of more than one month.

These aerobiological observations were supported and confirmed by some epidemiological studies, showing that tree pollen allergy has become more important in the last years compared to grass pollen allergy and herb pollen allergy.

The reason for the increase of tree pollen counts and the shift in the flowering time depends on the observed increase of the annual temperature, an increased input of nutrients like CO₂ or NO_x but probably also a real increase of certain trees, like birch for example, in parks and avenues.

Introduction

The traditional time of flowering for the different trees are, for the northern slope of the Alps in Switzerland, the spring months of February until May. Hence the released tree pollen can induce rhinitis and asthma; this effect is called the spring-pollinosis. The main tree pollen inducers of rhinitis are hazel, alder, birch, ash, oak and beech. Apart from that in the months of May, June and July, a second wave of rhinitis and asthma is observed due to grass pollen, which is called 'sommer-pollinosis', and a third wave in August is caused by the various herbs and called 'late summer-pollinosis'.

Generally it has been observed for a long time now that allergies caused by these different pollen increased dramatically during the last decades in all industrial societies (Wüthrich et al., 1989). The reason for the increase of allergies is caused by different factors, among which the following are discussed:

'western style of life', an increase of air pollution and an increase of the pollen load.

From an epidemiological point of view it was also observed that allergies related to tree pollen have increased in the last decades and has become more and more important (Frei et al., 1998a,b).

Epidemiological studies have been carried out in Switzerland for more than 70 years, showing an increase in pollen allergy from less than one percent to more than 10 percent in the population (Wüthrich et al., 1994).

Material and methods

Meteorological data

Meteorological data were collected at the meteorological station of Basel-Binningen, 316 m above sea level. The data from 1961 to 1990 were smoothed.

Pollen data

Tree pollen from *Alnus*, *Corylus*, *Betula*, *Fraxinus*, *Fagus*, and herb pollen from *Artemisia* as a control, were studied.

Data from a Burkard Seven Day Recording Volumetric Spore Trap (Hirst, 1952) with a sucking rate of 10 l minute⁻¹ were available for 30 years for Basel (1969–1998). The Kantonsspital building is 260 m above sea level. The distance between the pollen trap and the meteorological station is approximately 3 kilometers.

The pollen data from Basel were provided by R.M. Leuschner for 1969 to 1992. Since 1993, the Swiss Meteorological Institute is responsible for the pollen measurements all over Switzerland.

Hazel pollen data for 1975 are incomplete, therefore the mean of the years 1974 and 1976 was used in the analyses, except in the case of the number of days since the beginning of the year where 1975 has been omitted.

Hazel pollen data of January were incomplete for some years since hardly any pollen were found in the corresponding year.

Results

The time series analysis of the temperature for Basel over the last 30 years shows a continuous increase. As the meteorological station is not situated directly in the city itself but about 3 km far from it, this increase may not only be a 'city effect' (warming of the city because of increased circulation, industries and so on). The observed increase in temperature is responsible for a shift in flowering and pollen release especially of the trees as indicated in Table 1. Because of the mild winter, the dormancy is shortened and the flowering starts earlier (Frenguelli et al., 1992; Frenguelli et al., 1993; Frenguelli et al., 1997).

The behaviour of the different trees in terms of producing more pollen over the 30 years of observation is shown in Figure 2 to Figure 6. As a control, the behaviour of a herb, namely *Artemisia*, was studied as shown in Figure 7. All investigated trees in Figure 2 to Figure 6 show an increase of pollen production over the studied time period of 30 years as indicated by the linear trend line.

Table 1. Number of days from beginning of the year to the day of maximum daily occurrence of the corresponding pollen ($p < 0.05$ for *Alnus* and *Corylus*, $p > 0.05$ for *Betula*, *Fagus*, *Quercus* and *Artemisia*).

Type of pollen	Days at the beginning of the Trend Line 1969	Days at the end of the Trend Line 1998	Difference (Shift in days towards earlier flowering)
<i>Alnus</i>	74.88	55.10	-19.78
<i>Corylus</i>	72.15	43.53	-28.61
<i>Betula</i>	105.63	98.11	-7.52
<i>Fagus</i>	126.02	119.45	-6.57
<i>Quercus</i>	131.64	120.56	-11.08
<i>Artemisia</i>	221.64	215.56	-6.08

Discussion and conclusion

The impact of human intervention in a changing environment has brought about increased concern for detecting trends in various types of environmental data. A variety of studies have attempted to detect long-term trends (Weatherhead et al., 1998). Detection of long-term, linear trends is affected by a number of factors, including the size of trend to be detected, the time span of available data, and the magnitude of variability and autocorrelation of the noise in the data. For a typical range of values the number of years of data needed to detect a trend of 5%/decade can vary from 10 to 20 years. The early establishment of a pollen trap in Switzerland by one of the authors in 1969 now allows data interpretation of 30 years and the observations of long-term trends (Leuschner, 1974, 1991, 1994).

