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Lichenological studies in Turkey and their relevance to environmental interpretation

Abstract

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Progress in Turkish lichenology has been made in four areas: firstly, by evaluation of material collected by non-lichenologists during historical expeditions, secondly, by analyses of random collections made by lichenologists during sightseeing trips, thirdly, by special projects concerned with floristic studies, and finally through applied studies using lichens as environmental monitors. An analysis of the 361 papers covering these topics in relation to Turkey has been undertaken. Papers by Turkish authors, which first appeared in the 1980s, relate to floristics, chemistry, bioindication, microbiology and radioactivity, with a noticeable absence of publications on systematics, taxonomy, nomenclature and physiology. Lichenological studies are relevant to environmental interpretation in Turkey in different ways: the available database of floristic information can help to calculate the influence of changing agriculture and forestry management, focussing on eutrophication, afforestation and grazing by sheep and goats. The use of lichens to demonstrate fluctuations in air pollution has been demonstrated in Izmir, Eskişehir and Ankara. Further subjects in Turkey which need to be environmentally interpreted by means of lichens include radioactivity, tourism and global climatic change; initial studies in these areas are presented, and others are considered. Fortunately the increasing interest of young Turkish scientists in lichens and their involvement in the Turkish Lichen Association (TLT) receive recognition and support for their studies by officials in government. Nevertheless, much work needs to be done.

History of lichenological studies in Turkey

Since the 19th century, extensive expeditions to Turkey have been undertaken to observe most groups of animals and plants and to determine geological features. However, since the participants of these explorations were not trained in all disciplines of natural science, the lichen samples, like numerous other organisms, had to be sent to specialists for identification. In this way, information on the different groups was scattered in several countries and in different publications. A comprehensive discussion of all material assembled from these expeditions is unfortunately lacking. Therefore, we have only floristic lists from that time, generally complemented by some ecological information. Furthermore, the samples are stored in foreign, non-Turkish herbaria. Such basic lichen floristic informations, although scattered, cover most areas of Turkey.

This first period was followed by field trips undertaken by lichenologists in the second half of the 20th century. However, most of these journeys focussed on historical sight-seeing sites, the lichens being collected more or less randomly along roadsides between historical highlights or near to them. It should be noted that collecting lichens from historical monuments themselves is still strictly forbidden. Important collections were made, for example, by Klaus Kalb, Ivan Pisut, Herbert Schindler and Antonin Vezda. Furthermore, Kalb and Vezda merit special attention for their contribution of extensive lichen materíal distributed in herbaria.

The lichenology undertaken by Turkish scientists started in the 1980s (Fig. 1). Ayşen Türk (born Özdemir) is the first 'Turkish lichenologist', as a consequence becoming the first President of the Turkish Lichenological Society (TLT, Türk Lichen Topluluğu), the first scientific association of its kind in Turkey. This group of Turkish lichenologists has developed mainly from young scientists working on floristic studies in different regions of Turkey. They merit attention since their 86 publications cover 67% of all papers produced by Turkish lichenologists (Fig. 2). In a country of 814578 km^2 it is obvious that their efforts need to be sustained in the next decades. It should be stressed that all these data need to be assembled and interpreted in order to effectively monitor many aspects of environmental change in the future.

