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Diplomová práce

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Environmental changes and human land-use interactions in Ancient Thrace during the Iron Age: The impact of Greek colonization

Vzájemné vztahy změn přírodního prostředí a člověka ve starověké Thrákii v době železné: vliv řecké kolonizace

Praha 2016 Vedoucí práce: Doc. PhDr. Peter Pavúk, Ph.D.

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Prohlášení:

Prohlašuji, že jsem tuto diplomovou práci vypracovala samostatně a výhradně s použitím citovaných pramenů, literatury a dalších odborných zdrojů.

V Praze, dne 21. srpna 2016

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Jméno a příjmení

Abstrakt:

Tato práce se zabývá vzájemnými vztahy mezi environmentálními změnami a thráckou společností, jejíž rozvoj se odehrával v kulisách okolního přírodního prostředí, které procházelo v průběhu prvního tisíciletí př. n. l. zásadní proměnou. Od pozdní doby bronzové a rané doby železné byl detekován značně výraznější vliv činnosti člověka na krajinu, zejména se jedná o pěstování rostlin a pastevectví a s tím spojené odlesňování, související se zvyšujícím se sociálním a ekonomickým tlakem. Další fáze vývoje nastala v 7. století př. n. l., kdy byly v severním Egejském moři zakládány první řecké kolonie, a Thrákie se tak stala součástí makro-regionu Východního Středomoří. Vegetaci a její změny spojené s aktivitou člověka je možné zkoumat pomocí archeobotanických záznamů. Právě na základě identifikace a interpretace antropologických indikátorů lze pozorovat, jakým způsobem a v jakém rozsahu se měnilo využívání krajiny a způsob obživy. Z geografického hlediska se paleoekologické a archeobotanické studie zahrnuté v této diplomové práci zaměřují především na vnitrozemí starověké Thrákie, tedy na území moderního bulharského státu. Rekonstrukce vývoje vegetace, struktury osídlení a strategie obživy je utvářena na základě komparativní metody výsledků pylových a makrozbytkových analýz získaných z lokalit datovaných do rané doby železné (Ezero a jezero Durankulak) a mladšího, thráckého období (Koprivlen a Pistiros).

Abstract:

The present thesis deals with the interrelationship between environmental changes and the Thracian society whose development took place in the surrounding environment undergoing fundamental transformation during the first millennium BC. The more significant impact of increasing human activities on the landscape, namely cultivation of plants and pastoralism, both connected with extensive deforestation, associated with the higher social and economic pressure can be detected since the Late Bronze Age and Early Iron Age. In the following phase of agriculture development, since the seventh century BC when the first Greek colonies were founded in the Northern Aegean, Thrace became an important part of the Eastern Mediterranean macro-region. Vegetation cover and its changes influenced by local land-use and livelihoods is studied on the basis of identification and interpretation of anthropological indicators, contained in the plant macroremains and pollen assemblages. Geographically, the palaeoecological and archaeobotanical studies included in this thesis are focused on inland Ancient Thrace, i.e. the territory of the modern Bulgaria. For better understanding of vegetation history, settlement pattern and subsistence strategies, the archaeobotanical records of cultivated and ruderal plants or weeds acquired from the sites dated to the Early Iron Age (Ezero and Lake Durankulak) and the Thracian period (Koprivlen and Pistiros) are also compared.

Klíčová slova (česky)

Klima, vegetace, zemědělství, Thrákie, Pistiros, krajina

Klíčová slova (anglicky):

Climate, vegetation, agriculture, Thrace, Pistiros, environment

Table of Contents:

1. Introduction

Conducted in the last few decades, archaeological excavations together with a number of palaeoecological and archaeobotanical studies aimed to contribute to our knowledge of society-environment interactions and their development and processes related to the climate changes. Various subsistence practices have observable influence on the surrounding environment which is highly sensitive to both anthropogenic stress as well as the climate changes. This ambiguous and complicated interrelationship between climate, landscape and human society has been an issue of argument among many scholars.

In this thesis, a detailed research concerning the plant economy and impact of human activities on the landscape in Ancient Thrace is focused on the period of the first millennium B.C., respectively from the Early Iron Age to the Hellenistic epoch. Generally, during the Iron Age, numerous reconstructions of the vegetation and climate history show a significant increase in human pressure on the landscape with a slight divergence usually associated with the geographic location. With respect to different environmental, economic and socio-political situation, the coastal parts of the northern Aegean Sea called Aegean Thrace are not included into the spatial delimitation of the thesis. The core area of the interest is limited only to the territory of modern Bulgaria.

Analyzing the published results of the existing multi-disciplinary projects throughout Bulgaria, the primary aim is to present a state of the art of our understanding of the complex interactions among the Thracian agriculture and the regional climate and vegetation development. To complete the comprehension of the topic, several particular objectives and goals need to be accomplished:

- To define what changes or effects can be visible on vegetation cover in the different areas of Bulgaria during the Iron Age;
- To compare subsistence strategies and economic system of the Iron Age communities in diverse periods and Ancient Thrace landscapes;
- To explore whether the changes in land-use intensification in the second half of the first millennium B.C. is directly caused by the Greek colonization of the Thracian territory;
- To integrate this case study of Ancient Thrace to general discussions on the climate changes and their impacts on the human society.

Landscape transformation reflects both climate variability as well as human activity influences. A large amount of palaeoenvironmental elements involved in this system can be observed, however, an analysis of the anthropogenic indicators taken from the archaeobotanical records is a major focus. In order to gain the most accurate data, climate models can be used for interpretation of the regional environmental and societal development. In particular, this thesis is intended to combine historical-archaeological perspective with the archaeobotanical methods and approaches.

The current natural vegetation mosaic is the long-term result of the internal and external forces. In the first chapter, it is essential to briefly outline the main types of biomes and ecosystems in reference to the position of modern Bulgaria and its topographical and geomorphological setting. Also the climatic conditions perceived as the most important factor affecting the character of the environment need to be considered.

The second chapter deals with the historical review. In the Thracian society and culture undergoing fundamental changes during the first millennium B.C., the Greek influence played a very compelling role. Especially, an increase in agricultural areas and collected plants of economic importance suggests significant expansion of the interregional and long-distance trade network, including the system of commercial routes that can be seen as the other evidence of impact on the landscape.

In the next chapter, the principal sub-research questions and hypotheses are to be analyzed in details. Firstly, it will be specified which signs of land-cover human shaping activities can be preserved in archaeobotanical records. Secondly, the history of the development and changes of the Thracian agriculture driven by the economic growth and demands will be described by means of the archaeobotanical remains studied in the four contrasting settlements. The Bulgarian sites Ezero and Durankulak are dated to the Early Iron Age, whereas Pistiros and Koprivlen to the Archaic and Classical period.

In addition, the following discussion is aimed to incorporate multiple lines of the evidences into a broad survey of the human-environment relationship of the past.