Long-term trends investigations were also performed for other pollen monitoring stations, showing that for some of them there is also an increase of the observed pollen (Jäger et al., 1996; Spieksma et al., 1995). In some studies, the pollen increase was discussed as a possible consequence of global change (Emberlin et al., 1997; Frei, 1999). We found for the observed trees, which are especially important from an allergy point of view in Switzerland, that the pollen amount increased constantly for all investigated trees namely *Corylus*, *Alnus*, *Betula*, *Fraxinus*, *Fagus* and *Quercus*. Compared with a herb, like *Artemisia*, we did not observe such an increase. Moreover we found that due to the mild winter, especially, for *Corylus* and *Alnus*, the date of flowering and pollen release was anticipated in the corresponding year.

The observed increase of different tree pollen is also supported by different epidemiological investi-

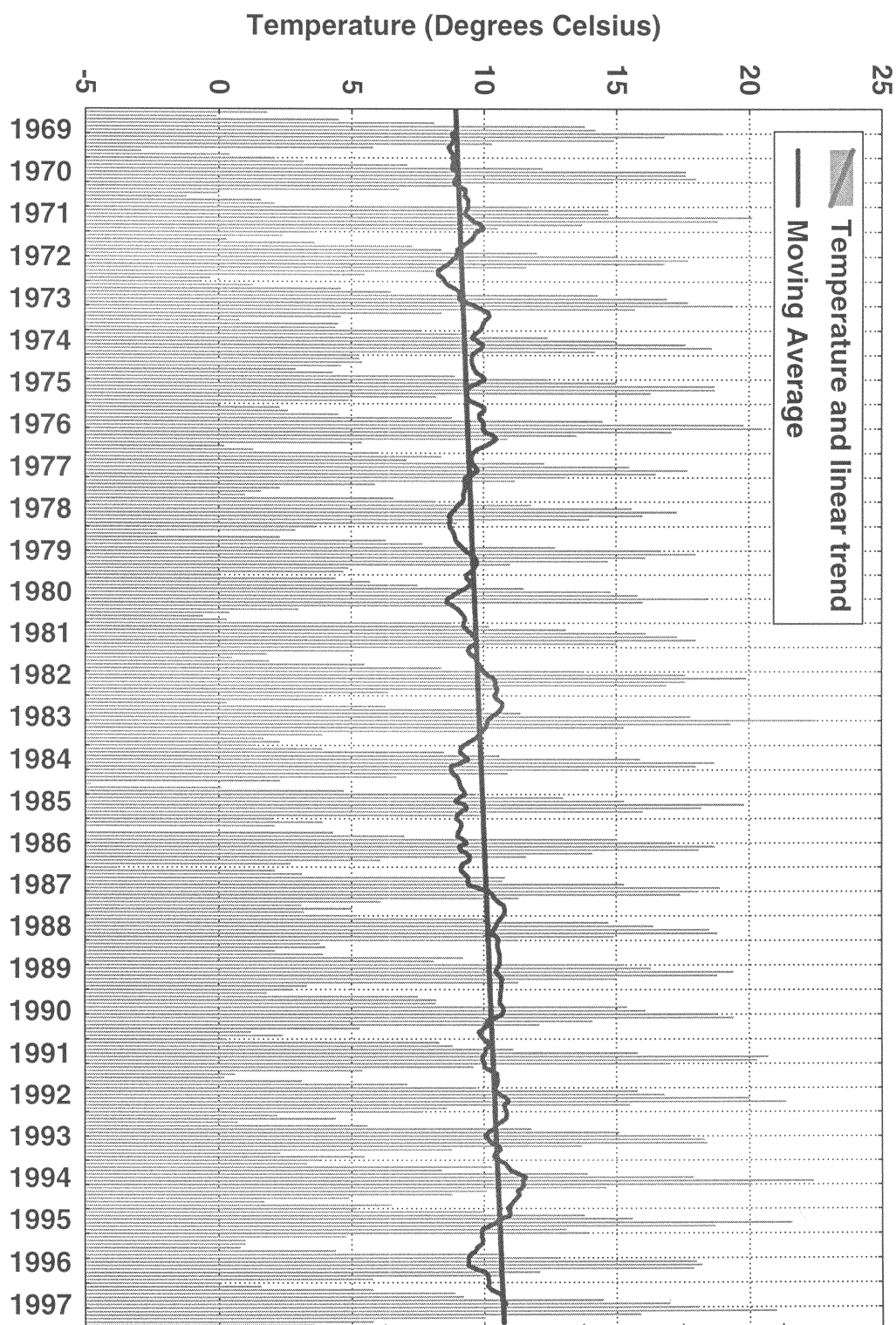


Figure 1. Air temperature with linear trend for Basel 1969–1997.

