Bull . Egyptian Geog. Soc. Vol. 68 , 1995
Page:157-177

EFFECTS OF CLIMATIC CHANGES ON THE VEGETATION IN THE NEAR EAST

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Key words : Climatic Changes, Palaeovegetation, Near East

ABSTRACT

The Near East was considerably affected by climatic changes during the Pleistocene and Early Holocene. Natural occurrence areas of vegetation communities belonging to different floristic regions were greatly shifted in response to the climatic changes .

During the last glacial period (c. 20000 yr BP), except the coastal belt of the Mediterranean and Caspian Sea, most part of the Anatolian plains, plateaus and the interior parts of the Arabian peninsula were covered by the deser steppe/steppe. The high parts of Taurus-Zagros mountains and Northern Anatolian- Elbruz mountains were occupied by glaciers; and the vicinity of the glaciated parts of the mountains may have occupied by Euro-Siberian elements especially Betula and pine species . Whereas some plant species belonging to Euro-Siberian phytogeographical region moved to coastal belt of the Black Sea region . In the Mediterranean region, some of the Mediterrnean elements sheltered in the karstic depression and deeply incised valleys

During the end of the post glacial and early Holocene, most of the Mediterranean elements which sheltered on the coastal belt have begun to expand towards inland and on the south-facing slopes the Taurus Mountains. On the other hand, the upper limit of coniferous forests rised due to the increase of temperature . Cedar (Cedrus libani) forests widespread in the Anti-Lebanon Mountains . Eu-Mediterranean Region

The inland parts of the Anatolia were mostly covered by the forest steppe and steppe .

Paleolithic and Neolithic sites were established on the Mediterranean coastal belt and the forest-steppe zone and the fertile crescent in which irrigation activities carried out .

After climatic optimum, the fact that the increase of aridity and the destruction of the natural vegetation in the arid and semi-arid parts of the Near East have led to the increase of desertification . For this reason, the climax vegetation communities of the Near East have begun to tend decrease.

(I) INTRODUCTION

The distribution of the past vegetation can be revealed through the pollen diagrams obtained from the sediments, plant macrofossil remains (seeds, fruits, wood), preserved in ancient settlement sites and relic vegetation to be sheltered favourable habitats, in general . Quaternary, especially Late Quaternary vegetation history of the Near East according to pollen profiles have been explained by van Zeist and Bottema and the other authors .

One of the methods to reconstruct the paleovegetation to establish the relation between the relic and the present vegetation properties and their floristic composition .

Indeed, the vegetation of earlier times can not be understood without knowledge of the modern vegetation in relation to environmental conditions . Relic vegetation which is commonly found in the mountainous areas due to the fact that these areas produce various habitat for the growing of plants belonging to different phytogeographic region . In other words, the mountainous areas are the main refruged areas of the previous plants . In the Near East, Taurus-Elbruz and Toros-Zagros mountains are rich both in relic and endemic plants . One can found Euro-Siberian plants in the western part of the Taurus mountains which are rich in karstic topography . At the same time, some Mediterranean, Euxian, Colchic and Irano-Turanian plant communities are found in the northern Anatolian orogenic belt . For example,

one can come across a rich Mediterranean plant community in the tectonic depression of the Black Sea Region belonging to Euro-Siberian phytogeographic region . Shortly, most of the orogenic belts of the Near East can be considered as a treasure of relic vegetation .

The main aim of this study is to explain the distribution of past vegetation of the Near East, especially under the light of the relic vegetation communities . In order to explain the vegetation history four maps, in concise form, relating to the periods 135 K, 20K, 9K and 4K are drawn .

(II) PHYSICAL GEOGRAPHY OF THE NEAR EAST

The Near East displays a great variation in topography and land-forms . Mountain chains, extending over hundreds of kilometers, dominate large areas, but also vast plains, plateaus and tectonic corridors occur . The Near East as whole, is under the Mediterranean climatic conditions and under the influences of tropical and polar air masses . During the winter period, polar forantal activities producing precipitation dominate on the western and southern region of Near East . But northern part of the region are generally under the polar air mass coming from the continental part of Europe and Siberia . During this period, snow fall and the harsh colds take place . Summer period is raninless except for Black Sea Region, and southern part of Caspian Sea due to the influence of tropical air mass . But topographic properties of Near East produce local climatic types in same region . First at all general topographic forms and climatic properties will be explained shortly in order to explain the effects of the topography on the climate and refruge of the past vegetation .

In the north, the E-W oriented, parallel ranges of the Northern Anatolian Mountains run in the southern part of the Black Sea . These coastal mountain ranges are broadest and highest in their eastern section, attaining elevations of over 3000 m (highest peak Kackar M. is 3937 m) . In the middle and west only a few peaks exceed 2500 m . These mountain ranges deeply dissected by the rivers and there is a great altitudinal differencies between river valley and the upper part of the mountains, attaining over 1000 m; and there are also tectonic depressions extending in E-W direction, in which

plains occur, at an elevation of 200-500 m in the orogenic range of Norhern Anatolia . The Northern Anatolian mountains joint Elbruz Mountains varies altitude of 2000-4000 m south of Caspian Sea, in Iran .