2. Land of Ancient Thrace

2.1 Topography of the Thracian region

Analyzing the relationship between climate changes and human settlements or land-use is very closely linked with topography of the study area. Why is topography and geography so important? Generally, topographical features affect local climate as well as settlement system and subsistence strategies. Mountain ranges and rivers served as natural barriers or communications for inhabitants, i.e. space where they lived. Economic and societal development works together with climatic and environmental conditions of the region as a whole (COLLINS, 20).

The land inhabited by the numerous Thracian tribe groups to the north of the Aegean Sea was the key region in connectivity strategy between the Eastern Mediterranean and central Europe. Besides regular commercial contacts, the Greeks had a relative awareness of the terms *Thrace* or *Thracians* from different types of Greek literary sources such as Herodotus, Thúkydides, Hacataeus of Miletus or Homeric poems (XYDOPOULOS 2006, 188). According to the mythological traditions, the Thracian land was well-known for fine horses and good wine associated with favorite Greek god Dionysos (XYDOPOULOS 2004, 19; 2006, 190; ILIEV 2013, 61).

The term Ancient Thrace is basically defined as a geographical and historical unit area lying in southeastern Europe comprising three main modern states of Bulgaria, northeastern Greece and the European part of Turkey. The best spatial delimitation of the Thracian territory is characterized by the Black Sea in the east, the Bosporus and the Marmara Sea in the southeast, the North Aegean coast and islands of Thasos and Samothrace in the south. The western border is constituted by the line of two rivers- the Struma and Morava, the Danube River flows along the northern border (BOUZEK – GRANINGER 2009, 13; XYDOPOULOS 2006, 192; JANOUCHOVÁ 2014, 68).

However, these geographical boundaries are not in perfect accordance with ethnographical determination. Traces of the Thracian tribes presence out of this territory are preserved in archaeological records founded also in the neighboring countries of Macedonia, Serbia, Romania, Moldavia and the Ukraine (BOUZEK – GRANINGER 2009, 12).

In the course of time, the historical boundaries of Thrace have varied. External forcing factors, especially the Greek and Macedonian political situation, affected surrounding regions including the Thracian land. Modern Bulgaria is perceived as the core area of the Thracian territory.

The Bulgarian landscape is diverse and clearly divided into different regions with specific geographical (Fig. 1), socio-economic and cultural aspects. Basically, more than half of the area is rugged to mountainous. The average elevation of the terrain is 480 m (HAMNETT 2006, 7; BOZHINOVA 2007, 51), decreasing from the west to the east and from the north to the south.

Hilly relief is composed of several huge mountain ranges reaching almost 3000 m a.s.l. The northern region is covered with long chain of the Balkan Mountains called the Stara Planina (ancient name Haemus) running from the northwestern border of Bulgaria and Serbia towards the Black Sea. Together with the Stara Planina, southwestern massifs of the Rila and the Rhodope Mountains belong to the highest uplands in the country. Lower massifs comprising the Pirin, the Osogovo or Vitosha Mountain complete the continuous mountain chain forming the western border of Bulgaria.

In southeastern part of the country, close to the border with Greece and Turkey, the landscape has significantly lower elevation than the west or center. The mountain ranges namely the Sakar and the Strandzha are located between the Maritza and Tundzha river valleys and the Black Sea coast.

Despite of the relatively high hilly characteristics, series of narrow plains filling the space between single heights are capable of providing the area with sufficient moisture and fertility. These lowlands are formed by combination of river valleys, basins, plateaus and isolated hills.

Also a position of the Bulgarian Mountains plays an important role because these uplands enclose the lowlands and shoreline, thereby create a rain shadow effect. In this manner, the Stara Planina has an influence on the air masses flowing from the north, the west and the east into the Danubian Plain situated in the north to the mountains (NIKOLOVA – VASSILEV 2005, 20), along the Danube River.

The Upper Thracian Plain is the heartland of modern Bulgaria but in the Antiquity it was part of the Northern Thrace. The extensive lowland formed by broad valley of the Maritza River extends between the Rhodopes and the south part of the Balkan Mountains called the Sredna Gora. According to the recent classification of this territory, the plain is the most fertile agricultural district in Bulgaria (BESHKOV 1939, 179; HAMNETT 2006, 7). Its average elevation is 168 m and it is consisted mostly of plains.

The Rose Valley stretches along the Toundzha River in the foothills of Stara Planina. The river valley was unofficially named after the location where a plant, oil-bearing rose, is presently cultivated on the fields near the towns Karlovo, Kazanlak or Nova Zagora. The valley landscape is more undulating than the southwestern Maritza river valley. The highest point with altitude of 710 m a.s.l. is situated in the town of Klisura.

Besides these most spacious lowlands, a natural potential of the land for rural sites can be found throughout the whole land of Ancient Thrace usually concentrated nearby the rivers. Some of the most important commercial centers are located in the vast and fruitful plain of the Serres region in northern Greece. The connection between inland settlement and the Aegean coast is provided by the Strymon River.

Water has an essential significance for life. The influence of climatic variability on water resources is displayed in every water system or hydrological cycle. Rivers, streams and their tributaries affected not only the shape of the landscape they run through but also local or long-distanced trade network, mobility in the country and land-use.

The area of the watershed belongs to the Aegean basin in the south or the Danube channel in the north. All rivers in Bulgaria are surrounded by highlands creating snow cover or sufficient amount of precipitations that continually feed river channels. In the characterization of the runoff regimes in the Bulgarian catchments, hydrological factors like soil moisture, underground water level, water reservoir conditions, streamflow etc. respond to short-term or long-term precipitation fluctuation (RIVAS-LIZAMA 2005, 86). General description and detailed geophysical and palaehydrological studies of the catchments have been carried out for last decades (KENDEROVA et al. 2007, 272; CHIVERRELL – ARCHIBALD 2009, 293; SKOULIKIDIS 2009, 428; ARCHIBALD 2010, 243).

The region of Ancient Thrace was bounded by two rivers and two seas. The Morava River (ancient name Marisos) running through the Drama Plain in the modern Serbian region flows into the Danube River (ancient name Istros) which empties into the Black Sea. The Sea of Marmara and the Aegean Sea separated Ancient Thrace from the rest of the Eastern Mediterranean but only till the Greek colonization when the barriers between these worlds have changed due to intensifying commercial activities.

Most of the large rivers were navigable and easily utilizable as natural trade routes in the Antiquity. These river streams rise in the central Thrace and flow into the Aegean Sea. This concerns the following rivers: the Struma River (ancient name Strymon), the Mesta River (ancient name Nestos) and the Maritza River (ancient name Hebros) (DE BOER 2010, 177). The other possible connection between the Balkans and the North Aegean is the Vardar River (ancient name Axious) flowing more in the west through Ancient Macedonia.