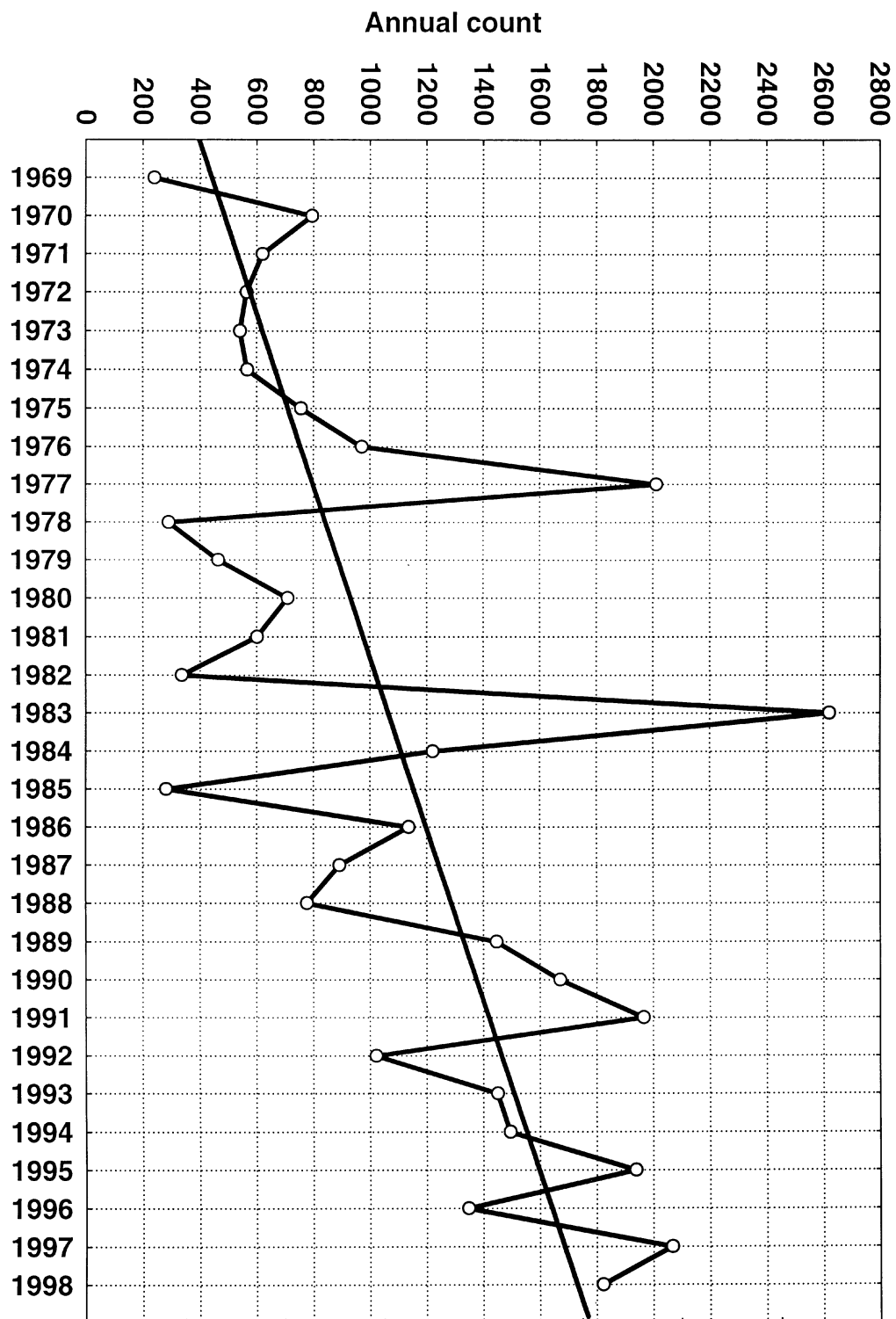


Figure 2. Annual count of hazel pollen in Basel 1969–1998 with linear trend ($p < 0.05$).