Northern Anatolian and Elbruz Mountains form a barrier between the Black Sea Capian and inland part of Central Anatolia and Iran . North-facing slopes of these mountains receive abundant precipitation . But tectonic depressions produce a semi-arid climatic conditions due to lee of the mountains .

Second main orogenic range, rising abruptly along the Mediterranean Sea, is the Taurus Mountains . Western part of this mountains extend in NE-SW direction in which tectonic depressions occur . After Gulf of Antalya, this range go on in direction of NW-SE . This part of the range is made up of the mesozoic comprehensive limestones which are rich in karstic land-forms, i.e. different size poljes, uvalas, dolines and "U" shaped vallaeys . On the other hand, western part of the Taurus mountains were dissected by the vertical tectonic movements producing deep and large depressions in which tectonic-karstic were formed .

Middle Taurus mountains deeply cut by Goksu river is an appearance a high plateau . Eastern Taurus Mountains begin Gulf of Iskenderun and continue, as in concave form, in the northern part of the SE Anatolian plains. The highest peaks, attaining elevations of over 4000 m occur eastern parts of the SE Taurus mountains . This mountains were deeply cut more than 1000 m by the Euphrates and Tigris rivers . One of the important barrier between Gulf of Iran-Mesopotamia and inner part of Iran is Zagros mountains, attaining 3000 m from the sea level . These mountains have a series of parallel ridges and deep intramontane basins and valleys .

There is mountain ranges named Anti-Lebanon and Ansariye in the eastern part of the Mediterranean Sea . These mountains contain a rift valley extending N-S direction in which Dead Sea was formed (at almost 400 m below the sea level) .

Western part of the Anatolia has a typical horst-graben system . Indeed, mountains extending in E-W direction correspond to horsts . Grabens in

which alluvial plains occur are the main course of the rivers . These is a great altitudunal differencies between grabens and horst, mostly exceeding 1000 m.

Eastern Anatolia has a high topography attaining over 2000 m, parallel ranges, rising up 3000-3500 m and tectonic depressions . On the other hand, young volcanic mountains, especially erupted during the Quaternary are found in the Eastern and Inner Anatolia (Mont Ararat, Tendurek, Erciyes, Suphan)

Vast plains occur both in the Inner Anatolia (Konya Plain) and South-eastern Anatolia (Harran Plain), in Mesopotamian lowland including the Khuzistan plain built up of alluvial deposits . High plateaus with altitudes of 1500 - 200 m are common on the sedimentary strata in the eastern part of the Inner Anatolia and on the basalt lavas with altitudes of 2000 - 2500 m in northeastern section of Eastern Anatolia .

Topographic conditions lead to changing of the climatic conditions in some climatic region . The slopes facing the sea both the Taurus and the Northern Anatolian and Elbruz mountains receives more than 1000 mm precipitation, in general, because of the fact that fronts intercept along these slopes . In addition, the moisture air coming from the Black and Caspian Sea climb up to the mountains . This process lead to the formation of fogs and/ on low clouds . Whereas, on slopes facing the inland part of mountain ranges, the amount of the precipitation decrease because of the rain-shadow effect of the mountain ranges . On the other hand, there is hig differencies in the amount of precipitation between the bottom land of river valley and high part of the mountain in the orogenic range . For example, the mean yearly precipitation of Coruh river valley, in the vicinity of Artvin, eastern part of Black Sea Region, is about 300 mm, whereas yearly precipitation of the slopes facing north of the Eastern Black Sea mountain is about 2400 mm . The winds bearing moisture penetrate towards the inland section through the tectonic depressions and river valleys in the Black Sea Region and the Aegean Region . This moisture air decreases the evapotranspiration .

On the other hand, yearly and monthly temperetures changes in a great extent between the tectonic depression , deep river valley and the

mountainous areas . For example, in the Eastern Black Sea Region, January temperature is over freezing point in the Coruh valley, but the higher part of the mountains this temperature is about -10oC . In the some tectonic depression of northeastern Anatolian plateau, January temperature fall as low as a result of the inversion of temperature .

The karstic depressions in the western part of the Taurus mountains produce somewhat mild and humid climatic conditions so that in these habitats hydrophyll plants grow .

Arid conditions prevail in the Central Plateau of Iran, southern part of Mesopotamia, Great Syrian Desert and Egypt . Mean annual precipitation ranges between 100-200 mm . Desertic plants are common .

1 - Pre-Quaternary Vegetation

The vegetation and flora composition of the Anatolian Peninsula is dependant upon the upper Tertiary . During the Miocene, most part of the Anatolia had been covered by the tropical - equatoral vegetation under the same climatic conditions . At that time, according to pollen data and/or profiles obtained from the lignite deposits which are found in the Neogene lake basins, the existence of different vegetation communuties composed of Abies, Cedrus, Larix, pinus, Acer, Alnus, Betule sambucus, Comus, Vaccinium, Castanea, Fagus, Laurus, Cercis Carya, Luglans, Pteracarya, Ficus, Fraxinus, Clemites, Frngula,Populus, Pragmites, Cryptomria, Cinnamophyllum are revealed (Gemici et al.,1987) . The vegetation communities which were composed of Pinus, Acer, Fagus, Quercus, Carya, Salix, Tilia, Alnus, Platanus, Luquidambar, Castanea, Populus are identified by the palynologic study carried out from the Eskihisar lignite deposits, Mugla province, SW Turkey . These plant species imply the mild and humid climate which prevailed during the Neogene (Gemici et al, 1987) .