A major river system in Bulgaria is represented by the above-mentioned Maritza River and the Toundzha River (ancient name Tonzos). Initially, both rivers emerge separately in the mountainous terrain and they continue southeastward through the lowlands. At the Turkish town of Edirne, the rivers join together to become the Evros River which enters the Aegean Sea near the harbor of Ainos (Oherova 2006, 6). The Toundzha is the most powerful tributary of the Maritza River but the Maritza accepts many tributaries like the Topolnitza, Arda or e.g. Ergene (DE BOER 2010, 177).

Palaeohydrological studies on the Maritza River have investigated fluvial history, primarily observing behavior of the main stream and its channels and changes during the second half of the first millennium B.C. (CHIVERRELL et al. 2009, 290). The landform surveys supported by satellite imaginary data and data acquired from sub-surface electrical imaging and gradiometry (ARCHIBALD 2010, 242) have successfully found out that the alluvial plain was composed of multiple paleochannels perceptible beneath the surface. The abandoned river canals were dried off as a result of intensive using river water for irrigation system (BALTAKOV et al. 1996, 184).

The soils in the country match the topographical features and geophysical variety as well as the climatic conditions. Well developed databases of soil data together with large-scale systematic and detailed mapping have been in progress since the first half of the twentieth century[1] (KOLCHAKOV et al. 2005, 86).

The extended list of the soils can be divided into three categories according to the geographical determination.

1. Northern Bulgaria where the greater part is covered by the Danubian Plain and mountains of the Stara Planina. The fertile lowlands are characterized by organically rich

[1]The basic monograph *Soils in Bulgaria* was published in 1948 (ANTIPOV – KARATAEV – GERASSIMOV 1948). On the base of new empiric data, the publication was reedited in 1960 (ANTIPOV – KARATAEV et al. 1960; KOLCHAKOV et al. 2005, 83; SHISHKOV – KOLEV 2014, 1).

and heavy black earth soil called chernozems. The grey forest soil dominates in the mountainous area (SHISHKOV – KOLEV 2014, 24).

2. Brown or cinnamon forest soil typically occurs in the forest land areas in Southern Bulgaria, especially on plateaus, mild slopes or low mountains. On the other side, chernozems is also known in this region, however, its characteristics are modified by the Mediterranean climate. These soils have deep humus horizon which is very important for agricultural fields and gardens. Also fine textured leached chernozems-smolnitza thrives farming in lowlands and alluvial areas (VESSELIN – KOLEV 2008, 33; SHISHKOV – KOLEV 2014, 103–105).

3. This category includes higher altitudes of the Bulgarian mountains. There are rather shallow dark brown forest soils with strong acidity and greater erosion tendency than fertile land (HAMNETT 2006, 7; MARINOVA et al. 2012, 468; 127). Soils in the valleys close to the large rivers are consisted of fluvial sand and loam (SHISHKOV – KOLEV 2014, 134).

2.2 Climate

2.2.1 Complexity of the climatic system

The Holocene period is the youngest epoch of the Earth's geological history. Climatically, the Holocene onset, generally dated around 11 500 cal. BP, corresponded with the global warming and increasing humidity, following the cooler and more arid Pleistocene. From archaeological and historical perspective, climate is one of the most important factors affecting the landscape and its changes play a crucial role in social and cultural evolution. In this brief overview of the climate history, past climatic variability and changes are explored at a global, regional and local scale.

The climate is an extremely complex system determined by quite a number of external and internal forces. According to the commonly respected definition of climate, although it is not unified[2], the classification of climate comprises the five major components: the atmosphere, the hydrosphere (the oceans and other water bodies), the cryosphere (snow and ice), the land surface and the biosphere (BAEDE et al. 2001, 87). In practice, the climate is usually described in terms of the average annual temperature and precipitation in a place for a period of time (LE TREUT 2007, 96).

Over the time-scale of millions of years, the Sun and the orbital variations have always represented the most influential external forcing mechanism which has powered all elements in the climatic system. As demonstrated by the plentiful palaeoclimatological studies, the documented fluctuations in solar activity have coincided with the Earth's climatic anomalies. This relationship between the Earth's surface and the Sun energy can be observed on the geographical distribution of the solar irradiance and its impact on the regional climate pattern. The climate variability for a given area depends primarily on latitude, however, it can change from place to place depending on elevation, distance from the seashore, geomorphological features and vegetation cover as well (BAEDE et al. 2001, 87). For purpose to filling gaps in our knowledge of the climate history, gained information are formed by means of comparisons of large-scale analyses of available multi-proxy data with using the global climate models.

In general, palaeoclimatic data is preserved in the form of wide fossil material variety of which provides indirect[3] past climatic conditions evidence. Usually these proxy data indicate some kind of specific secondary information about environmental properties influenced by local climate change, for instance the thickness of tree rings, pollen assemblages, ice cores and ocean or lacustrine sediments belong to the best proxy parameters reflecting temperature or water level fluctuation as well as rainfall amount in the surrounding area (PUHE – ULRICH 2000, 35–37). Pollen series also yield a comprehensive insight into a potential connection between climate, vegetation and human activities.

In an effort to reconstruct a broad chronological framework for the Holocene climate changes and events, the palaeclimatic signals obtained from proxy records must be properly interpreted and calibrated by multivariate interdisciplinary methods and

[2] According to the World Meteorological Organization the climate is defined as the "average weather" or "the statistical description in terms of the mean and variability of relevant quantities over a period of time." (WMO: https://www.wmo.int/pages/themes/climate/).

[3] Direct measurements of single meteorological parameters, including records of temperature or precipitation etc., through the use of proxy data is very rare. The documentary records of climatic events have occurred more often since the historical times.

techniques (BRADLEY 2014, 4–6). Nevertheless, such a climate reconstruction requires a combination of a large amount of proxy data and it is necessary to consider difficulties in interpretation and especially the issues of reliability of these palaeoclimatic indicators.

Firstly, different methods of analysis and dating can conduce to a bias in the interpretation of signals or complex network of interactions among every single proxy data. Furthermore, principal disadvantage of proxies is sensitivity. The climatic conditions in each Earth's geographical region are affected by local environmental factors (e.g. geomorphological setting), hence, the global climate models cannot precisely respond to regional parameters. As much as strong regionalism in climate trends, misleading estimating human influence intensity can cause complications in interpretation. The basic question in palaeoecological studies is how natural transformation of environment can be recognized from the changes of the anthropogenic character (DRESLEROVÁ 2011, 14–15; FINNÉ et al. 2011, 3168–3169).

In spite of these uncertainties in climate reconstructions, vegetation trends directly follow the regional climate variability. In these circumstances we can only define an impact on the local vegetation cover in terms of duration of given climatic events.

2.2.2 Holocene climate variability

The signs of climate changes in proxy archives across the world provide surprisingly still relatively sparse conception about a very long sequence of major climatic periods and events in timespan of centuries to millennia. Recent larger progress in archaeobotanical and palaeoclimatic survey and the chronology of the climate development on a global-scale have pointed towards a better understanding of the regional climatic fluctuation during the Holocene.

