Preface

According to a recently published report, the emissions of acidifying and eutrophying substances and ground-level ozone precursors have fallen substantially throughout Europe since 1990, but they continue to pose risks to human health and the environment[1]. In contrast, other pollutants like fine particles containing organic compounds as well as elements like platinum or antimony that are increasingly being released into the environment due to new technological production processes, volatile organic compounds (VOC) and several other organic pollutants as well as the mutagenic potential of contaminated air are coming more and more to the fore.

Air pollution is a transboundary, multi-pollutant/multi-effect environmental problem. Consequently, transboundary problems affecting human health and natural and man-made ecosystems in wide areas of Europe require European solutions. The European Union tackles the issue of air pollution for instance in the frame of the Sixth Environment Action Programme or the LIFE Environment Programme and within the scope of the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP).

However, air pollution is not only a regional problem of highly industrialised countries but a reason for global concern. More than half of the world's population live in urban areas in Asia. Urban air pollution in most of Asian major cities such as Beijing, New Delhi and Jakarta has worsened drastically due to the cumulative effects of population growth, industrialisation and increased vehicle use and is resulting in considerable health consequences[2]. The same holds true for many urban and industrialised agglomerations in Africa and Latin America. Various global scenarios indicate that air quality in large regions of the developing countries will further deteriorate rather than improve in the 21st century[3]. Clean air, however, is an important prerequisite for sustainable economic development and a basic requirement for human health and welfare. In addition, air pollutants contribute to atmospheric problems such as acidification and global climate change, which have impacts on crop productivity, forest growth, biodiversity, buildings and cultural monuments.

As a consequence of the development outlined above, monitoring techniques are needed that address the physical and chemical aspects of air pollution as well as its adverse effects on living organisms and whole ecosystems. Bioindicator plants have proved to be effective and reliable tools for the detection and monitoring of air pollutant impacts. As they work at low cost and operating expense they allow for effect-related monitoring of air quality in dense measuring grids in urban

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[1] EEA European Environment Agency, 2003. Europe's environment: the third assessment.
[2] www.asiairnet.org
[3] e.g. Prather et al., 2003. Fresh air in the 21st century? Geophys. Res. Letters 30 (2), 1100, doi:10.1029/2002GL016285

centres and are also very valuable in studies in remote areas, in extensive monitoring networks covering wide geographical areas and in regions with little financial resources.

In November 2002, the major outcomes of EuroBionet, the 'European Network for the Assessment of Air Quality by the Use of Bioindicator Plants', and the main conclusions and recommendations concerning the use of bioindicator plants in environmental monitoring and education programmes were presented during an international conference on 'Urban Air Pollution, Bioindication and Environmental Awareness' at the University of Hohenheim. Experts from 20 countries in Europe, Asia and Latin America took the opportunity to showcase results from various biomonitoring studies and environmental education campaigns, to present new methodological approaches and to discuss further steps in establishing bioindication methods in routine air quality monitoring at the European level. The present book contains the lectures and poster presentations as well as the recommendations adopted by the participants of the final panel discussion. We are very grateful to the attendees of the conference and to the contributors of this proceedings volume. We also wish to thank the European Commission for funding the EuroBionet project, the Stiftung Landesbank Baden-Württemberg LBBW and the Universitätsbund Hohenheim e.V. for supporting the conference, and Alexander Hamilton for his commitment with the project and the art contribution to this book.

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Air pollution research in London

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Abstract

This paper describes past and current work on air pollution in London, with emphasis on impacts on vegetation and biomonitoring. Much of the current research is under the auspices of the Air Pollution Research in London (APRIL) network which brings together a wide range of interested parties. The Mayor of London has published his Air Quality Strategy aimed at reducing pollutants to levels not damaging to human health. Current NO_x levels across London exceed the Objective for sensitive vegetation and ecosystems. Major studies on epiphytic lichens have indicated increases in nitrophilic species and SO_2 no longer appears to be a major factor contributing to lichen distribution in London. APRIL projects include lichen transplant studies, measurements of nitrogen levels in *Calluna* and analysis of bird population data in relation to air pollution. In the days when London was heavily polluted with coal smoke and SO_2 there were severe effects on many higher plant species. However, even with the major improvements in air quality, filtration and transect studies in the 1980s still indicated adverse impacts of ambient pollution on plant health. Recent work has examined impacts of diesel exhaust on native plant species and shown adverse growth and physiological effects at ambient levels. An ongoing long-term transect study has shown that lichens growing on oaks are only slowly recolonising London. The highly SO_2-tolerant lichen, *Lecanora conizaeoides*, has effectively disappeared from this transect, providing evidence of falling SO_2 concentrations. Two fungal pathogens, *Rhytisma acerinum* (cause of tarspot of sycamore) and *Diplocarpon rosae* (cause of blackspot of roses) have reinvaded areas of the UK where SO_2 had previously prevented infection, but the former is still absent from London, probably due to prevailing NO_x levels. Research at Imperial College has demonstrated clearly that ambient pollution in London can markedly stimulate the performance of aphids.

