The Palaeoenvironment of Prehistoric Man in the Near East : Some Aspects of Palynological Research

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The Palaeoenvironment of Prehistoric Man in the Near East: Some Aspects of Palynological Research

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Various aspects of the palaeoenvironment of prehistoric man in the Near East are treated on the basis of the pollen record. A review of relevant literature on the subject is given. Information on new research in North and West Turkey is given on three geographical units: the Anatolian steppe, the east-west oriented mountain ridges of the Black Sea forest, and the northern and western lowland. The difference or similarity in time and composition of the pollen record of the units are discussed.

The increasing pressure of human habitation and the declining change in climate from the Late Glacial to the Holocene are treated. The value of the AP/NAP ratio indicating deforestation is treated. A characteristic event during the second millennium BC forms the socalled Beyşehir occupation phase that is explained here in connection with a climatic change.

Keywords; PALAEOENVIRONMENT NEAR EAST POLLEN LATE GLACIAL HOLOCENE CLIMATIC CHANGE VEGETATION HUMAN IMPACT

INTRODUCTION

The part of the Near East that may be successfully covered by palynological research is delimited approximately by the 300 mm isohyet. Where annual precipitation is lower, lake or marsh sediments are very scarce and even if sedimentation takes place, pollen is rapidly oxidized. For instance, our research at the edge of the Arabian-Persian Gulf in Kuweit and the Emirates conducted in co-operation with P. Sanlaville, (Lyon, France) and in Oman with Chr. Hannß (Tübingen, Germany) yielded no palynological remains.

In this paper the evidence from those parts of the Near East that has been published is listed in a bibliography. Preliminary information will be given from unpublished or partly published diagrams of cores collected in central, northern and western Turkey. The results from Iran have been published by Wright et al. (1967), van Zeist & Wright (1963), van Zeist & Bottema (1977) and Bottema (1986). The northeast of Turkey was palynologically investigated by Aytug et al. (1975) and the northwest by Beug (1967). The publication of the results from the

southwestern part (van Zeist et al., 1975) was the beginning of systematic investigations in Turkey, which was followed by the eastern part (van Zeist & Woldring, 1978) and the southwest (Bottema & Woldring, 1984 (1986), 1990). For the western part, a core near Izmir was studied by Sullivan et al. (pers. comm.). No conclusions are available of a pilot study of a core taken in the Azraq valley in Jordan by R. Neef (München, Germany). For Syria we have information mainly from the northern half. The Khabur valley in the east has been studied by Gremmen & Bottema (1991). From the central north, a study focussing upon the Balikh valley has been published (Bottema 1989). Northwestern Syria was treated by Niklewski & van Zeist (1970) and van Zeist & Woldring (1980). Some information on the area west of Damascus is supplied by Bottema (1975-77). An extensive study on the modern pollen precipitation of Lebanon and Syria has been published by Bottema & Barkoudah (1979). Studies on Israel have appeared by Horowitz (1971), Weinstein-Evron (1976), Tsukada (in van Zeist & Bottema, 1982), Baruch (1986, 1990), and Baruch & Bottema (1990). From the Arabian peninsula only little evidence is available. The reason has been explained above. Some lake deposits from Saudi Arabia of Pleistocene and Holocene age have been studied by Schulz & Whitney (1986). Worth mentioning is the study of deep-sea cores off the south coast of the Arabian peninsula by Van Campo (1983).

Palynological investigations of archaeological sites have been conducted by various researchers. The value of such studies is questionable however; for results the reader is referred to a review by Turner (1985).

Present and future palynological research in the Near East

The introduction mentioned a range of publications on palynological investigations in the Near East. A complete work on the 'Late Quaternary vegetation of the Near East' by van Zeist & Bottema (1991) has appeared in the 'Beihefte zum Tübinger Atlas des Vorderen Orients, Reihe A (Naturwissenschaften) Nr. 18'. Two palaeo-vegetation maps of this area are already available (Bottema & van Zeist, 1989, 1990) presenting various time slices from several periods of the Late Quaternary.