This epoch, compared to the Pleistocene climate cycles, coincides with an emphasizing decrease in the amplitude of climatic oscillation, nevertheless, the palaeoclimatic evidences have recorded several exceeding climate fluctuations as well. Currently, the pioneering studies of the American geologist G.C. Bond have identified an existence of the eight North Atlantic cycles with duration of approximately 1500 ± 500 years (BOND et al. 2001; WANNER – BÜTIKOFER 2008). Special attention is put on the most influential Holocene rapid climate changes (RCC) and their connection with the dramatic transformation of native vegetation cover as well as changes in the human occupation pattern and culture.

Focusing on the study area, it is possible to monitor the local and regional processes of changing climate conditions roughly in relation to the Bond cycles. The 8200 cal. BP (6200 cal. BC) cooling and drying event (Bond cycle 5) corresponds with the pervasive environmental changes throughout the north hemisphere, and in particular drier conditions in the Eastern Mediterranean (Mesopotamia, Levant, Anatolia) supported the agricultural upswing and the following expansion to Greece, Macedonia, Thessaly and Bulgaria (WENINGER et al. 2006, 405). The archaeological data with radiocarbon dating suggest that the first phases of the Neolithic way of life in the Bulgarian territory were fully in the process by the end of the seventh millennium BC (MARINOVA et al. 2013, 467).

During the Middle Holocene, around 6000-5000 BP, prosperous warm and relatively stable climate so-called the Holocene climatic optimum[4] shifted from wetter to drier conditions in many areas (FINNÉ et al. 2011). These profound climatic and environmental changes were preceded by another Bond cooling event 4 dated around 5900 cal. BP (3900 cal. BC) (BROOKS 2006, 32). According to the Bulgarian archaeological data, an abrupt decrease in humidity indicators around 5400–4800 cal. BP (3450–2850 cal. BC) can be in line with the beginning of the Early Bronze Age (3000–2800 cal. BC) (JALUT et al. 2009, 10; MARINOVA et al. 2012a, 414; TONKOV et al. 2013a, 284).

Recent studies concerning the ancient societies in the Eastern Mediterranean during the Bronze Age and Iron Age, attempt to clarify an influence of climate change on the civilization collapses. Notably across North Africa, the Middle East, Anatolia, Greece to the western Mediterranean, the two extreme cooling events (Bond cycles 3 and 2), whose consequences are considered to be one of the principal explanation of the dramatic changes in settlement pattern or social and economic situation in that time have been well-documented (DRAKE 2012, 1862).

The first of them, the 4200 cal. BP (ca. 2200 cal. BC) event is characterized by the distinct period of severe drought which caused abrupt decline of favorable conditions for economic advancement as attested by archaeological evidence, e.g. in Egypt or

[4] Interval of the Holocene climatic optimum is not uniformly defined because an influence of the climate change described in different areas had various extent and duration. The characteristic abrupt decline of average temperature has been recorded in the Greenland ice-core GRIP2 (JALUT et al. 2009, 13). In North Africa, the humid period was replaced by the extreme arid phase around 5500 cal. BP (KALIS et al. 2003, 33). The onset of the dry phase in the western Mediterranean has been dated around 5300 cal. BP as well as the final humid period in the Alps corresponds with time between 5600-5300 cal. BP (JALUT et al. 2009, 10).

Mesopotamia (JALUT et al. 2009, 10; WEIBERG et al. 2016, 7). Presumably, available data make it possible to recognize this arid phase more clearly at low- and mid- latitudes of the north hemisphere because a potential feedback on the climatic deterioration in Central and North Europe was not as drastic as in the Mediterranean region. In Bulgaria, this climatic episode is contemporary with the second half of the Early Bronze Age during which a density of settlement conspicuously decreased (MARINOVA et al. 2012a, 414).

The next Bond cycle 2 took place around 2850 cal. BP (ca. 900–850 cal. BC). Relatively rapid shift from warm and dry Subboreal climate regime to cooler and wetter Subatlantic conditions (MORRIS 2009, 67; DRAKE 2012, 1863) presaged staggering transformation of landscape cover preferring a wetland where numerous formation of peat-bogs growth started. This was supported by lower average temperatures, higher precipitation amount together with the rise of the groundwater table (SPERANZA et al. 2002, 59; BOZILOVA et al. 2004, 245). In regard to the socio-economic changes in the Late Bronze and Early Iron Age, this transition period of climate deterioration initiated population collapse and settlement abandonment in many areas throughout Europe, some upland regions in particular (DARK 2006, 1382).

The mentioned links between the multicentennial and multimillennial wet-dry oscillation and the regional environmental or socio-economic dramatic changes across the Eastern Mediterranean are substantially simplified in this thesis to present a short overview of the most significant climate changes during the Holocene. However, synchronizing all these timelines can be very difficult and uncertain due to heterogeneous development and expression of each event in the regional landscape (ROBERTS et al. 2011, 150).

2.2.3 Climatic zones in Bulgaria

On the basis of the Köeppen Climate Classification System[5], the current spatial structure of Earth's climate variability is divided into the climatic zones with specific meteorological characteristics (patterns of average temperature and average precipitation) in compliance with distribution of natural vegetation formations. Despite the small range, Bulgaria has

[5] The climate system was classified at the end of the nineteenth century by Russian-German climatologist and meteorologist Wladimir Köeppen. His monograph called *Das Geographische System der Climate* was published in 1884 and then republished in 1929 and 1936. The following works modified and improved the original system of climatic zone, e.g. the Köeppen-Geiger system or the Trewartha climate classification (1966, 1980).

relatively multifarious climatic regime. The country with the geographic coordinates of the latitude between ca. 41° – 43° N lies on the border of two major climatic systems (Fig. 2) but the whole area is subdivided into the five inner zones[6].

The greater part of Bulgaria is included in the temperate continental zone whose primary characteristic feature consists of relatively hot summers and long, cold winters. The air mass flowing from the west and the north towards the Danubian Plain affects the northern interior of Bulgaria, i.e. approximately north of the Konyavska Planina but far away from the seashore.

Southward, the area between the southern frontier of the Stara Planina and the Rhodope Mountains including the upper Thracian Plain is classified as the transitional continental zone, in other words, it is a combination of the continental and the Mediterranean climatic systems with slight predominance in the northern continental regime. On the contrary, more emphatic Mediterranean influence is recognized in the lower section of the country (the Thracian Plain and e.g. the valleys of the Mesta, Struma or Maritza River). However, there is no stringent borderline. The essential distinctions between them are expressed through the meteorological measurements (seasonal average temperatures, precipitation amount, and snow cover duration)[7] in a particular place or position. To the northward, summer drought, more typical for the southern Mediterranean region, is gradually moderated, while mild winters are replaced by steady cooling conditions (HAMNETT 2006).