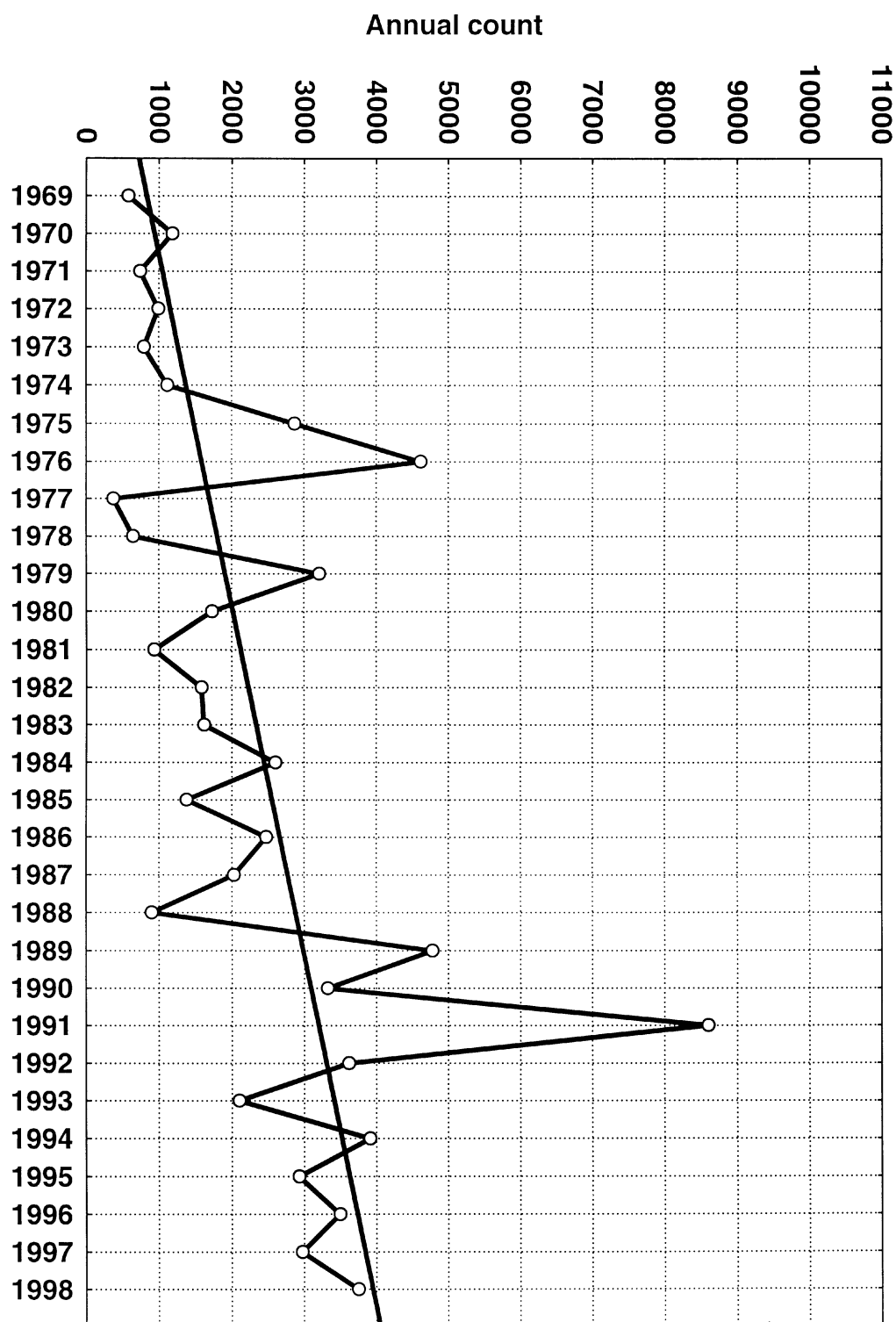


Figure 3. Annual count of alder pollen in Basel 1969–1998 with linear trend ($p < 0.05$).