1) Northern Turkey

At present two projects dealing with the history of the Late Quaternary vegetation and climate of Turkey are running. One was started in 1984 in central and northern Turkey. The research forms a joint project of Professor B. Aytuğ (Orman Fakültesi, University of Istanbul) and the Palaeobotanical department of the Biologisch-Archaeologisch Instituut (State University of Groningen). Thirteen sites were cored in the area between Adapazari in the west and Samsun in the east. The Kizilirmak river borders the research area in the south. Pollen diagrams have been prepared for these sites by H. Woldring, J. Olde Loohuis and the present author. The investigations include a study on the modern pollen rain.

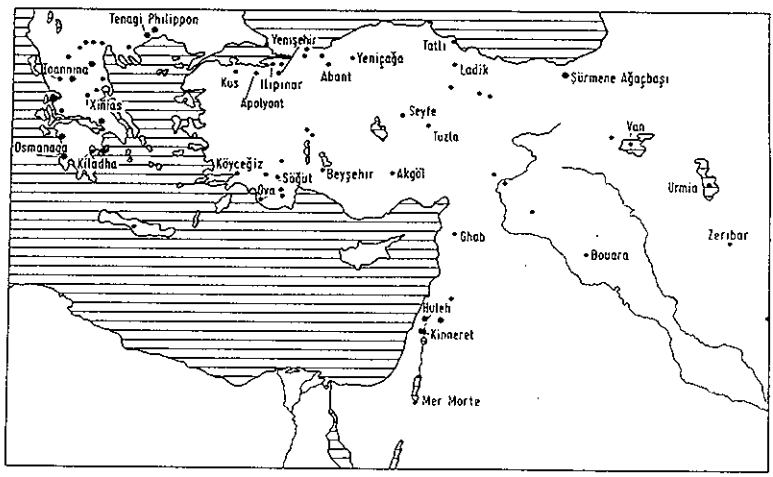

Fig. 1. Map of the Near East with core locations.

Central and northern Turkey cover a large and diverse area with many contrasts. More than 1000 mm of rain falls in the coastal part, whereas in the southern part in the Kizilirmak valley precipitation is less than 400 mm.

The cores collected for this project come from the three main geographical areas: the Anatolian steppe; the high mountain ridges bordering the Black Sea and the Black Sea coast. The cores from the Anatolian steppe were collected from the banks of saline lakes. Samples from deposits that were found under conditions which for an important part must have been saline, are often devoid of pollen. This is possibly due to oxidation under alternating dry and wet conditions. When pollen is present, selective corrosion is indicated by high percentages of pollen types which are known to be comparatively resistant (Havinga, 1984). Thus, diagrams from the lakes of Seyfe and Tuzla show a marked over-representation of Liguliflorae. This type not only survives corrosion better than most types, but also can be identified very easily.

The age of the clay and sand sediments of the steppe lakes cannot be measured by radiocarbon dating because they contain no organic material. The period covered by the pollen diagrams of Tuzla and Seyfe can only be dated by cross-correlation with other, dated diagrams. They point to the younger half of the Holocene.

Pollen diagrams of the mountain area in northern Turkey, with an annual precipitation of more than 600 mm, are prepared from sediments of permanent lakes and marshes found in intramontane depressions. The pollen record often covers the Holocene and the Late Glacial. Cores taken from the Black Sea coast turned out to be younger than those from the mountains. The coastal sediment dated by radiocarbon covers at most c. 6000 years. The presence of pollen-bearing sediments along the Black Sea is determined by hydrological developments since the Ice Age.

Around 6000 BP conditions seem to have stabilized and sediments started to form where the run-off water from the mainland met the shore and sand bars of the Black Sea. Older sediments must be present under water, off the shore. Sand layers hindered coring with traditional equipment and in many cases even prevented sampling.

In places where much water from the mainland is transported by discharging rivers, such as the Sakkarya and the Kizilirmak, deposits are easily destroyed and redeposited elsewhere. In such unstable sand and gravel, coring is useless. Clay deposits turned out to be very young and pollen concentration was low because of rapid deposition.

The conclusion is that the pollen record of the steppe covers the younger half of the Holocene only and suffers from bad preservation (Seyfe Gölü, Tuzla Gölü). The record of the Black Sea coast covers about the same period but the pollen conservation and concentration is much better (Tatli Gölü, Küçük Akgöl, Akgöl Adatepe).

Between the steppe and the Black Sea coast, the mountain area is a profitable source of information producing long pollen sequences with a good prospect for isotope dating (Abant Gölü, Yeniçaga Gölü, Ladik Gölü, Kaz Gölü, Melen Gölü).