The immediate narrow line along the Black Sea coast is under the control of the humid maritime climate. Considerable reduction of temperature fluctuation accompanied by higher air humidity and strong winds extends the influence to the boundaries of the Strandzha Mountains. Only at the highest altitudes (above 900–1000 m a.s.l.), prevailing climate-forming factors can be assigned to the representative montane climatic zone, which is marked by readily apparent decline of mean temperature with higher elevation (about 5-10°C in the lower mountains and it drops by 0,5°C with each 100 m increase in altitude)

[6] Taking into account that the total area of Ancient Thrace (during the first millennium B.C.) reached the coast of the Aegean Sea, the Mediterranean climatic zone is needed to be considered as well. The accurate climatic specifications depend on the latitudinal and longitudinal situation, however the Mediterranean climate is characterized by relatively hot, dry summers and mild, wet winters with three times higher rainfall amount than during summer in general (JALUT et al. 2009, 5).

[7] The average annual temperature of Bulgaria is 10, 6°C with varies in lowlands about 13,9°C (TONKOV. – POSSNERT 2014, 312), a range from about 10°C in the north to 14°C in the south is usually is presented (MARINOVA et al. 2012a, 414). The mean annual precipitation about 670-700 mm have been measured (source: www.stringmeteo.com, www.weatheronline.co.uk).

and long-lasting winter snow cover. The annual average precipitation exceeds 800 mm (MARINOVA et al. 2012a, 414; TONKOV et al. 2013, 238).

2.3 Vegetation

2.3.1 Present-day biomes

Currently, the burgeoning amount of knowledge concerning the Holocene climate changes and human impact on vegetation in different parts of the world is based primarily on the studying of biotic and abiotic components of present-day ecosystems. Modern natural vegetation cover (Fig. 5) is the reflection of the long-duration evolution affected by numerous climate anomalies and anthropogenic activities. Since the Quaternary, especially later periods of the Holocene, nature and human development have been inseparably bounded. The vegetation monitoring contributes to actual information about biogeographical pattern and terrestrial organism vulnerability to different internal or external processes.

As it was previously mentioned, Ancient Thrace or modern Bulgaria lies on the border of two climatic systems and similar pattern is demonstrated for the biomes division in this area (Fig. 2). The territory between the North Aegean coast and the southern Bulgaria belongs to the Mediterranean biome and the rest of the Thracian land is described as the biome of a temperate deciduous or mixed forest (JALUT et al. 2009, 5). The transitional area is called sub-Mediterranean subregion (MEUSEL – JÄGER 1989, 315). The clearly defined boundary does not exist. This division depends on specific characterization of concrete ecosystems that are geographically and ecologically allotted according to the complex of climate diversity, relief, geology and substrate together with similar plant and animal communities (EASTWOOD 2004, 24–25; PRACH et al. 2009, 7).

The Mediterranean forest, woodland and scrub biome[8] immediately surrounds the Mediterranean Sea, around mid-latitudes (30–40° N/ 40° S). Typical mild and rainy winters, dry summers and large amount of sunshine support unique and rich biodiversity of fauna and plants as well as year-round agriculture. Among of all ecoregions of this biome,

[8] The biome comprises world ecozones in the Mediterranean area, California, Chile, South Africa and Southwest Australia (PRACH et al. 2009, 53).

the European Mediterranean is most intensely affected by human activity. It is supposed that the anthropogenic and climatic[9] reasons are the main explanation of biodiversity differences between the western and eastern part of the Mediterranean basin. Major vegetation types include forests and woodlands, savanna, grasslands and shrublands (PRACH et al. 2009, 56), nonetheless, during the last millennia extensive areas have been converted to agricultural fields.

These climatic conditions of the narrow and dry zone have favored distribution of the xeromorphic and sclerophyllous group of trees and shrubs (*Pistacia lentiscus, Phillyrea latifolia, Erica arborea, Myrtus communis, Buxus sempervirens, Rosmarinus officinalis, Cistus* sp. etc.) characterized by evergreen, small, hard and thick leaves adapted to drought (JALUT et al. 2009, 5). Growth of evergreen olive trees (*Olea europeae*) is one of the most significant indicators of the Mediterranean climate.

At low and mid-altitudes, the Eastern Mediterranean forests are generally composed of deciduous broad-leaf trees, such as oak (e.g. *Quercus coccifera, Q. cerris, Q. pubescens*) (PRACH et al. 2009, 56–57). In the original composition of the forest, *Quercus ilex* dominated but presently this type of oak is spread only across the Western and Central Mediterranean. More frequent Kermes oak (*Q. coccifera*) grows into the height of smaller trees (less than 2 m) but more likely it is found as a shrub with thorny leaves (TSIOUVARAS 1987, 542). A remarkable increase of this species during the last millennia is related to its capability to easily colonize previously destroyed areas, usually associated with fire ecology in the Mediterranean. It represents the pioneering stage of ecological secondary succession.

Coniferous forests (e.g. *Pinus halepensis, Pinus pinaster, Pinea pinea, Juniperus* sp.) occur at higher altitudes. Especially *P. halepensis* commonly known as Aleppo pine is one the most representative evergreen species in the Eastern Mediterranean. Since the ancient times, this type of pine has been admired for its picturesque appearance, edible seeds (pine nuts) and resin used as a unique flavoring in white wine. Hence, it is difficult to distinguish naturally and intentionally cultivated growths.

The northern border of the Mediterranean biome referred to as the sub-Mediterranean ranges from the eastern Pyrenean Peninsula along the Dalmatic and Aegean coast towards the Black Sea. Climatically, the zone differs from the rest of the Mediterranean in some small but noticeable anomalies, for instance a less intensive and

[9] In the Eastern Mediterranean the temperature and humidity differences are greater than in the Western Mediterranean, which is affected by the Atlantic Ocean.

short drought summer duration that simultaneously affects the floristic composition and diversity.

Some sclerophyllous species are replaced by deciduous trees being more tolerant to dry summers but also forbearing to colder winters. The climax vegetation is composed mostly of the thermophilous types of oak woodland (*Quercetalia pubescentis*). Regarding the taxonomy of the genus Quercus, *Q. pubescens, Q. cerris* and *Q. frainetto* (JALUT et al. 2009, 5) are the most widespread forest habitats in the Balkan. The secondary species of the sub-Mediterranean deciduous forests are hornbeam (*Carpinus orientalis)*[10], manna ash tree (*Fraxinus ornus*), maple (*Acer obtusatum*), hop hornbeam (*Ostrya carpinifolia*), Judas tree (*Cercis siliquastrum*) and Rhus cotinus (*Cotinus coggygria*). Different varieties reflect different soil types.

The areas nearby the alluvial plains are covered with riparian forests with dominating elm (*Ulmus* sp.), silver poplar (*Populus alba*), willow (*Salix alba*), walnut (*Juglans regia*), oriental plane tree (*Platanus orientalis*) and hazel (*Corylus*). Abrupt expansion of chestnut forest (*Castanea sativa*) occurring on the high acid substrate is usually explained by directed cultivation of chestnut trees in orchards.