Key words: **air pollution, London, lichens, higher plants, fungal plant pathogens, herbivorous insects, transects, filtration**

Air Pollution Research in London Network (APRIL)

Five years ago representatives from London's leading academic institutions, national and local government and other organisations with an interest in air quality proposed that an air pollution research network be established. The demands of new legislation, the introduction of a strategic body for London, the Greater London Authority (GLA) with an elected Assembly and Mayor, and concerns over the health of Londoners and the state of their environment meant that collaboration to identify, prioritise and deliver appropriate research to deal with air pollution was essential. It was also acknowledged that with over one hundred monitoring stations recording continuous measurements of ambient air, good emissions inventories and large databases covering social, economic and environmental statistics, London provided an excellent laboratory for experimental work. The Engineering and Physical Sciences Research Council (EPSRC) provided financial support in 1999 and the Air Pollution Research in London (APRIL) Network was established. Steered by a committee chaired by Professor Helen ApSimon of Imperial College London, the network developed through a programme of conferences, seminars and specialist group meetings. Experts were appointed to lead the specialist groups and they in turn invited other scientists and interested parties from across the UK and abroad to discuss urban air quality issues, disseminate new research results and address current and future research needs. Two major research programmes have been agreed and numerous smaller projects established. A major cross-disciplinary project investigates the dispersion of air pollutants and their penetration into the local environment (D.A.P.P.L.E.) [1]. The field campaign involves the release of a tracer gas and measurements at a range of heights and distances along the Marylebone Road, a major road junction in the London Borough of Westminster. Personal exposure of pedestrians and transport users, and a range of traffic and meteorological data are also being collected. The results will be further investigated using wind tunnel experiments and the information gained applied to urban scale computerised models as well as more generally in public health and air quality. The second major programme addresses the air mass coming into London, influenced by European emissions, the chemistry over London and the air mass leaving the city. APRIL organises specialist groups on Measurements, Modelling, Meteorology, Health, Transport, Indoor Air, and Planning & Socio-Economic Aspects of Air Quality and of particular relevance to the EuroBionet Conference, a Natural Environment Group. Members have a wide range of expertise, which they apply to the unique pollution climate of London.

Air quality in London

Following the completion of the review and assessment of air quality in accordance with EU and UK statutory requirements, the London Mayor published his Air Quality Strategy in 2002 [2]. Concentrations of sulphur dioxide have fallen from an annual mean high of over 350 µg m^{-3} in the seventies to an annual average across London in 2001 of 3 µg m^{-3}, with no exceedance of the EU Objectives for health or vegetation expected. A UK Objective of 266 µg m^{-3} as a fifteen-minute mean is, however, exceeded in some parts of the south east due to emissions from power stations and refineries operating on the banks of the River Thames. Ozone has increased by an average of 15 % over the past five years, [3] peaking in 2000 with some exceedances of the Objectives for human health, mainly in the outer London boroughs. Conversely the Objectives for nitrogen and particulate matter (PM_{10}) are widely exceeded. PM_{10} exceedances, expressed as the number of days over the 24 hour Objective of 50 µg m^{-3} do occur, particularly in the centre of London. Westminster, for example, recorded 106 days above the 24 hour threshold in 2001. Annual concentrations were recorded as 44 µg m^{-3}. This exceeds the annual mean Objective of 40 µg m^{-3} for the UK to be achieved by 2004 and the new UK PM_{10} Objective of 20 µg m^{-3} to be achieved by 2010. London has been designated a special case for the new longer term Objective and has a less stringent annual Objective of 23–25 µg m^{-3}. Exceedances of the 24-hour mean are also lowered, with 10–14 days allowed over the 50 µg m^{-3} Objective compared with only 7 days for other areas of England. Ozone increases with distance from the city centre and NO_2 decreases (Figures 1 & 2).