2) Western Turkey

Western Turkey is of special interest because of its extensive Mediterranean lowlands and its prehistoric/historical settlement. Lowland coring sites were investigated before, partly in the Mediterranean vegetation belt, but such sites were situated in a narrow zone at the foot of steep mountains bordering the Anatolian plateau (Köyceğiz Gölü, Ova Gölü, Tatli Gölü).

Mountains or mountain ridges in western Turkey, at the edge of the lowland plains, seldom rise to over 600 m. Only the solitary Uludağ (2493 m) peaks high above the landscape. Eu-Mediterranean vegetation penetrates far into the interior. Western Turkey was and is favourable to agriculture and horticulture and since long large areas have been worked into farmland.

In connection with the excavations at Ilipinar, directed by Dr. J.J. Roodenberg (Dutch Historical Archaeological Institute, Istanbul), a joint project was started in 1988 with Professor I. Kayan (Ege University, Izmir). The prehistoric site of Ilipinar, not far from Orhangazi, drew Roodenberg's attention because it might contribute to the knowledge of the routes agriculture took as it spread from its origins in the Fertile Crescent. For this reason the position of Ilipinar on the way to Thracia and the Danube area was considered promising. In four seasons of excavation, important evidence has come to light. The site, which started in the 8th millennium BP, differs from counterparts more to the east. The abundant presence of timber immediately around the site and in its wider surroundings enabled the inhabitants of Ilipinar to build their houses of wood. In this respect the settlement differed markedly from the mudbrick houses of the eastern parts of Turkey. The study of the wood remains will be complementary to the palynological investigations.

The site of Ilipinar lies on the west side of Lake Izunik (Greek Nicea) and cor-

ing for pollen started in that area. Further southwest, Kus Gölü (Manyas Gölü) and Apolyont Gölü were sampled. Between Iznik Gölü and Uludağ, the recently drained marshes of Yenişehir were sampled for investigation. Woldring's study revealed that the pollen records of Apolyont, Kus and Iznik Gölü cover the last few millennia only. The core from Yenişehir, however, includes the Holocene and the Late Glacial, as concluded from the pollen assemblages. Radiocarbon dating is impossible because hardly any organic deposits are present in the clay sediment of Yenişehir.

In theory, one would assume Late Glacial conditions in the Yenişehir area to be favourable for forest growth. If a universal lowering of the global temperature during the last glacial was also felt in the Yenişehir basin, a cool-temperate forest could have grown there. In reality the pollen record indicates the opposite. The area of Yenişehir saw a steppe vegetation, including *Artemisia* and Chenopodiaceae as the dominant herbs.

The area south of Iznik Gölü lies between the Euxinian mixed deciduous zone, the Mediterranean xerophytic forest and Sub-Euxinian deciduous forest (Mayer & Aksoy, 1986). The upper timberline must have been lower under glacial conditions, but this cannot explain the scarcity or absence of tree species. Today the upper tree limit is barely visible in the area, because it is considerably higher than the relatively low hills and mountains, apart from the higher slopes of the Uludağ. The steppe vegatation as concluded from the pollen spectra can only be explained by the prevalence of a climate markedly different from the present one. Such a climate would be characterized by very low precipitation.

The above conclusion is somewhat unexpected, because it leaves no refuge zones which might profit from winds carrying rain towards western Turkey during a period when on the high plateau of Anatolia severe conditions prevailed. The evidence points to the survival of individuals in restricted spots rather than survival in vegetation belts as we know them today. The palynological picture for the Late Glacial in western Turkey may still be preliminary; yet so far it strongly resembles that obtained for the Anatolian high plateau.

GENERAL REVIEW

The pollen evidence gathered in the Near East, like that obtained for other parts of the world, is used for the reconstruction of past vegetations and subsequently for the reconstruction of past climates. Information on such conditions is concluded from the composition of the pollen assemblages and their respective changes. Abiotic factors were not the only ones which have influenced the presence and/or change of the vegetation. Human impact became an increasingly important factor, especially after the development of agriculture and associated sedentism.

During the Late Glacial (about 14,000-10,000 BP) changes in the vegetation predominantly were caused by changes in the climate. Still the sedentary Natufians

and contemporaneous tribes in the Euphrates valley around Abu Hureyra already will have influenced their environment more than hunter/gatherers in other parts of the Near East. The question about early man is: how far-reaching was the impact upon the environment and is it visible in the pollen precipitation?