In contrast to the Mediterranean biome, *Pinus halepensis* demanding higher air temperature does not grow in these more northern regions. On the other hand, other pine species, such as black pine (*Pinus nigra*) are very frequent. It can be found in the higher altitudes mostly on the rocky surface.

The third type of biome extended to the Balkan Peninsula is called the temperate deciduous forest corresponding to Central Europe. The natural vegetation is modified to warm summers and cold winters typical for the European temperate latitudes. All trees, shrubs and forest herbs require sufficient rainfall during growing seasons. The native woodland is rich in species variation but it is limited by changes in temperature and precipitation and an amount of solar radiation.

Among temperate hardwood communities a formation of oak, elm, maple and beech is the most common. Towards the southern Europe, the thermophilous deciduous oak trees begin to predominate, namely *Quercus pubescens*, *Q. cerris* and *Q. frainetto*. These oak taxa are widespread and dominant on the Balkan Peninsula where the transitional area between climate and biomes systems passes through. The northern border

[10] The oak-hornbeam forest also known as the Thracian white forest has earned its name because these kinds of woodland are light a thin, partially caused by anthropogenic degradation (TZONEV et al. 2011).

of their occurrence in Europe goes across the south parts of Slovenia but some scattered traces are known from the warmest places of the Czech Republic (PRACH et al. 2009, 74).

In northeastern Bulgarian region, small relicts of original steppe vegetation have survived till the present-day. Steppe and forest-steppe zone covers the territory of Southern Dobrudzha (Bulgarian), along the Black Sea coast, up to Northern Dobrudza (Romanian) and the Lower Danubian province as the western Pontic border of the Euroasian steppe and forest-steppe area. Local representatives of open steppe vegetation dominate in the natural environment with the altitude between 100 to 800 m a.s.l., comprising in particular Chenopodiaceae, Asteraceae, Poaceae and Apiaceae species, *Artemisia*, *Achillea*, *Alyssum caliacrae*, *Agropyron cristatum*, *Adonis* and many others (TZONEV et al. 2000; TONKOV et al. 2013a; SHISHKOV – KOLEV 2014, 13).

2.3.2 The Bulgarian ecosystems

The terrestrial geobiodiversity database of the Bulgarian territory is compiled on the base of taxonomic, geographic and geomorphological information gathered from different levels of altitudinal zonation. Species richness depends on characteristic environmental conditions determined mainly by temperature, solar radiation, humidity and soil substrate. The important factor in the local climate and ecosystem is the elevation. Similar to the ecological pattern of latitudinal diversity gradient related to the biome division, the elevation diversity gradient describes changing biodiversity with increasing altitudes (MCCAIN – GRYTNES 2010, 2).

With respect to phytogeographical boundaries of the biomes, the contemporary plant and tree species are clustered into highly distinctive vegetation belts and layers. Basically, the Bulgarian environment is divided into following two major sub-regions: lowlands with river valleys and mountain ranges (GRUNEWALD – SCHEITHAUER 2010, 22; MARINOVA et al. 2012a, 414) and six altitudinal belts (Fig. 3): 1. the oak forest (up to 600–700 m a.s.l.), 2. the oak and hornbeam forest (600–1000 m a.s.l.), 3. the beech belt (1000–1600 m a.s.l.), 4. the coniferous belt (1600–2000/2200 m a.s.l.), 5. the sub-alpine (2200–2500 m a.s.l.) and 6. alpine belt (above 2500 m a.s.l.) (BOZILOVA – TONKOV 2000, 316; TONKOV et al. 2001, 168; POPOV 2007, 233).

The sites occurring at the relatively low altitudes (up to ca. 900–1000 m a.s.l.) (MARINOVA et al. 2012a, 414) are very attractive for botanical analyses including palaeoecological researches of the local history of the natural vegetation cover. A wide variety of wetland ecosystems linked by seasonally or permanently inundated riverine fringe, lake margins, marshes, mires, fens, peat bogs or swampy terraces relies upon constant water level. Demonstrated plant diversity and composition of wetlands can be well-observed in the vicinity of some Bulgarian mountainous lakes[11] where the elevation gradient is clearly obvious and distinguishable (Fig. 4).

The zone between lake border and peripheral parts of wet meadow is occupied by the hydrophilous or hygrophilous plant communities, among which grow primarily *Phragmites australis*, *Typha latifolia, Lycopus europaeus*, *Schoenoplectus lacustris*, *Potamogeton fluitans or P. crispus, Ranunculus aquatilis, Lythrum salicaria*, *Lemna minor*, *Carex acuta* L., *C. rostrata, C. echinata* Murr., *Juncus eddusus* L., *Hypericum tetrapterum, Mentha aquatic, Potentilla* sp, *Galium* sp. etc. (TONKOV et al. 2008, 186; VAN HUIS et al. 2013, 170; HRISTEVA et al. 2015, 114). Along the edge of the body of water, sparse sphagnum (*Sphagnum* sp.) mosses are developed as a floating interface of the open water and shoreline where the water level is shallower (TONKOV – POSSNERT 2014, 1).

The woodland units covering the hills surrounding the damp lowland areas consist of the xerothermic and mesoxerophilous tree species. In the lower belts of the xerothermic forests, the association of *Quercus*-*Carpinus* (*Quercus pubescens, Q. cerris, Q. frainetto, Q. dalechampii* and *Carpinus orientalis, C. betulus*) dominates, followed by *Fraxinus ornus*, *Ulmus minor*, *U. glabra*, *Acer campestre*, *A. pataniodes*, *A. pseudoplatanus, Juniperus oxycedrus, Coronilla emerus, Ostrya carpinifolia* as an admixture. These ascendant species can be mixed in some places with *Prunus mahaleb, Syringa vulgaria, Cornus mas* and *Pinus nigra* (BOZILOVA – TONKOV 2000, 317; TONKOV et al. 2001, 169; TONKOV et al. 2008, 187; MARINOVA et al. 2012a, 415; VAN HUIS et al. 2013, 170; LAZAROVA et al. 2015, 2).

Regarding the mountain ranges of the Balkan interior, the vegetation cover resembles more the Central European landscape than the Mediterranean region (SAVIĆ 2008, 61). Natural woodland edge is not always sharp, hence, many tree species penetrate into adjacent belt in line with the suitable abiotic factors. The scattered traces of the

[11] The alpine lakes of glacial origin are located in the mountain ranges of the Rhodopes: e.g. Smolyan lakes (VAN HUIS et al. 2013, 170); the Rila Mountains: Seven Rila Lakes (BOZILOVA – TONKOV 2000, 316).

thermophilous sub-Mediterranean flora, where the oak forest belongs, can be visible only in the low mountain massifs.