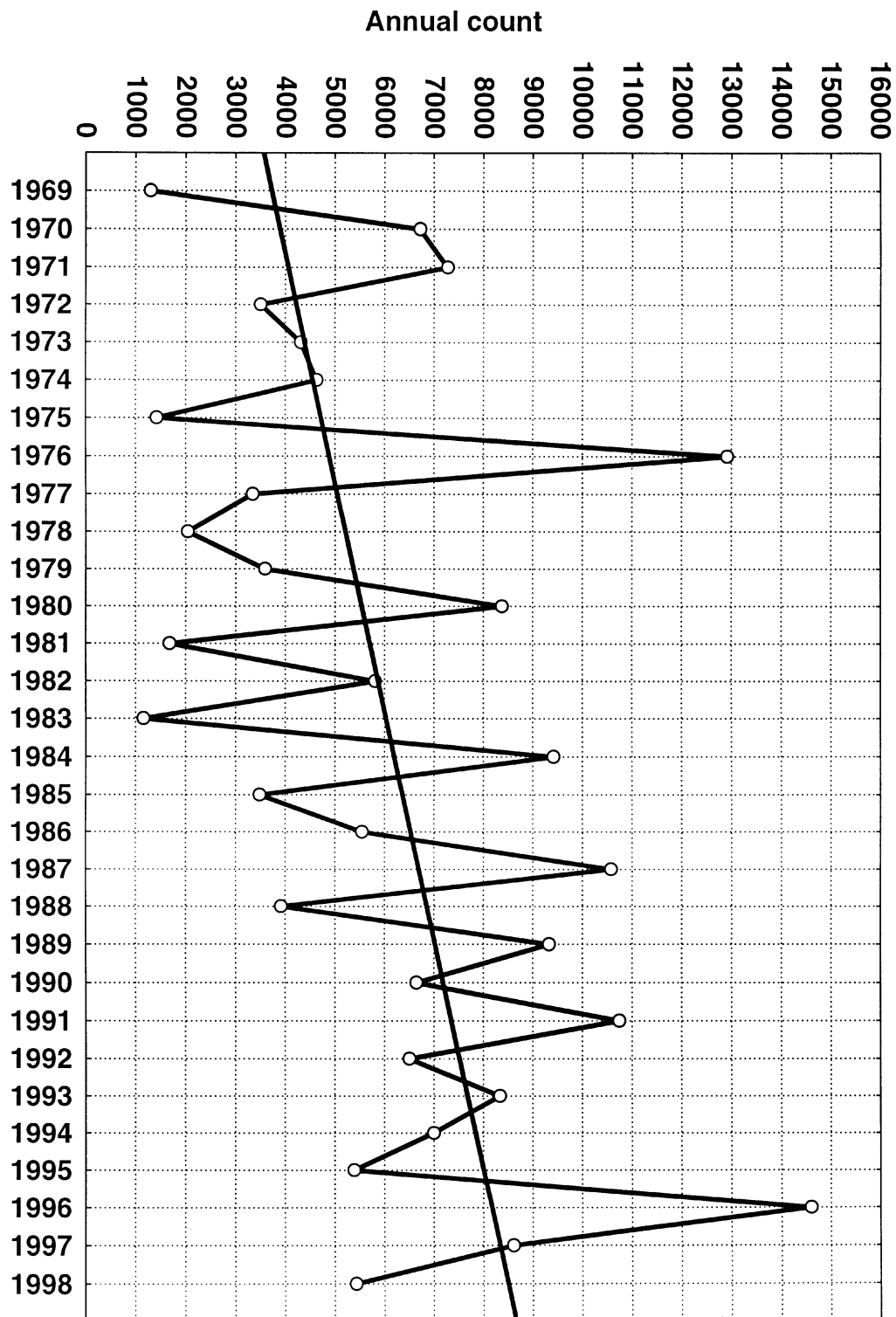


Figure 4. Annual count of birch pollen in Basel 1969–1998 with linear trend ($p < 0.05$).