The pollen profile obtained from the Soma neogene lignite deposit which is located in the NW part of Anatolia contains Pinus, Cryptomeria, Glytostrobus europeaus, Sequoia, Thuja, Buxus, Pistacia, Acer, Frangula, Ziziphus, Ulmus, Zelkowa, Ficus, Cercis, Luquidambar, Colutea, Cornus, Salix, Alnus, Castanea. Fagus, Quercus, Carya, Sambucus . In a great

theüüüamount of Pinus, Quercus and Glyptosrobus europeans may indicate existence of the humid and hot climatic conditions . It could be stated that the swamp forest-type containing G. europeans may have been occured in the edge of the lakes, and the forests composed of Pinus and Quercus grown on the backward region of the neogene lake (Gemici et al, 1989a and 1989 b) .

According to these data, during the upper Tertiary a major part of the Anatolia had subject to the subtropical climate so that the rich vegetation cover resembling present-day humid subtropical vegetation grown .

The climate changing frequently during the Quaternary has accounted for the breaking of the natural vegetational regions of Upper Tertiary era both in the Near East and European continent . But some of the present-day plants contain belonging to Tertiary flora and/or vegetation compositions . As a result of the climatic changing some plants were extincted such as Larix, Thuja, Sequoia and some were sheltered on the favourable habitats such as Luquidambar orientalis which is come across on the bottom alluvial land of Lake Koycegiz and within the valley of Esen and Manavgat, SW Anatolia

2 - Before The last Glacial Period

During the last interglacial period (Riss-Mindel interglacial which is longer than the other interglacial periods), Mediterranean vegetation must have covered a great part of the Anatolia under sub-tropical climatic conditions . In that time, some Mediterranean elements migrated to the northern section of the Anatolia and some of them which survived and / or grown on the favourable habitat (Map 1 and 2) . According to relic species of present day, the Mediterranean plants which spread to the Northern Anatolia are as follows : Pinus brutia Arbutus unedo, Arbutus andrachne, Phillyrea latifolia, Quercus coccifera, Juniperus oxycedrus, Celcis siliqua strum, Olae euporea, Mrytus communis, Laurus nobilis, Ceratonia siliqua, Rhus coriaria, Paliurus spina christii, Paliurus aceulatus, Pistacia terebinthus and some Cistus species .

Red pine (Pinus brutia) and evergreen shrubs which are the climax elements of Mediterranean phytogeographical region expanded towards the tectonic depression of the backward section of Black Sea Region . On the other hand, Cedar (Cedrus libani) may have migrated to the backward section of the northern Anatolian mountains along the Anatolian diagonal . The remnant of the Cedrus communities composed of some Euro-Siberian plant elements appear in the Erbaa-Niksar area, and in the backward section of Eastern Black Sea subregion (Atalay, 1983; 1987a) . Thus, it could be stated most of the Anatolian peninsula was occupied by the Mediterranean geographical region, except for the higher part of the mountainous areas .

In that time, some Euro-Siberian plants must have survived on the facing-north slopes of the Northern Anatolian mountains . Such plants are of Picea orientalis, Pinus sylvestris, Betula, and Fagus orientalis, Castanea sativa, Carpinus betulus, C. orientalis, Alnus barbata, A. glutinosa, Acer campestre, Ulmus montana and some shrubs such as Prunus laurocerasus, Rhododendron species, Ilex aqifolium, I. colchica, Buxus sempervirens, Taxus baccata etc. which are the leading species belonging to humid and cool climate must have grown on the slopes of the middle level of the mountains (Map 1 and 4) .

The broad-leaved deciduous forests grown on the north facing slopes and the upper level of the Taurus mountains and the western part of the Anatolian mountains . The relic communities, consisted of Fagus orientalis, Tilia rubra, Castanea, Sorbus torminalis, Corylus avellana, Taxus baccata are found in the western part of the Anatolia imply the widespread existence of the broad-leaved forests belonging to present day vegetation of the Black Sea Region .

During the last interglacial scotch pine (Pinus sylvestris) and oriental spruce (Picea orientalis) may have spread the higher part of the northeastern part of the Anatolia .

On the other hand, some parts of the central, eastern Anatolia and Iran may have sparsely covered by woodland mostly containing oak .

Desert-steppe and as a cluster of steppe forests were found in the Mesopotamia (Map 1) .

3 - Last Glacial Period

During the last glacial (Wurm period,), arid and cold climatic conditions prevailed continental part of the region . While cold and somewhat moist climate dominated on the coastal belt of the region . The temperature of this period was lower 6-8oC than the present-day (Messerli 1967, van Zeist and Bottema 1991) . Climatic conditions are considered to have been the limiting factor for tree growth in the inland part of the Near East . Steppe and desert steppe may have dominated the areas below 1000 m, especially in the foothills of the Zagros mountains and Mesopotamian lowland and its adjoining areas . In fact, no arboreal vegetation is found in the Zeribar pollen diagram, obtained from an elevation of 1300 m, in Zagros mountains, western part of Iran (van Zeist and Bottema, 1991) . During this period the upper parts of the mountainous areas which are higher than 2000 m in the coastal areas and the mountainous areas higher than 2500 m were occupied by glaciers . The sea level was lowered as low as 100 m from its present level (Atalay, 1987c; 1992b) .