Ecologically speaking, it can be postulated that Late-Pleistocene people exerted some pressure upon their surroundings, as all living creatures do, but it is impossible to measure this impact from the pollen record. The change from hunting/gathering to farming probably could be read from detailed pollen diagrams, were it not that a major change in climate masks this effect.

The effects of changing climate in the Near East were not synchronous, not even after the most important climatological change from the Glacial to the Holocene had taken place. Optimal conditions shifted gradually over the area from northern Israel to Iran with a lag of c. 5000 years (van Zeist & Bottema, 1982).

It is without any doubt that permanent settlement in some parts of the Near East had important consequences for the environment. It is clear that changes caused in the vegetation under the new settlement regime differed basically from those caused by the preceding hunter/gatherer culture. Gradually or suddenly, human impact became a factor which was far more important than climate. This was possible only because the climate had changed from Glacial to Postglacial/Holocene conditions and remained relatively stable during the latter period. Even when the vegetation suggests small changes in climate during the Holocene period, these changes hardly can be told apart from the effects of human pressure. If any changes in climate are thought to have occurred, they are always put in relative terms and unfortunately very rarely quantified.

The definition of 'natural conditions'

Ecological research on behalf of nature management has indicated that full regeneration of a vegetation when human influence ceases, rarely occurs. In irrigated desert or in drained coastal swamps a return to a dynamic system ruled by a dominant factor might be possible. However, in those parts of the Fertile Crescent where farming has been practised in some way or another, irreversible changes have since long occurred. Palynological investigations are an obvious way to obtain information about the economic exploitation of the various landscapes of the Near East. Two examples follow of the possibilities and limitations of interpreting the pollen record with a view to reconstructing the prehistoric landscape and its use by man.

First, the AP/NAP ratio as a means to indicate the amount of forest and open landscape, a first attempt to a quantitative analysis of the environment.

Secondly, the Beyşehir occupation phase in relation to the Santorini volcanic eruption. A conspicuous change in species composition of the pollen content of sediment from the 4th millennium BP is interpreted in terms of the development and distribution of horticulture. The botanical phenomena are linked with the

catastrophic Santorini event.

1) The AP/NAP ratio

In general pollen records provide ample information on questions of qualitative vegetation history. If, however, the location and the number of postulated plants or trees in the area is questioned, whether it may be in pure stands or mixed, then the information is not sufficient. The vegetation, in terms of forest, arable land, scrub etc., is of great interest for archaeology because it indicates to what extent prehistoric people influenced, (over) exploited or even destroyed their environment. A next question could be: to what extent did prehistoric people affect the climate in this way?

Still, many problems arise if we want to find out, by translating the pollen record into terms of quantitative plant or tree cover, how much land was forested and how much had been cleared. For the Near East no absolute pollen records are available as the sediments are not suitable for this kind of research. Dating of clay deposits is impossible and in those records where organic sediments could be dated it became clear that such sediments often were deposited very irregularly. For quantitative information, other evidence in the pollen record has to be looked for.

Of every pollen spectrum the ratio between tree (arboreal) and herb (non-arboreal) pollen can be calculated. One would expect the amount of arboreal pollen (AP) to inform us about the amount of trees or tree cover and the amount of non-arboreal (NAP) to do the same for open landscape. The question is, can we translate this ratio into terms of forest and open landscape?

The reconstruction of past vegetations has always depended upon the mobility of pollen. In lakes, swamps or peat bogs we find pollen not only from aquatic or marsh plants, but also from vegetations which occurred farther away, outside the swamp. The mobility of the pollen grains enables us to reconstruct the general vegetation, not only that of the local marsh but also the surrounding vegetation. While arboreal pollen is found in places where trees cannot grow, the same must hold for the upland herb pollen; this we must keep in mind when we want to use the AP/NAP ratio to indicate the amount of cover.

Studies of modern pollen precipitation supply us with the unknown factor in the prehistoric situation: the actual vegetation. We can describe the modern vegetation in terms of forest, arable land, burnt scrub etc. and measure its pollen precipitation. This last word has to be emphasized. Pollen which is caught in the air, for instance by means of a Burkard sampler, has a different composition (Spieksma & Bottema, 1989) from the pollen content of moss cushions formed beneath the same Burkard sampler.