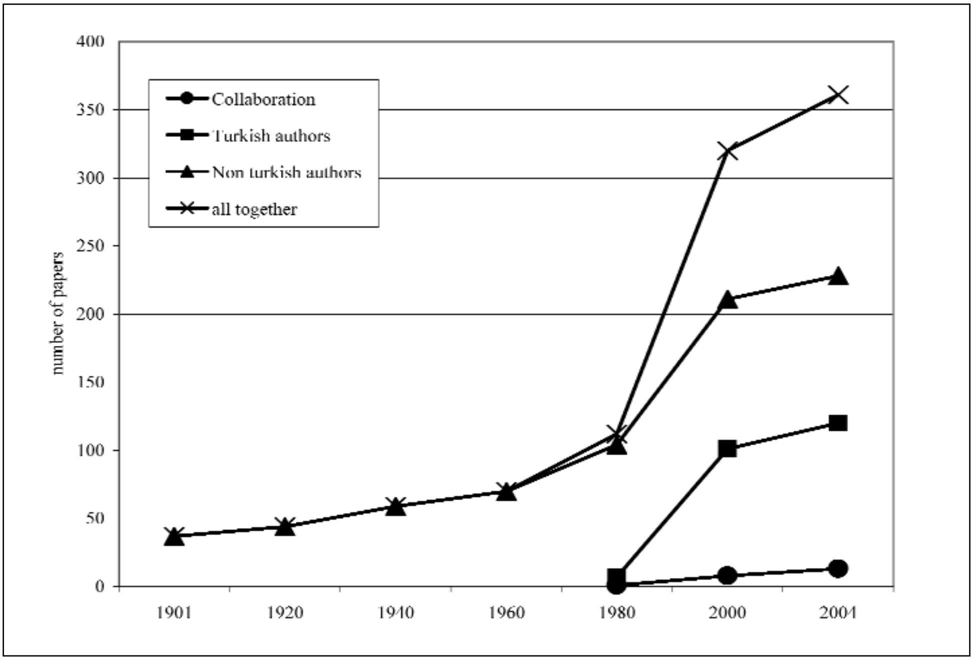

Fig. 1. Development of literature (cumulative) on Turkish lichens published by Non-Turkish authors, Turkish authors and joint papers.

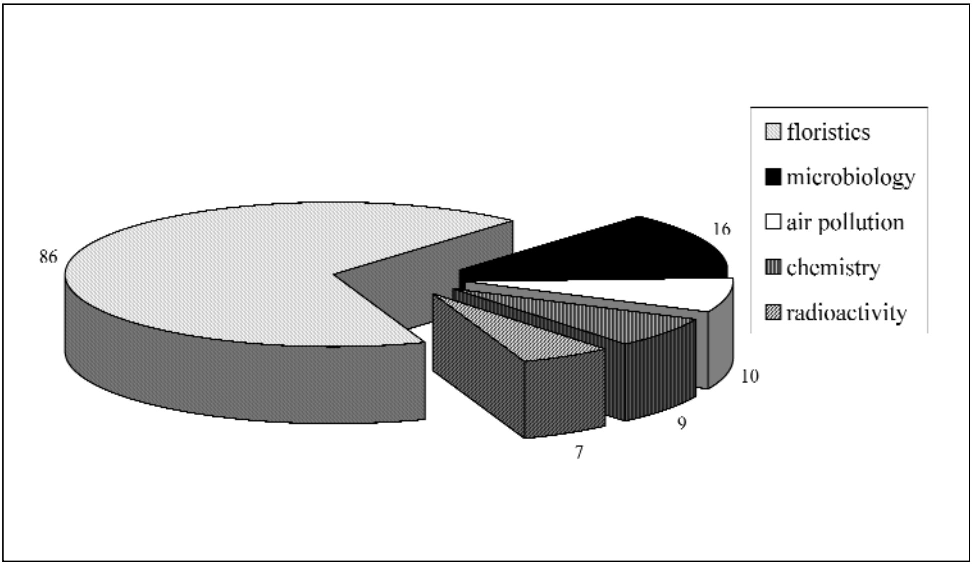

Fig. 2. Number of papers on lichens published by Turkish lichenologists and their specifications to different fields in lichenology.

Lichenological studies in Turkey focussing on applied science which employ lichens include research in microbiology (16 papers, 13%), air pollution (10 papers, 8%), chemistry (9 papers, 7%) and radioactivity (7 papers, 5%).

The remarkable result of all these activities is a number of more than 200 papers dealing with Turkish lichens in the two decades between 1980 and 2000. Note that the number of papers published by Turkish scientists in the period 2001-2004 exceeds those by non-Turkish lichenologists for the first time (Fig. 3).

Comprehensive documentation of information on Turkish lichens is in preparation, and a forthcoming publication resulting from the OPTIMA Commission initiative will include a bibliography, an up-to-date checklist, literature for the identification of Turkish lichens and information on relevant illustrations. The literature references will be ordered according to the 81 provinces of Turkey. Finally distribution maps (more precisely “known distribution”), based on the Flora Europaea grid of UTM 50 x 50 km squares, will be provided for every species (Fig. 4).

Relevance to environmental interpretation

The importance of lichen mapping based on rigorous and workable protocols has already been mentioned by Seaward (2004) in this meeting. Therefore the following second part will concentrate on showing some examples showing the relevance of lichenological studies for the interpretation of the different environmental characteristics and problems in Turkey.