The interior parts of the Near East were occupied by the steppe and desert steppe . While the lower parts of the coastal mountains may have covered by the forests . As a matter of fact, the deciduous forests occured along the narrowcoastal belt of the Northern Anatolian-Elbruz mountains . Coniferous forests also migrated toward the coastal belts . The relict communities such as scotch pine (Pinus sylvestris) which are seen near the coastal strip of Black Sea subregion may clearly reflect the shifting of the coniferous forests . On the other hand, Pinus sylvestris communities spread in the lower level of the northern part of the Anatolia and they migrated as far as northern edge of the Taurus mountains . Scotch pine (Pinus sylvestris) which are found as a small relic communities in the eastern part of the Inner Anatolia (Gurun district), and norther part of the Inner Anatolia (Akdag madeni district and the wastern parts of the Anatolia around the Denizli province) may have support this consideration (Atalay 1939; 1991; 1992a and 1992b) . The Mediterranean vegetation refruged lower part of the tectonic depressions and deeply opened river valleys such as Coruh and Kelkit river extending backward section of the Black Sea Region .

Mediterranean vegetation sheltered along the coastal belt of the Mediterranean region and lower slopes facing-south of the Taurus mountains . Oro-Mediterranean forest vegetation composed of Cedrus libani, Abies cilicica, and Pinus nigra migrated lower part of the mountains .

Some Euro-Siberian vegetation communities mainly composed of Betula sp. grown in the vicinity of the glaciated areas . The remnant of these are seen in the higher part of the Mont Ararat, Munzur Mountains and eastern section of the Black Sea Mountains (Map 2) .

During the glacial period, most part of Anatolia, Mesopotamia and the inner section of Iran may have covered by desert steppe and steppe vegetation . Especially steppes composed of Artemisia Sp. were dominated . Woodland composed of oaks and steppe occured as a small cluster on the higher areas and/or orogenic belts extending continental parts of the Middle East (Van Zeist and Bottema, 1991) .

One of the most important event of the last glacial period is the wind action . Winds orginating from the Arabian peninsula transported eolian materials and these materials mostly accumulated on the inner part of the Anatolia . The eolian sediments which are found in the terra rossa (Alfisols) in the Mediterranean and Aegean regions and aridsols in the Southeastern Anatolia clearly reflect the eolian transportation and accumulation . On the othe hand, calcerous soils which are found on the non-calcerous parent material brough about due to the accumulation of calcerous eolian particles (Dinc et al., 1988; Atalay 1989a, 1989b and 1992b) .

4 - Early Holocene Period

Cold and dry climatic conditions prevailing on the most part of the Middle East was gradually changed towards the present- day conditions from the period of 10000-9000 yr BP. With the increase of temperature and precipitation, the sea level has gradually begun to raise and the glaciers covering the mountains have continued to melt . As result of the melting of the glaciers the permanent snow line was increased (Map 1 and 3) .

The rising in temperature could have resulted the drastic change and the shifting of the vegetation communities . Namely, the coniferous forests found on the coastal belt of the Black Sea and Caspian Sea migrated towards the upper part of the mountains . Whereas coniferous forest areas were considerable occupied by deciduous forest which sheltered favourable habitats of the coastal belts . At the same time, the mediterranean elements, especially cold-sensitive species such as red Pine (Pinus brutia), Arbutus unedo, A. andrachne, Mrytus communis, Laurus nobilis which had refruged within the tectonic depression extending backward section of the Black Sea region begun to spread along tectonic depression and the slopes facing-south in the Taurus mountains .

As to the Mediterranean phytogeoraphic region, Oro- Mediterranean coniferous forests shifted towards the upper part of the Taurus mountains . The plant communities of eu-Mediterranean composed of Pinus brutia and maquis enlarged their own occurrence areas along the coastal belt of the Mediterranean Sea and Aegean Sea . The some Euro-Siberian plants refruged the karstic depression and/or holes widened their own natural occurrence areas . Fagus orientalis forests which were found as a small cluster on the Nur (Amanos) mountains, eastern part of the Mediterranean region, expanded towards the slopes facing-north .

Coniferous forests expanded towards the inner section of the lake Region of Anatolia . As a matter of fact, the mountainous areas encircling the intermontane basins occupied by the cedar forests (van Zeist, Woldring and Stepart 1979; van Zeist and Bottema 1988) . The interior part of the Anatolia became the main natural occurrence areas of forest composed of mainly oaks . Some tectonic depression and closed basins of the Inner Anatolia was the steppe areas . In addition, a great part of Southeastern Anatolia and northern part of the Syria were the main occurrence areas of steppe .

In the period about 10000-9000 yr BP. the Neolithic settlemets were set up on the receded lake areas in which forest-steppe occur and in these areas

agricultural activities carried out, that is wild cereals were cultivated on the alluvial land near the lakes and wild animals were domesticated .