At higher altitudes, usually between 900-1000 m a.s.l. and 1300-1600 m a.s.l. (VULCHEV et al. 2000, 103; MARINOVA et al. 2012a, 415), the zone of common beech forest has been well-developed in all local uplands. Besides almost monodominant formation of *Fagus sylvatica*, fragmentary signs of other species (e.g. *Carpinus betulus*) are known as a subdominant (VULCHEV et al. 2000, 105). The rare patches of *Alba abies, Picea abies* and *Pinus nigra* stand close to the superior border (1000-1600 m a.s.l.) of the belt (LAZAROVA et al. 2015, 2). From the southern parts of Europe, forest of the Eastern beech (*Fagus orientalis*) is extended to the Bulgarian mountains, especially the Straldza and the Rhodopes.

At the beech zone, the isolated islands of spruce, fir and pine can be found mostly nearby the extreme rocky habitats at first, and then with increasing elevation, the coniferous trees replace the remnants of mixed deciduous woodland. Above the altitude of 1500-1600 m a.s.l., the landscape is covered with the coniferous forest with principal representatives of *Picea abies, Abies alba, Pinus sylvestris* and *P. peuce* (BOZILOVA – TONKOV 2000, 317-318; (TONKOV et al. 2001, 169–170; MARINOVA et al. 2012a, 415; LAZAROVA et al. 2015, 2). In addition, a slight occurrence of *Juniperus communis*, *Betula pendula, Populus tremula* or *Vaccinium myrtillus* is recorded as well, often found on the slope depression (TONKOV et al. 2013, 1).

The subsequent vegetation zones, above ca. 2000 m a.s.l. can be developed only in the highest mountain ranges in the country, e.g. the Rhodopes and the Rila Mountains. The subalpine and alpine belts comprise arboreal infiltration from the lower altitudes. The other prevailing species correspond to the harsh environmental conditions of the heights, such as dwarf trees like *Pinus mugo*, *Juniperus siberica* and shrub or herb communities: *Bruckenthalia spiculifolia, Festuca paniculata, F. picta, F. valida, Alnus viridis*, *Salix lapponum, S. reticulate, S. herbaceae, Carex curyula, Nardus stricta, Rumex alpines* etc. (BOZILOVA – TONKOV 2000, 318; TONKOV et al. 2001, 170).

2.3.3 The Holocene vegetation history

The current situation of the vegetation, as described in the previous sub-chapter, specifies the regional pattern of vegetation in dependence on the elevation associated with other environmental aspects needed for the development of natural vegetation cover. In this chapter, the development and changes in the distribution and composition of vegetation in the specific regions of Bulgaria during the Holocene epoch is particularly described. The Bulgarian mountainous areas situated in the transition between moderate continental and sub-Mediterranean climatic system offers abundant attractive places for palaeoenvironmental research. The territory includes a complex assortment of landforms, which allows investigating wide spectrum of natural archives, such as numerous fluvial, lacustrine, mires or peat-bogs sediments etc., containing archaeobotanical records of vegetation succession. Combined pollen and plant macroremains studies with radiocarbon dating and multi-proxy reconstruction of the Holocene climatic fluctuation provide more quantitative palaeoecological information about natural environment and the potential climate and human influence in the past.

The Postglacial pollen stratigraphy indicates dynamic ecological processes within the biodiversity initiated by the warming at the beginning of the Holocene. In the case of the mountains in the southwestern Bulgaria (the Rhodopes, the Rila, the Pirin, the Osogovo), the pollen data suggest that abrupt tree vegetation expansion strongly influenced the entire system of the regional altitudinal belts. The groups of pine (*Pinus mugo, P. sylvestris, P. peuce*) mixed with *Juniperus* dominated at the higher altitudes (2300 m a.s.l.), however, in the pollen profiles of the subalpine lake sediments in the Pirin Mountains, an increase in birch (*Betula pendula*) pollen percentage values above 1900 m a.s.l. is also noticeable (GRUNEWALD – SCHEITHAUER 2010, 40–41). In comparison with the present-day situation, spread of this tree species proves that the treeline was quickly shifted upward.

The Early Holocene afforestation processes in lowlands were displayed by a sharp increase in temperate and broad-leaves trees and shrubs, such as *Quercus, Ulmus, Tilia, Carpinus, Corylus, Fraxinus, Acer, Alnus* and *Salix* (GRUNEWALD – SCHEITHAUER 2008, 317). The herb vegetation consisted of a diverse mixture of Poaceae, Cyperaceae, Brassicaceae species and other taxa of e.g. *Typha, Sparganium, Ranunculus* or *Plantago* (TONKOV et al. 2013, 3). Some localities with high soil moisture constituted potential support for the first spread of mesophilous tree species, such as *Fagus, Abies, Picea*-types.

Despite the fact that the ecological conditions changed in many respects during the Middle Holocene, the pollen diagrams have not detected any significant revolution in the composition of arboreal vegetation, on the other hand, the favorable more humid and warmer climate caused rising timberline to the higher elevations. The striking expansion of coniferous trees was represented especially by pines (*Pinus peuce, P. sylvestris, P. mugo*). In the time of its maximum expansion around 6000 BC (between 8000 and 7000 cal. BP), the *Pinus* genus reached the spatial boundary over 2000 m a.s.l. (WILLIS et al. 2000, 117; GRUNEWALD – SCHEITHAUER 2010, 42).

The Atlantic deciduous forest (*Quercus, Ulmus, Tilia, Alnus, Betula*) limits extend up to 1900 m a.s.l., which was more than 800 m higher than today (STEFANOVA 2003, 109). On the contrary, a close look at the pollen records from the western part of the Rhodopes has revealed some temporally reduction of *Fagus* and *Abies* (TONKOV et al. 2013, 3). Since ca. 4500 BC (6500 cal. BP), *Abies alba* with better adaptation capabilities in the places where birch trees had usually grown, began expanding into the forests up to the elevations of 1900–2000 m a.s.l. The maximum distribution of fir trees is estimated between 6500–4800 cal. BP (STEFANOVA 2003, 109; GRUNEWALD – SCHEITHAUER 2010, 42) and after ca. 1700 BC (3700 cal. BP) its distribution began to decrease (BOZILOVA et al. 2004, 244).

At the later phase of the Late Holocene, *Fagus sylvatica* spread out from small isolated stands in open forests to one of the most dominant population in the Bulgarian woodlands, either as the important component of mixed beech-fir forest, or as the principal in almost pure beech forest (PANOVSKA et al. 1995, 42). According to the palaeovegetation reconstruction, increasing formation of beech forests corresponded with the extensive decline of coniferous trees in the same areas between 3500–3200 cal. BP (LAZAROVA et al. 2009, 149; 2015, 5).