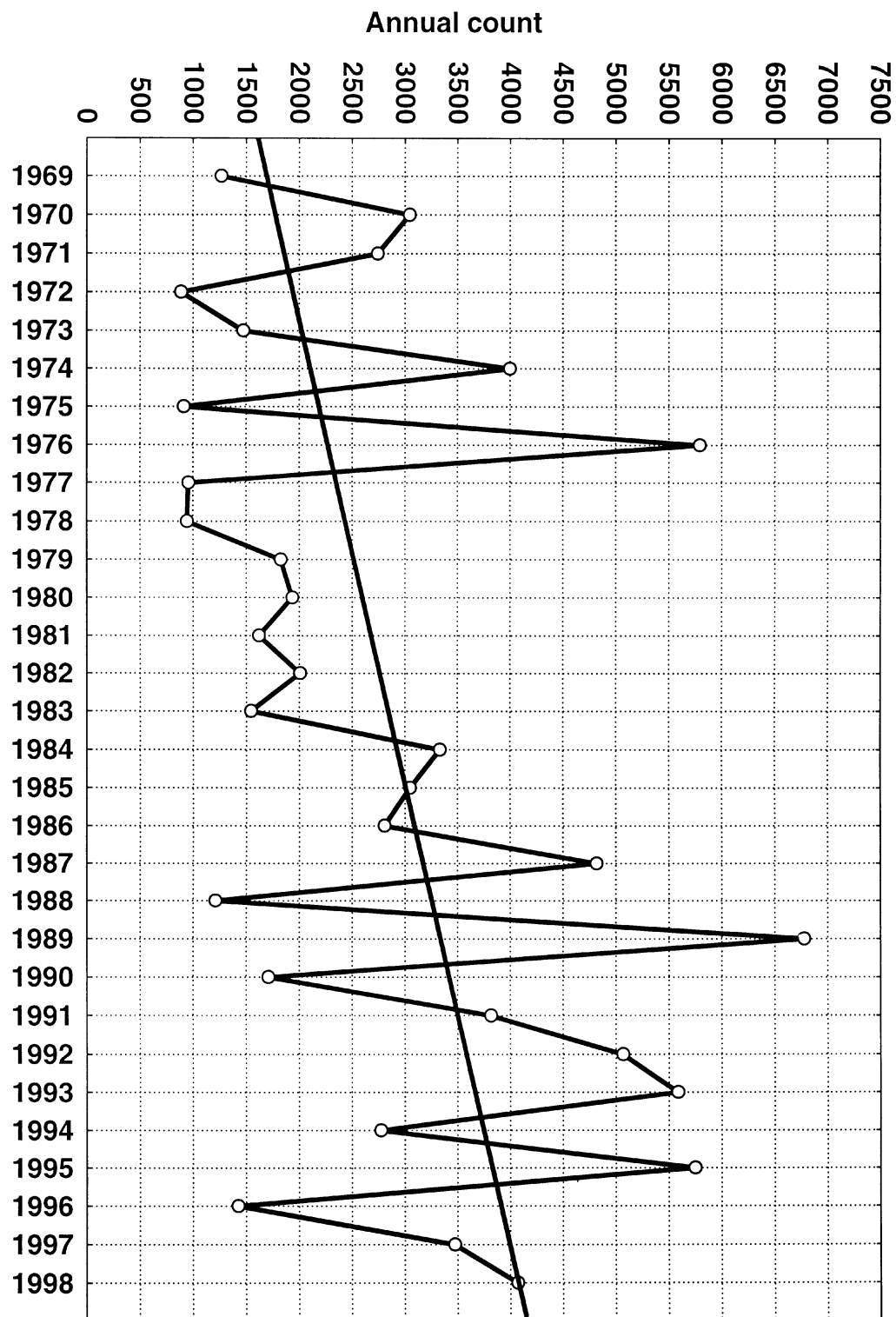


Figure 5. Annual count of oak pollen in Basel 1969-1998 with linear trend ($p < 0.05$).