To what extent does the amount of tree cover around the pollen surface samples, described in the field notes, tally with the arboreal pollen/herb pollen ratio? Long transects of surface samples through mainland Greece demonstrate that many factors such as elevation, vegetation zone, exposure of slopes, distance from important vegetation elements etc., will affect the assumed correspondence.

The share of tree pollen (AP) from samples taken in predominantly deciduous

forest growing on Mt. Pieria has been compared with that from scrub growing on the same mountain. Quite unexpectedly, higher AP values were measured in the samples from scrub vegetation than in those collected in the forest (Fig.2).

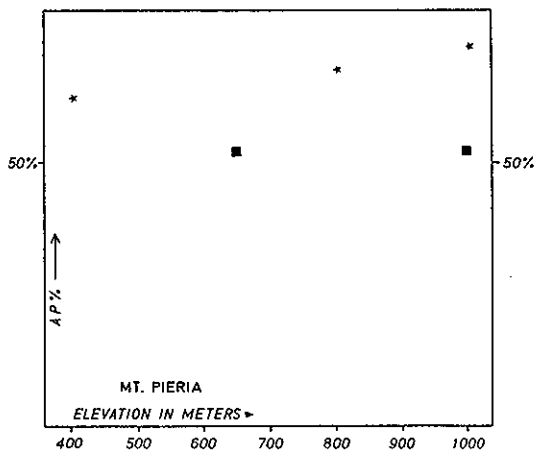

Fig. 2. AP/NAP ratios for surface samples collected on Mount Pieria (Greek Macedonia) plotted against elevation. Black squares represent samples from forest; black stars are from scrub.

A transect of surface samples taken through the cultivated, almost treeless plain of Macedonia towards the crest of the Vermion mountains demonstrates that from about 400 m upwards no difference can be seen in AP percentages on cultivated land, in forest or in scrubland. Tree pollen carried in from mountain forest must be responsible for the AP percentages in the cultivated plain.

A detailed discussion on the use of the AP/NAP ratio for the degree of tree cover in the Eastern Mediterranean area will soon appear in the proceedings of the symposium of the European Program on Climatic History Workshop entitled "Evolution of Land Surface Cleared from Forests in the Mediterranean Region during the Time of the Roman Empire", held in March 1991 in Mainz (Germany) as a supplementary volume of "Paläoklimaforschung", edited by B. Frenzel.

2) The Beyşehir occupation phase

The second example of an investigation into the relation between prehistoric man and the vegetation deals with the indicative value of certain pollen types in connection with horticulture. This subject is treated extensively by Bottema & Woldring (1984(1986), 1990). The sudden development of a new kind of horticulture with species such as walnut (*Juglans regia*), sweet chestnut (*Castanea sativa*), manna-ash (*Fraxinus ornus*), olive (*Olea europaea*) and the unexplained appearance of the plane tree (*Platanus europaeus*) is found in pollen diagrams from Turkey and Greece. It was named the Beyşehir occupation phase because it was very clearly expressed in a core near Lake Beyşehir studied by Van Zeist et al. (1975) (Fig.3). This phenomenon was also recorded in northwestern Greece (Bottema,