In the eastern mountainous areas of the Mediterranean covering Syria and Palestine forest vegetation must have expanded rapidly. Indeed, pollen evidence shows that forest reached a maximum distribution in early Holocene, in the period of 10000 to 8000 yr BP. Pinus, Carpinus, Ostyrea and Olea become important constituents of the upland forest (van Zeist and Bottema, 1991) . Almond-pistachio forest-steppe in which some deciduous oak occured near the inland part of the Mediterranean coastal belt .

It can be stated that at about 4000 yr BP the present-day natural occurrence of forests, woodland, steppe and desert steppe have established itself in broad outline (Map 4) .

5 - Human Impact Period

The interference of man on the vegetation dated from about 5000-4000 yr BP. First Neolithic settlements were set up in the vicinity of the lakes such as Lake Burdur (Hacilar), southern part of old Lake konya (can Hasan), Lake Beysehir (Suberde), in Anatolia; northern edge of fertile crescent and eastern part of the Mediterranean coastal belt so that first forest-clearing and agricultural activities have begun . According to pollen diagrams, first forest-clearing and agricultural activities were remarkable begun in the vicinity of Lake Beysehir, SW Turkey (van Zeist and Bottema, 1991); western part of the eastern Mediterranean coasts, and the foot-slopes of the Taurus and Zagros mountains . In these areas two important events were revealed . One of them is the change of vegetation and the second is the growing of fruit trees .

As a matter of fact, in the ancient settlement areas, forest trees shows a marked decline, whereas herbaceous including Artemisia, Chenopodiaceae, Graminieae and Plantago increased markedly . Various arboreal taxa, fruit trees, in particular Fraxinus ornus, Olive, Castanea, Juglans were also increased . For example, eastern coastal belt of the Mediterranean Sea olive and pistacio cultivation areas considerably increased within the natural

occurrence areas of Mediterranean vegetation . In the Taurus mountains Quercus and Juniperus communities which are found on the natural occurence areas of Cedrus libani and Pinus nigra can be termed as the secondary succession . Steppe areas which are common on the high parts of the mountains and plateau areas of the Inner and Eastern Anatolia and the Eastern Taurus mountains and Zagros can be considered as a antropogenic steppe . Because these areas are favourable habitat for the growing of oak forests . As a result of forest-clearing and heavy grazing activites these oak forest area converted into antropogenic steppe areas (Atalay, 1983, 1987a,b; 1988; 1992a and 1992b) .

Shrub formations consist of maquis and garriques in Mediterranean region of Turkey can be termed as a secondary successions .

CONCLUSION

It can be reach some conclusions relating to relic plant communities on the vegetation history of the Near East .

1 - Mediterranean plant communities which are common within the western part coastal belt of Black Sea and the tectonic corridor extending backward of the Black Sea region imply the past existence of the Mediterranean climatic influence . The cold-resistant coniferous forest cluster which are found along the eastern part of the Black Sea coast may indicate the previous cold period .

2 Euro-Siberian plant elements which sheltered in the karstic depression in the Taurus mountains can be considered to be remnant of the Euro-Siberian elements . The birch (Betula sp) come across on the high mountainous areas such as Mont Ararat, Munzur and Eastern Black Sea mountains may be considered as a relic of the previous cold period .

3 - Climatic changes have been changed the natural vegetation composition and occurrence areas of the vegetation . For example, one can found the Euro-Siberian and Mediterranean element together in the Coruh valley, northeastern part of the Black Sea region . In that area , Pinus sylvestris

belonging to Euro-Siberian phytogeographic region and Arbutus andrachne which is climax shrub of Mediterranean phytogeographic region are found in the same places .

4 - Human interference on the vegetation brough about regressive and/ or seconrdary succession in the plant cover . Juniperus and Quercus communities on the Taurus mountains may be considered as a secondary succession . A great majority of the steppes which are common both in Inner and the Eastern Anatolia are in antropogenic character .

Legend to Map 1 , 2 , 3 and 4

1 - Eu-Mediterranean evergreen vegetation composed of pinus brutia and maquis (pistacia terebinthus , p. lentiscus , Olea europea Mrytus communis , Ceratonia siliqua Laurus nobilis , Arbutus andrachne, A. unedo , Quercus coccifera) mostly sensitive to cold .

2 - Oro - Mediterranean coniferous forests (Cedrus libani , pinus nigra and Abies cilicica) , resistant to cold .

3 - Euro - Siberian broad - leaved deciduous forests (Fagus orientalis , Tilia rubra T. tomentosa Castanea sativa Alnus glutinosa A. barbata Carpinus orientalis ; shrubs are Rhododendron ponticum , Corylus avellana Buxus sempervirens , llex colchica Euonymus latifolia Taxus baccata prunus laurocerasus etc) .