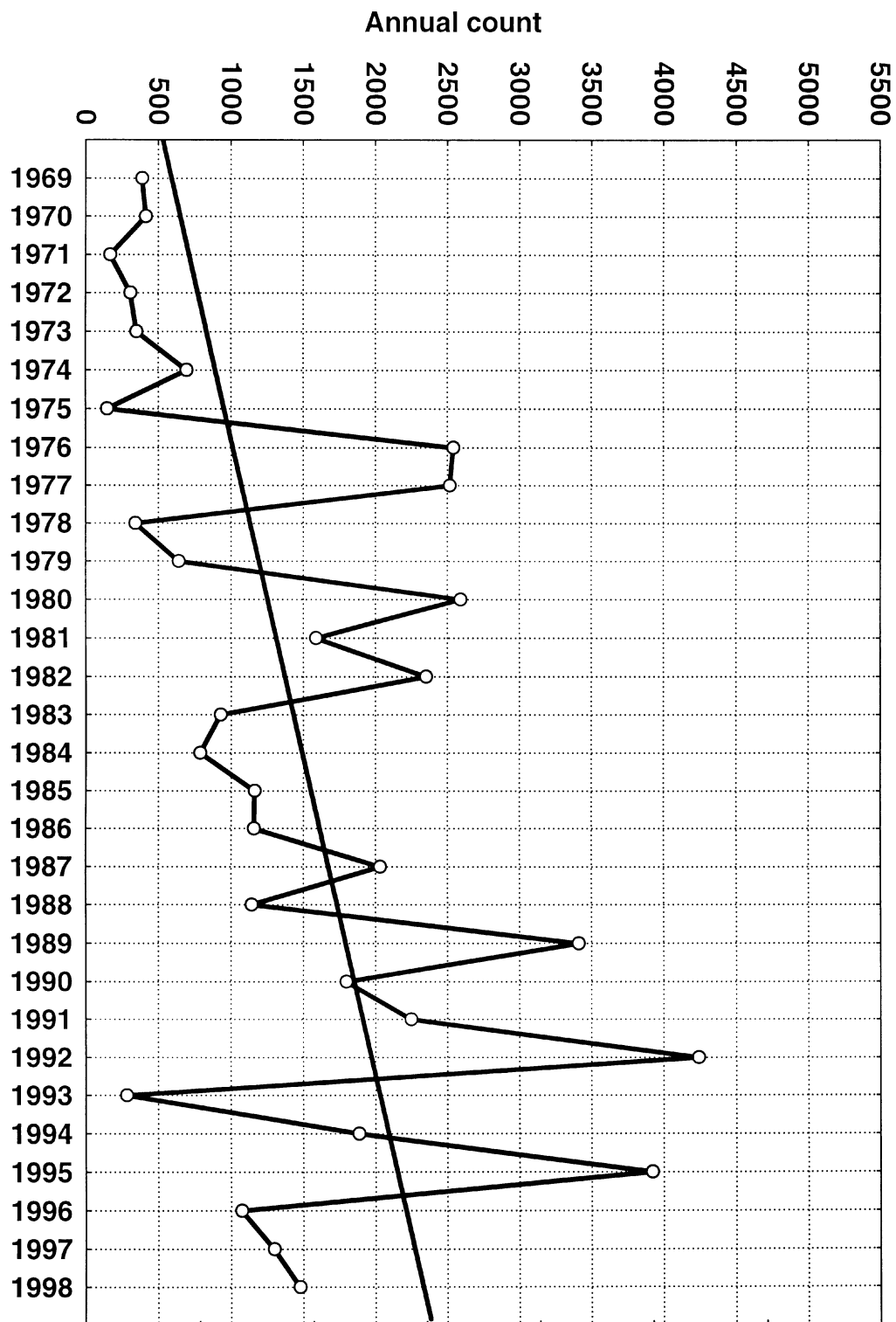


Figure 6. Annual count of beech pollen in Basel 1969–1998 with linear trend ($p < 0.05$).

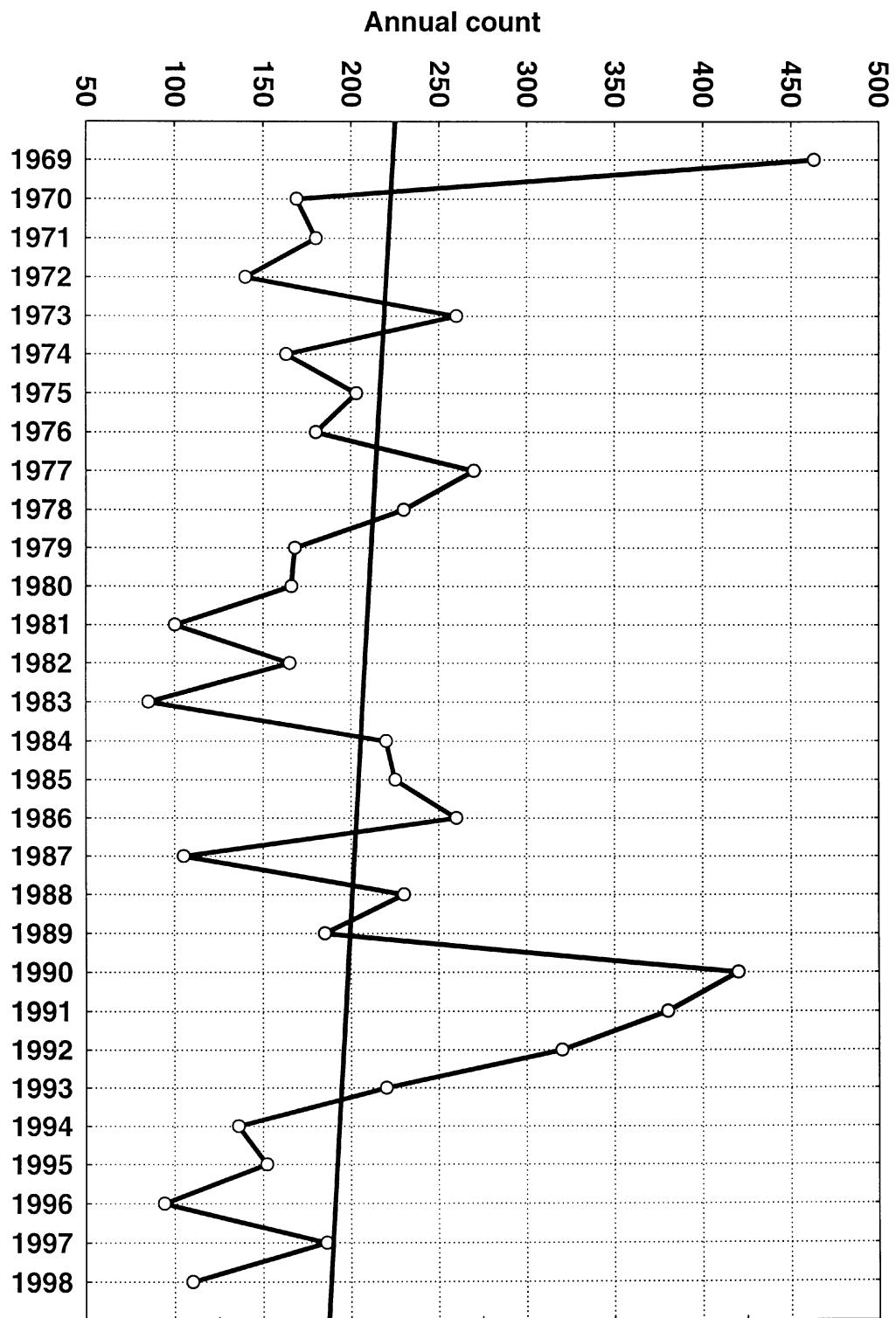


Figure 7. Annual count of mugwort pollen in Basel 1969–1998 with linear trend ($p > 0.05$).

gations, showing that allergy towards tree pollen becomes more and more important compared with allergy towards grass or herb pollen (Frei et al., 1998a; Frei, 1998b).