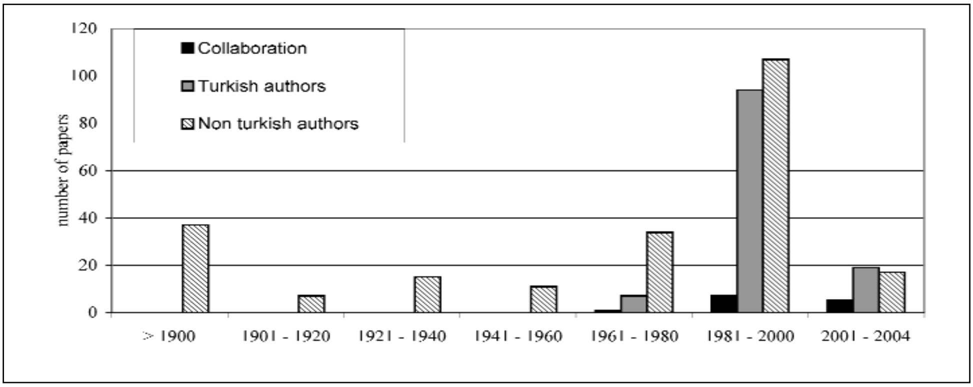

Fig. 3. Number of papers on lichens in Turkey published in periods of 20 years by Non-Turkish lichenologists, Turkish lichenologists and in collaboration of them.

Air pollution in cities and industrial agglomerations

For nearly half a century, the power of lichens as monitors was dominated by their use as indicators for air pollution, focussing on sulfur dioxide emissions. Examples of this classical use of lichens can be found for the Turkish cities of Bilecik, Bursa, Eskişehir and İzmir. Furthermore, data based on floristic observations can be used in this way for the calibration of air quality in İstanbul, Giresun and Ankara (Fig. 5).

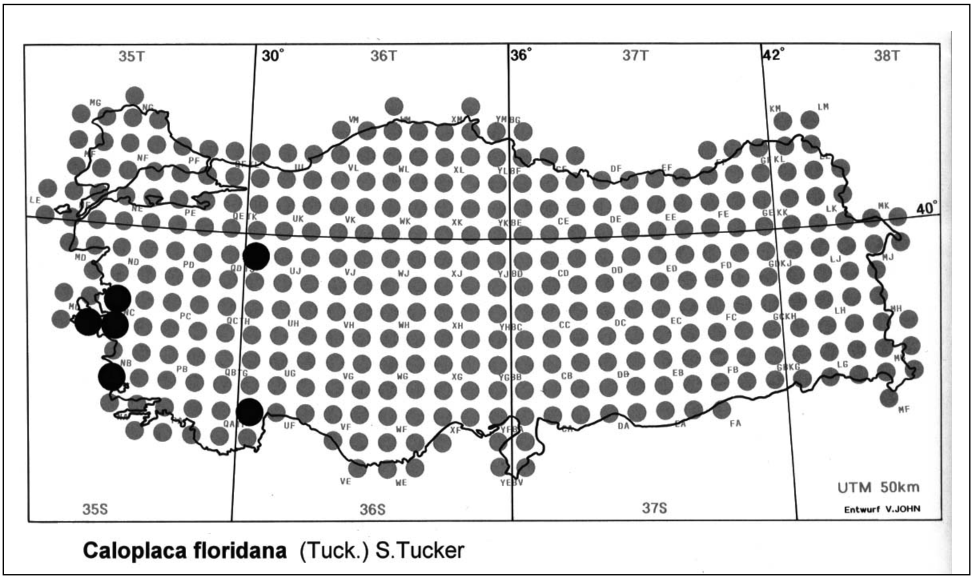

Fig. 4. UTM grid system based on 50 x 50 km squares.