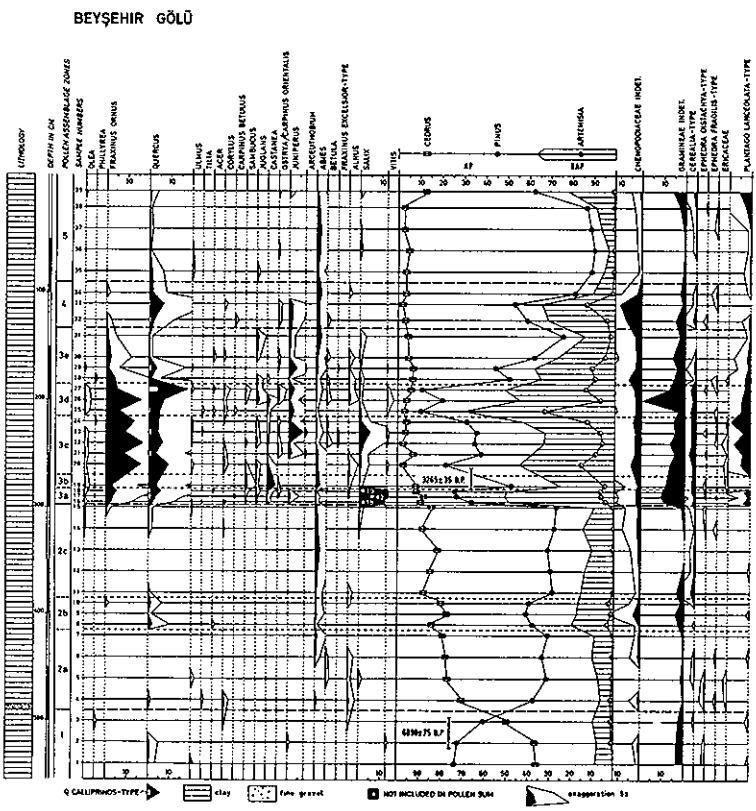

Fig. 3. Part of the Beyşehir pollen diagram showing the occupation phase (pollen assemblage zone 3) at a depth of 130-300 cm.

1974: p. 133).

The radiocarbon date of the appearance of this horticultural phase is about 3100-3200 BP. Often the date cannot be exactly applied to the appearance of the set of indicative pollen types because not enough organic material was available for radiocarbon dating. The measured date may also be somewhat distorted because the piece of sediment core has to be rather long, to contain enough organic material.

The event itself is very interesting, but questions on the mechanism behind it soon arise. Who were the people that started to nurse these tree species, how were the trees distributed so rapidly, why was this horticulture accepted over such a large area and where did it start?

A striking fact in connection with the Beyşehir occupation phase is the eruption of Santorini dated at 1629 BC by tree-ring chronology in Irish peat bogs (Baillie & Munro, 1988). When transformed to uncalibrated radiocarbon years BP this date would be about 3300 BP. At first there seems to be no obvious reason to connect the sudden appearance of a group of horticultural tree species around 3100-3200

BP with a volcanic eruption. Sullivan (1988) discovered Santorini tephra under an organic deposit in Gölcük about 80 km east of Izmir in western Turkey. Organic material, 30 cm above the tephra, gave a date of 3110 ± 160 BP, calibrated to about 1420 BC. The date of 3110 BP is synchronic with dates obtained for the beginning of the Beyşehir occupation phase in several locations in Turkey and northern Greece.

On the southwestern coast of Turkey, at Köyceğiz, the beginning of the Beyşehir occupation phase is dated 3070 ± 55 BP at a depth of 3.98-4.01 m. Sullivan identified a layer at 4.14-4.23 m as Santorini tephra. The sediment underneath the tephra layer did not contain any pollen of the group of horticultural tree species which define the Beyşehir Occupation Phase. They appear immediately in the first sample above the tephra. The volcanic deposit itself is devoid of pollen, as could be expected. Sullivan (1988) discusses the possible effect in southwestern Turkey of the deposition of tephra as found in Gölcük. He suggests that it was sufficient to damage structures and severely disrupt agriculture.

What happened after the tephra fall-out? In this respect the pollen diagrams point to an open "niche", filled by a completely new assortment of trees in some way or another useful to man. Various pollen types with conspicuous patterns suggest a possible change in climate during the Beyşehir occupation phase. A possible change from a continental climate to a more "Atlantic" climate starting around 3200 BP and lasting until 1500 BP is discussed by Bottema & Woldring (1990).

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近東の先史時代人の古環境－花粉学的調査からみた二・三の考察－

S. Bottema

要旨：本報告は、近東の先史時代の古環境を花粉分析の結果から論じたものである。

北部・西部トルコは、アナトリア高原地帯のステップ、黒海沿岸の森林地帯そして北部と西部の低地に区分され、これらの地域間の古環境の変遷の地域性を花粉分析の結果から比較検討した。

特に晩氷期から完新世への移行期における人類の自然への干渉の地域性や気候の変動が人類文明の盛衰に与える影響の地域性について本報告では重点的に論述した。

また、トルコ南西部のベイシェヒール湖の花粉分析の結果から初めて指摘された紀元前2000年紀の樹木花粉と草本花粉の比率の特徴的な変化は、気候変動と深いかかわりがあることを指摘した。