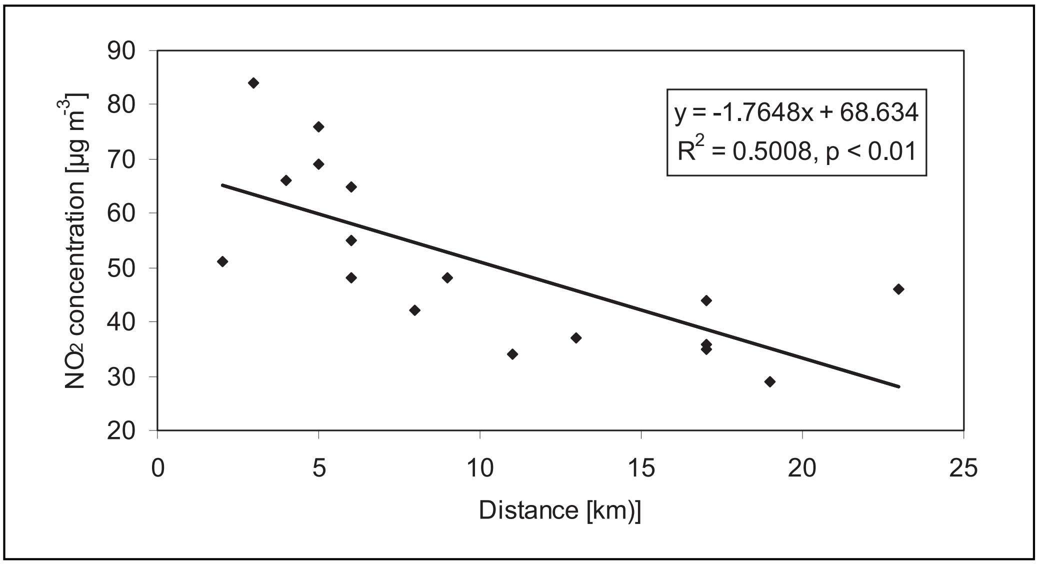

Fig. 1. Annual mean concentrations of nitrogen dioxide vs. distance from the city centre.

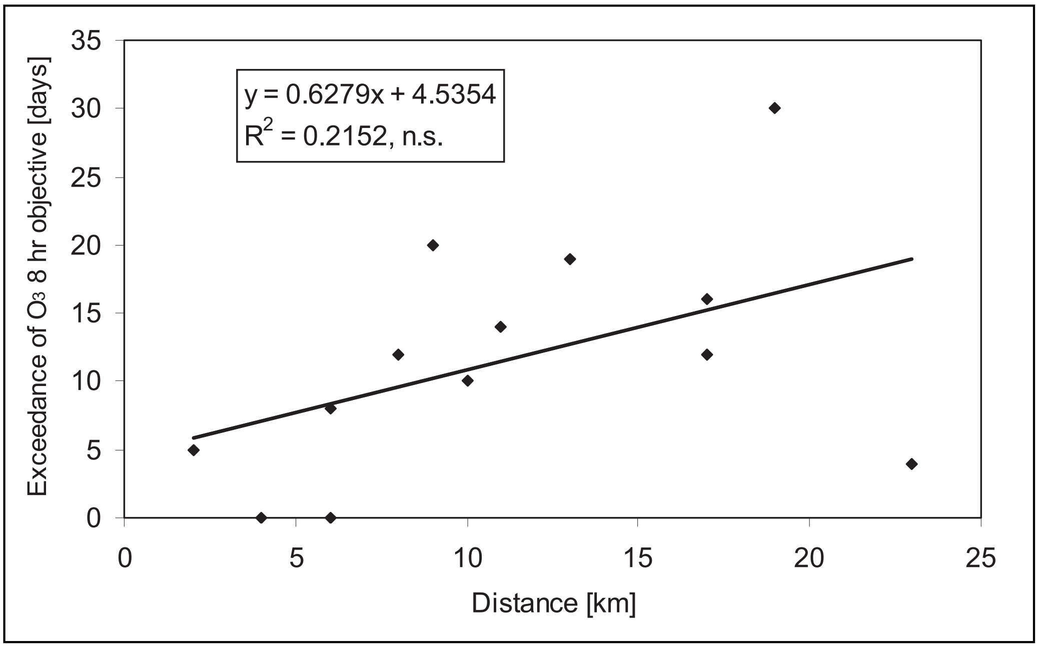

Fig. 2. No. of days exceeding the 8 hour ozone Objective for human health vs. distance from the city centre.