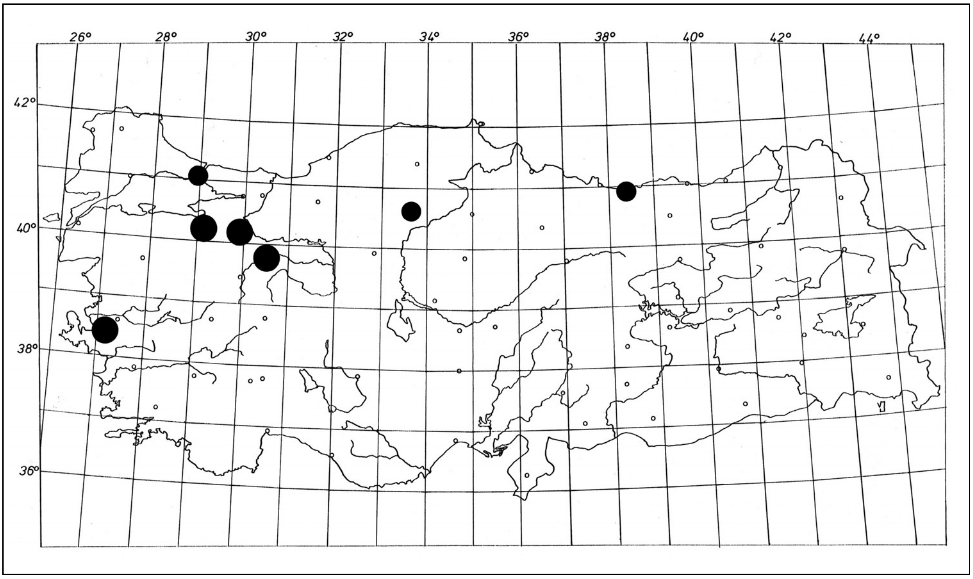

Fig. 5. Locations of the cities where an air pollution monitoring with lichens has been done (big dots) and where floristic data of the lichen vegetation can be used to calculate air pollution (small dots).

In the area of Izmir, change in air pollution could not be detected by this means during a 5-year period. However, Ankara and Eskişehir cities showed a decrease in sulphur dioxide emissions as a result of changing from coal to gas fired heating, where a clear recolonization of tree bark by lichens can be observed. The almost completed new tramway system in Eskişehir, thereby reducing pollution by motor vehicles, will undoubtedly also improves lichen recolonization, the effect as yet to be monitored. In Ankara, the recently created fountains in the city centre, by raising humidity levels, may cause a further improvement in lichen colonisation.

In the cities of Bilecik, Giresun, Izmir and Kayseri lichens have been used as bioindicators to estimate the relative input of the different heavy metals to the environment.

Monitoring radioactivity

The Chernobyl disaster resulted in a number of studies (seven papers) related to the accumulation of radiactive elements in lichens in Turkey. It should be noted that there were already relatively high background levels in some industrial areas caused by cement factories and agglomerations of certain building materials in the Aegean region which did not increase significantly as a consequence of Chernobyl (Topcuoğlu & al. 1992). In the naturally unpolluted region of the Black Sea region, the very low background level was considerably exceeded after Chernobyl. Contamination studies with lichens must accompany the planning and construction of the projected atomic power station in Turkey.

Road construction

Road construction in forestry areas, as pointed out by Degelius (1935) when he showed that enlarging a road by only 1 metre can affect the lichen flora up to a distance of 50 metres into the forest on both sides of the road. These effects can be observed in many regions of Turkey (John & Breuss 2004), the influence of road construction on the micro- and meso-climate being reinforced in some cases by the regulation of water-flow with these new road systems (Fig. 6). As the extension of all main roads in Turkey to broader highways is a governmental priority, the dry-plain areas in Central Anatolia and their associated lichen floras, as well as the forests, might be suffering under the diminution of such areas; lichen communities growing on gypsum soil clearly exemplifies these problems.

One of the saddest events of international importance resulting from roadway construction involves the "Gülekboğazı" in the Toros Mountains, made famous by Alexander the Great, which supports a unique, rich and diverse flora and fauna: wholesale landscape changes here have affected all aspects of its environment, the lichens suffering as consquence like most other organisms (Fig. 7). Coastal rocks are also suffering, or even disappearing, under road constructions; therefore, monitoring the lichens of the sea-cliffs in Turkey should be a priority.

Monitoring agricultural and forestry management practices

In Central Europe, impact of nitrogen has received more importance than sulphur dioxide in recent years. These new environmental conditions necessitate a renewal of monitoring guidelines for lichens, particularly in respect of fertilizer and pesticide applications (Verein Deutscher Ingenieure 2004). One of the gravest problems in Turkish agriculture is the grazing of sheep and goat, which cause different effects in the various climatic ecoregions of Turkey. On one hand, many lichen species are usefull as food for these animals, on the other hand they indicate overgrazing and nitrification.