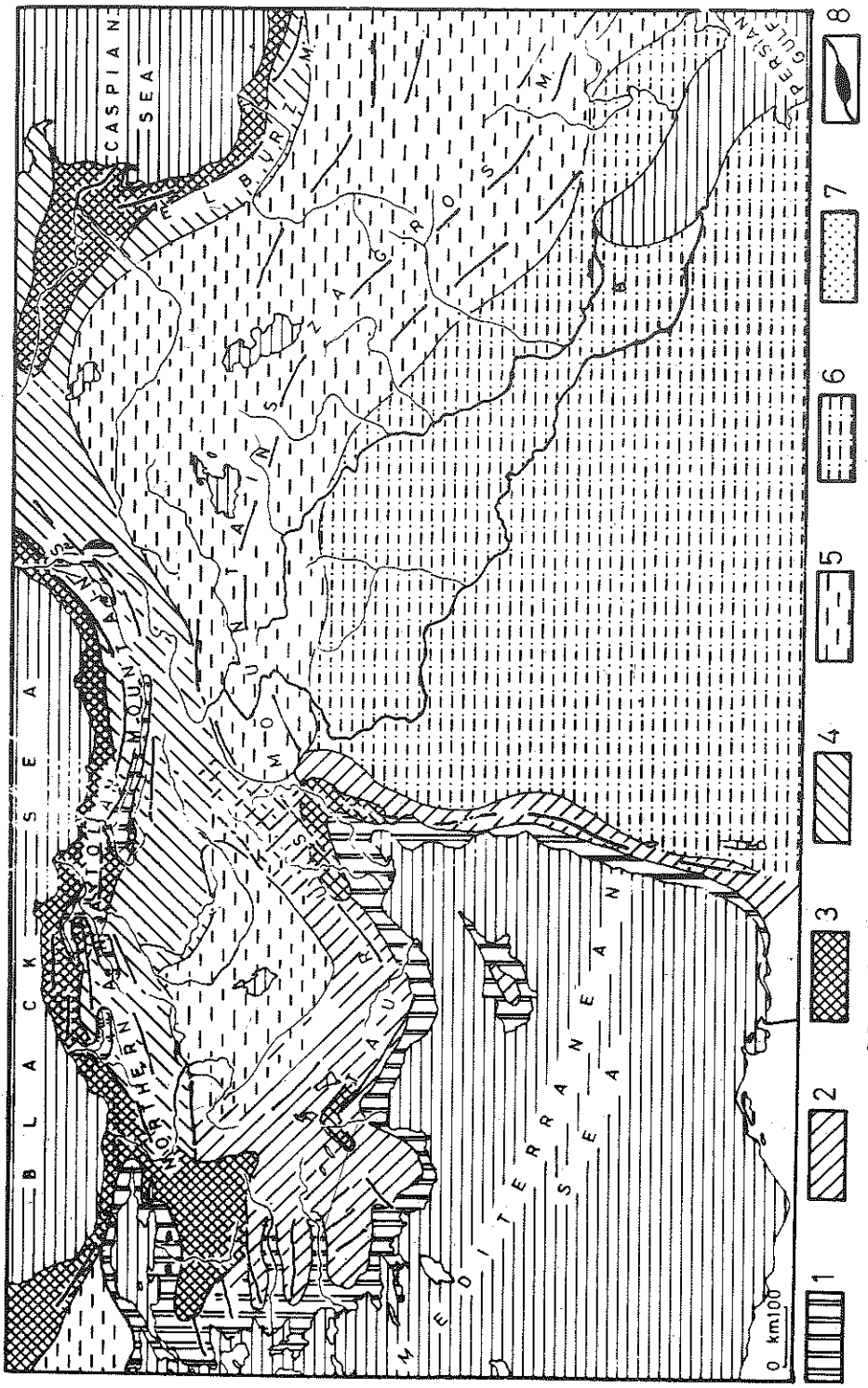
4 - Euro-Siberian coniferous forests , resistant to cold (pinus sylvestris , picea orientalis , pinus nigra Abies nordmanniana A. bommulleriana) .

5 - Woodland , dry forests (mainly Quercus sp.) .