More tree pollen, among other factors like the 'western style of life' (Nowak et al., 1998), may be one of the reasons why allergies in general have increased dramatically in all western societies (Wüthrich et al., 1989).

The reason why there are now more pollen observed than some years ago may be explained by an increase of CO₂ and NO_x concentration as an input of nutrients as well as the increased air temperature to support production of more pollen (Miglietta et al., 1995). Certain trees like *Betula* may also really have increased by human activities in parks and avenues.

References

- Emberlin J., Mullins J., Corden J., Millington W., Brooke M., Savage M. and Jones S.: 1997, The trend to earlier Birch pollen season in the U.K.: A biotic response to changes in weather conditions? *Grana* **36**, 29–33.
- Frenguelli G., Bricchi E., Romano B., Mincigrucci G., Ferranti F. and Antognozzi E.: 1992, The role of air temperature in determining dormancy release and flowering of *Corylus avellana* L. *Aerobiologia* **8**, 415–418.
- Frenguelli G., Ferranti F., Romano B., Bricchi E., Mincigrucci G., Fornaciari M. and Spieksma F.Th.M.: 1993, Temperature influence on differentiation and release of hazel pollen. *Allergie et Immunologie* **25**, 147–149.
- Frenguelli G., Ferranti F., Tedeschini E. and Andreutti R.: 1997, Volume changes in the pollen grain of *Corylus avellana* L. (Corylaceae) during development. *Grana* **36**, 289–292.
- Frei Th., Oertmann Ch. and Bergmann K.-Ch.: 1998a, Vergleich von Pollenflugdaten und pollenassoziiertem oralem Allergiesyndrom. *Allergologie* **21**, 98–104.
- Frei Th.: 1998b, The effects of climate change in Switzerland 1969–1996 on airborne pollen quantities from hazel, birch and grass. *Grana* **37**, 172–179.
- Frei Th.: 1999, Pollenasthma in der Schweiz 1993–1997. *Allergologie* **22**, 382–387.
- Hirst, J.M.: 1952, An automatic volumetric spore trap. *Annual Applied Biology* **39**, 257–265.
- Jäger S., Nilsson S., Berggren B., Pessi A.-M., Helander M. and Ramfjord H.: 1996, Trends of some airborne tree pollen in the Nordic countries and Austria, 1980–1993. *Grana* **35**, 171–178.
- Nowak D., Wichmann H.E. and Magnussen H.: 1998, Asthma and atopy in Western and Eastern communities – current status and open questions. *Clinical and Experimental Allergy* **28**, 1043–1046.
- Leuschner R.M.: 1974, Luftpollenbestimmung in Basel während der Jahre 1969 und 1970. *Verhandl Naturforschenden Gesellschaft Basel* **84**, 521–626.
- Leuschner R.M.: 1991, Comparison of airborne pollen levels in Switzerland at four recording stations in Davos, Lucerne Nyon and Basle during 1989. *International Journal of Biometeorology* **35**.
- Leuschner R.M.: 1994, Vergleich der Luftpollen an drei Messstellen: Davos-Wolfgang, Wiesen GR und Basel. *Allergologie* **17**, 505–508.
- Miglietta F., Tanasescu M. and Marica, A.: 1995, The expected effects of climate change on wheat development. *Global Change Biology* **1**, 407–415.
- Spieksma F.Th.M., Emberlin J.C., Hjelmroos M., Jäger S. and Leuschner R.M.: 1995, Atmospheric birch (*Betula*) pollen in Europe: Trends and fluctuations in annual quantities and the starting dates of the seasons. *Grana* **34**, 51–57.
- Weatherhead E., Reinsel G.C., Tiao C., Meng X.-L., Choi D., Cheang W.-K., Keller T., DeLuisi J., Wuebbles D.J., Kerr J.B., Miller A.J., Oltmans S.J. and Frederick J.E.: 1998, Factors affecting the detection of trends: Statistical considerations and applications to environmental data. *Journal of Geophysical Research* **103**, 17149–17161.
- Wüthrich B.: 1989, Epidemiology of the allergic diseases: Are they really in the increase? *International Archives Allergy Applied Immunology* **90**, 3–10.
- Wüthrich B., Peeters A.G., Schindler Ch., Brändli O. and SAPALDIA-Team: 1994, Prevalence of atopy, hay fever and asthma in eight areas of Switzerland (SAPALDIA-Study). *ACI News Supplementum* **2**, 112.