There seems to be no other country undertaking so much effort in reforestation than Turkey. Keeping sheep and goats out of young plantations and protecting these areas against artificial fire allows huge areas to be recovered by forest, which will clearly change the micro-, meso- and even macro-climate (Fig. 8). Karabulut & al. (2004) give a good demonstration of this fact, the indicator values in respect of Turkish lichens aiding considerably environmental interpretation of this phenomenon.

Observance of climatic changes and Lichenometry

The global changes of climate are composed of numerous effects. Nearly all of them can be monitored by the use of lichens. Lichen physiology helps in detecting carbondioxide and even the evaluation of simple floristic inquiries demonstrate global warming (van Herk & al. 2002). As detailed and comprehensive floristic data from the past are allmost lacking in respect of the lichens in Turkey, a survey of the lichen distribution at the present time is in deep need to receive a baseline document, with the objective to monitor changes in the future. Lichenometry (Lock & al. 1979) is a tool to detect local differences

Fig. 6. Ecological features of special landscapes are well defined by the lichen vegetation. The biological balance is highly endangered by road construction and water flow changes. Black Sea mountains 1997.

Fig. 7. Toxitolerant and ubiquitous lichens characterize such destroyed habitats. Taurus Mountains 1992.

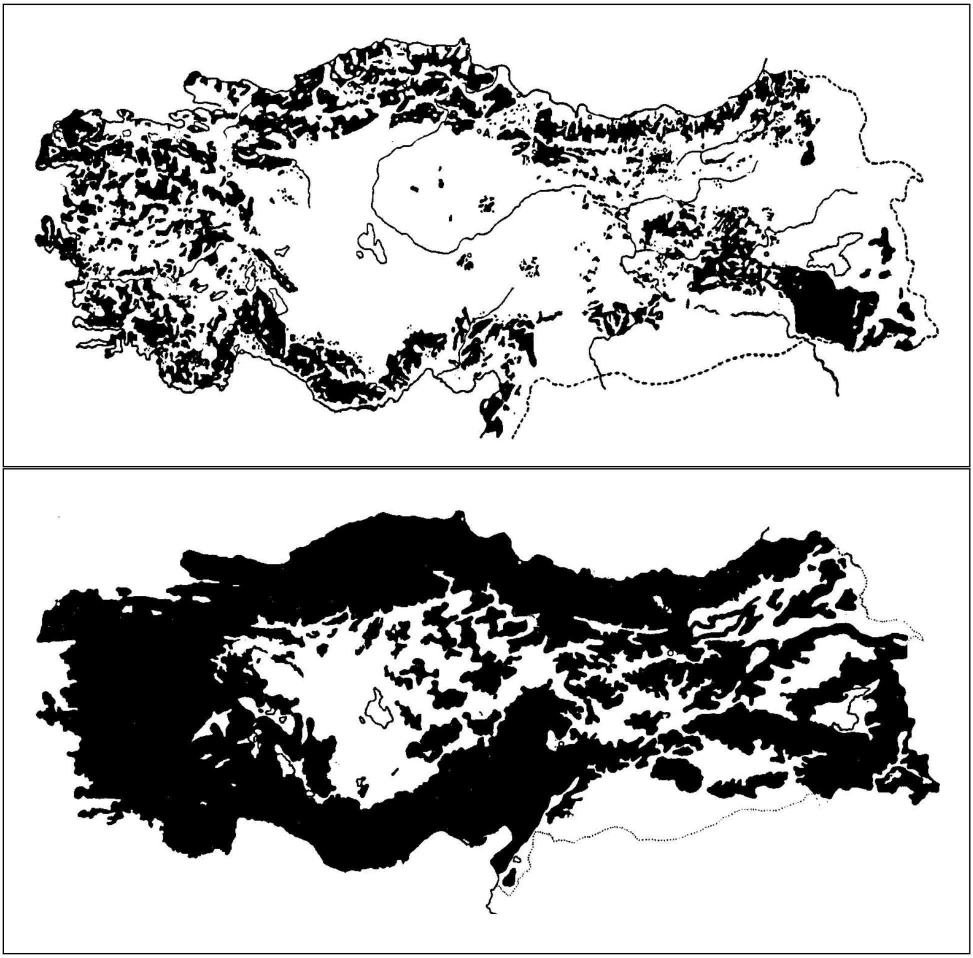

Fig. 8. The climatic effect of changing from present (above) to potential forest areas (below) can be estimated by the use of lichens in different ways.

caused by afforestation or by daming up in recent times and to describe geomorphological particularities in historical times.

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