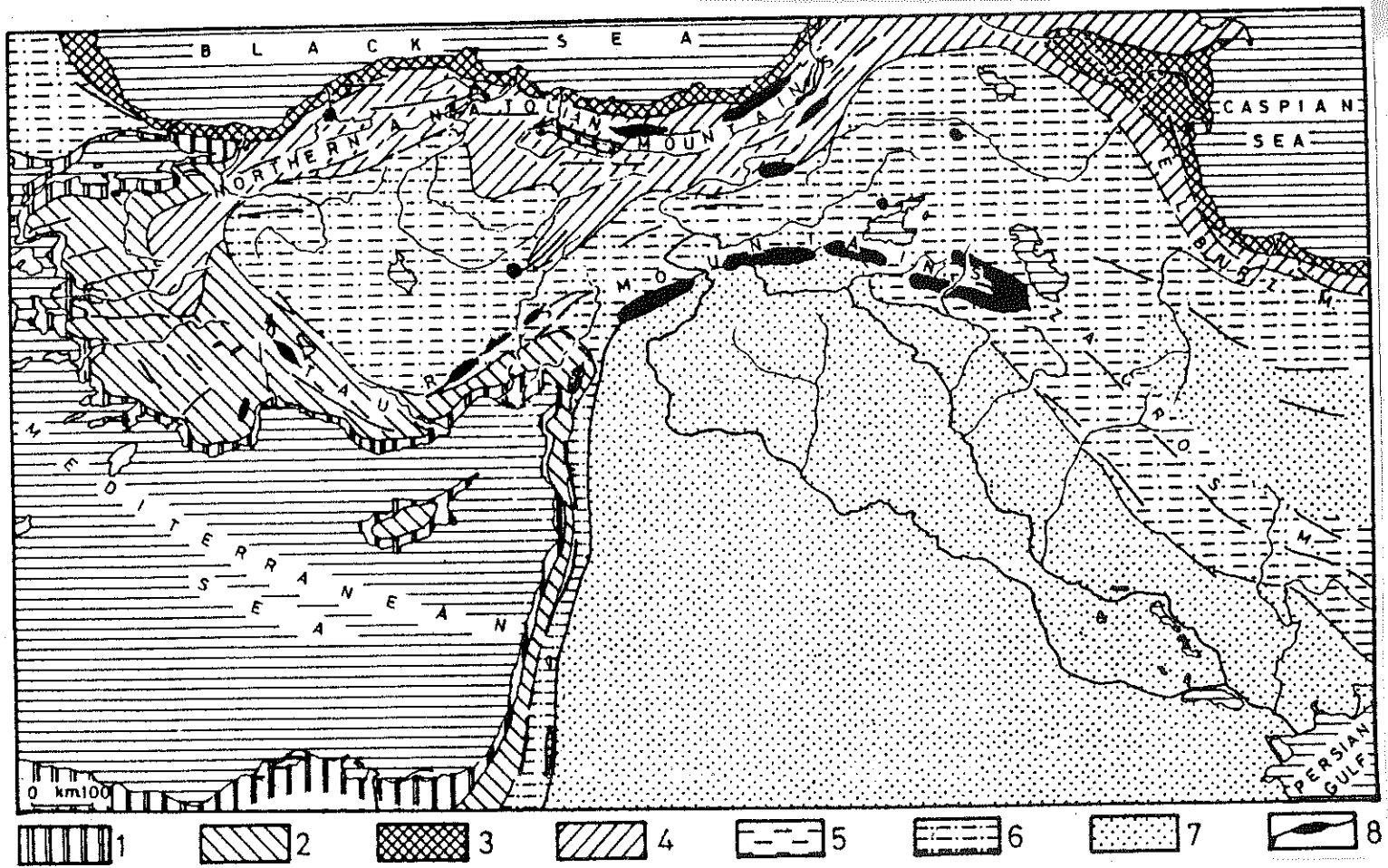
6 - Steppes (with tree) .

7 - Desert - steppe .

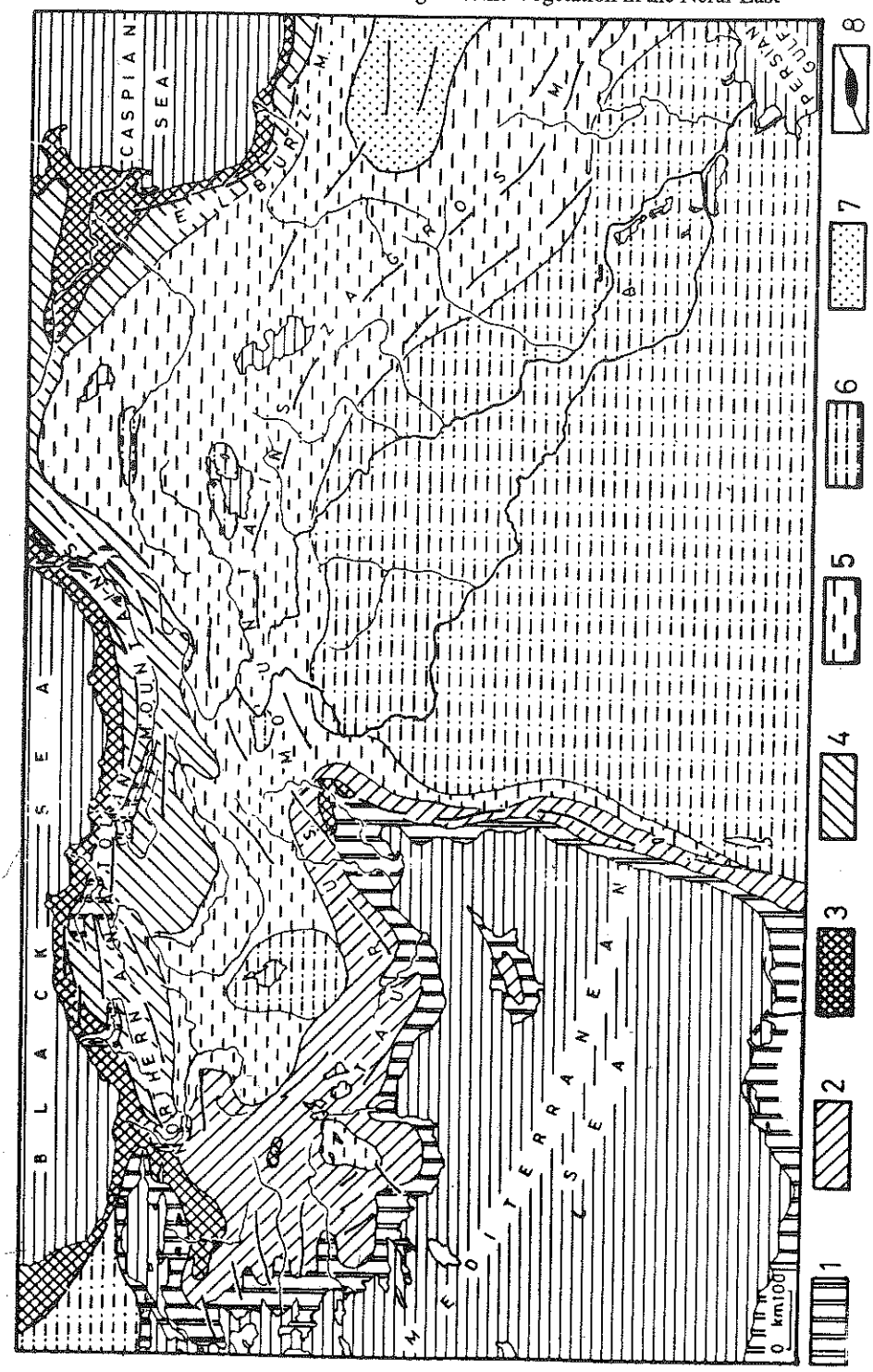
8 - Glaciated areas .



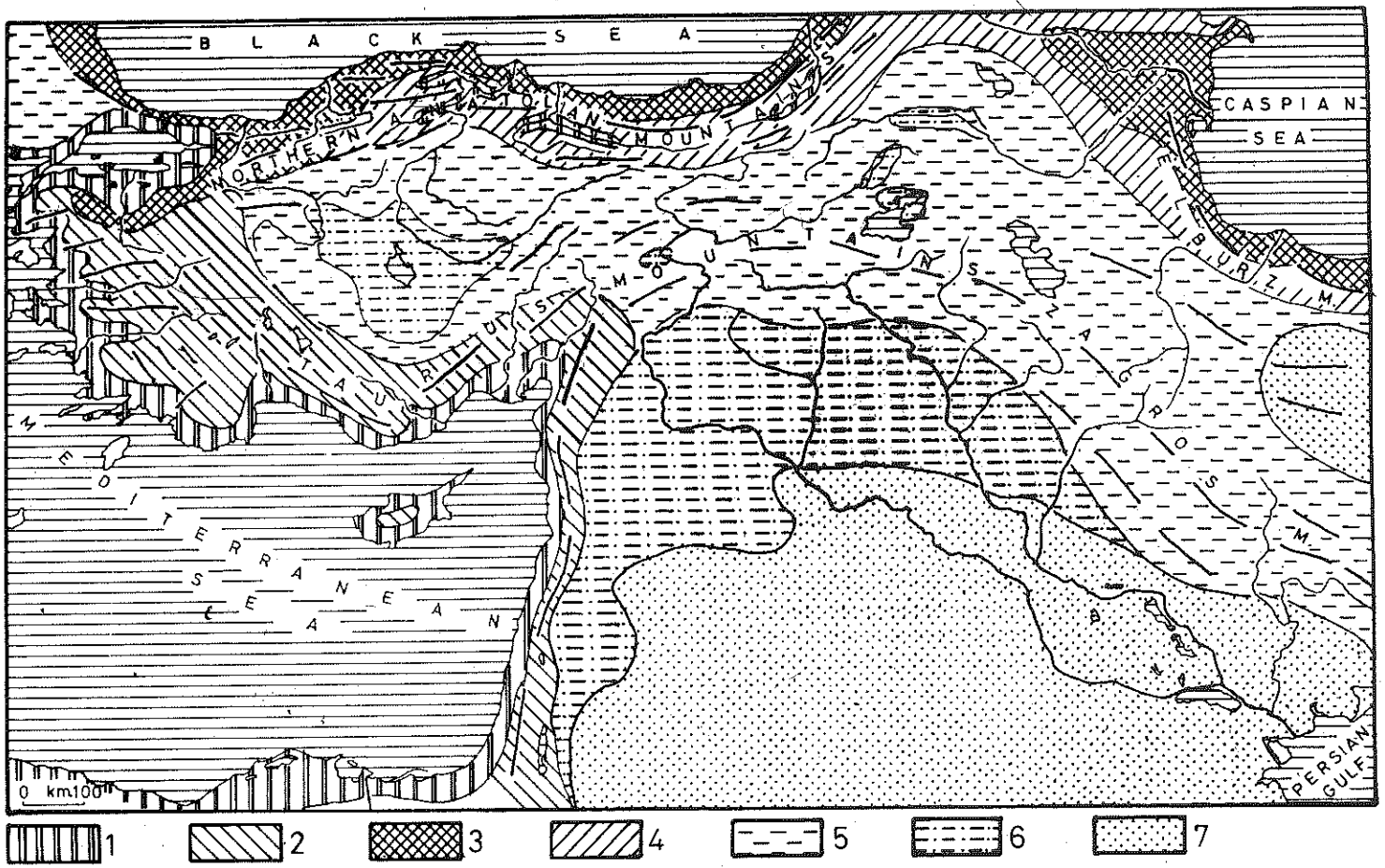
Map . 1 : General Vegetation distribution of pre-last glacial period (interglacial) in the Near East .



Map . 2 : General Vegetation distribution of last glacial (20 KBP) in the Near East .



Map . 3 : General Vegetation distribution of early Holocene (9 K BP) in the Near East .



Map . 4 : General Vegetation distribution of middle Holocene (4 K BP) in the Near East .

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