The development of such a vegetation pattern continued during the Subboreal-Subatlantic transition and onwards. Other dynamic changes of vegetation diversity have been documented throughout all the altitudinal belts. After ca. 2300 BC (4300 cal. BP) the highest mountainous areas with still active pedogenesis were covered with subalpine coniferous forests (*Pinus mugo, Juniperus*) and various herb species (e.g. *Ranunculus,* Poaceae, Brassicaceae, Apiaceae). The coniferous forests composed of *Pinus sylvestris, P. peuce, P, nigra* and *Abies* with slight admixture of sciophylous plants and fern species dominated on the slopes of hills (LAZAROVA et al. 2009, 149; TONKOV et al. 2013, 3).

However, there is also an evidence for gradual decline of *Abies alba* after 3700–3400 cal. BP, and at the same time, the increasing population of *Picea abies* mixed into the coniferous communities (STEFANOVA 2003, 109; LAZAROVA et al. 2015, 7). GRUNEWALD – SCHEITHAUER 2010, 43).

Besides *Fagus sylvatica* as mentioned above, a very distinct increase of *Carpinus orientalis/Ostrya* pollen has been found in the structure of mixed and deciduous forests at lower altitudes, where oak trees with elm, hazel and lime trees occurred. *Salix* and *Alnus* grew usually along streams and brooks or near the peripheral parts of mires and peat-bogs (LAZAROVA et al. 2009, 149).

In contrast to the Subboreal lowlands and humid surface characterized by hygrophyte vegetation (*Phragmites, Typha, Carex*, Poaceae, Cyperaceae) and hydrophilous herbs (*Potamogeton, Myriophyllum*), in the Subatlantic time the pollen diagram shows decline of these species and rising appearance of halophilous species of Chenopodiaceae (Amaranthaceae) demanding salty terrain (TONKOV et al. 2008, 190).

The major climatic and vegetation trends in the past were quite logically deduced from the numerous palaeoecological studies monitoring the local treeline shifting in tandem with the climatic and lake level fluctuation or soil moisture in diverse areas. Notwithstanding the climate as the main driving force, during the Late Holocene the natural vegetation cover was strongly adjusted by human activities. In this sense, the palynological and plant macroremains research on anthropogenic indicators is also important in evaluating more precisely the social and cultural development in Ancient Thrace.

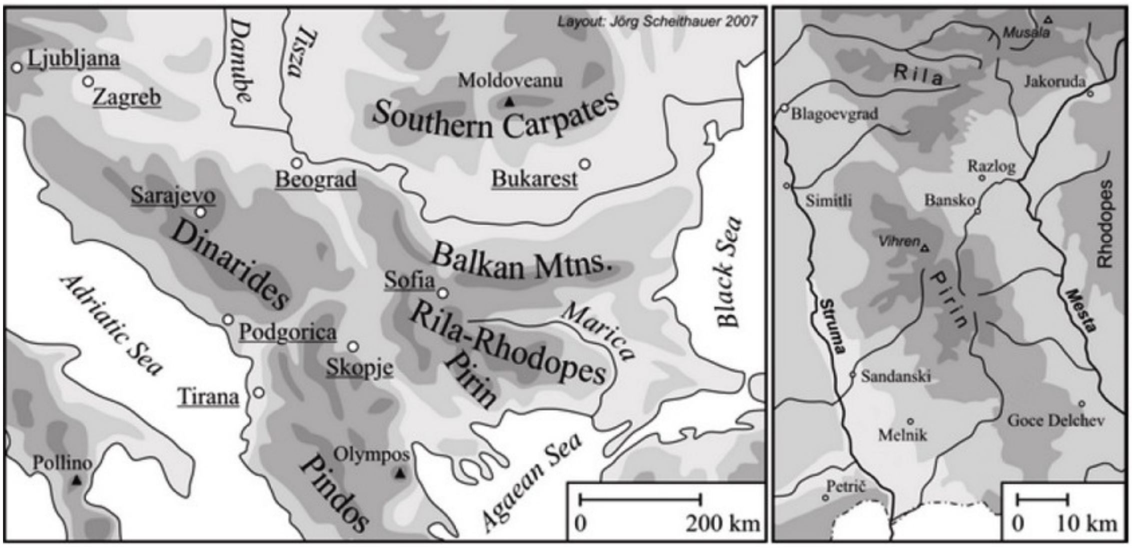

Fig. 1: Map of Bulgaria showing main topographic features (mountains, basins and valleys) (after GRUNEWALD – SCHEITHAUER 2010).

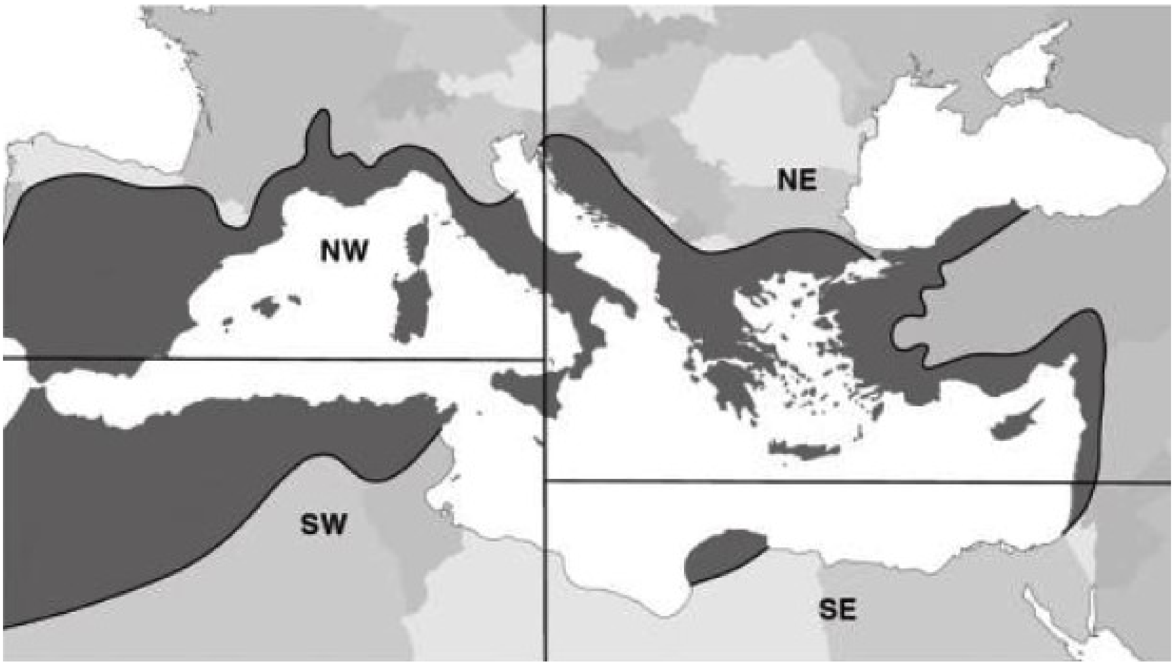

Fig. 2: The biogeographical zones of the Mediterranean region (after WALSH 2014).

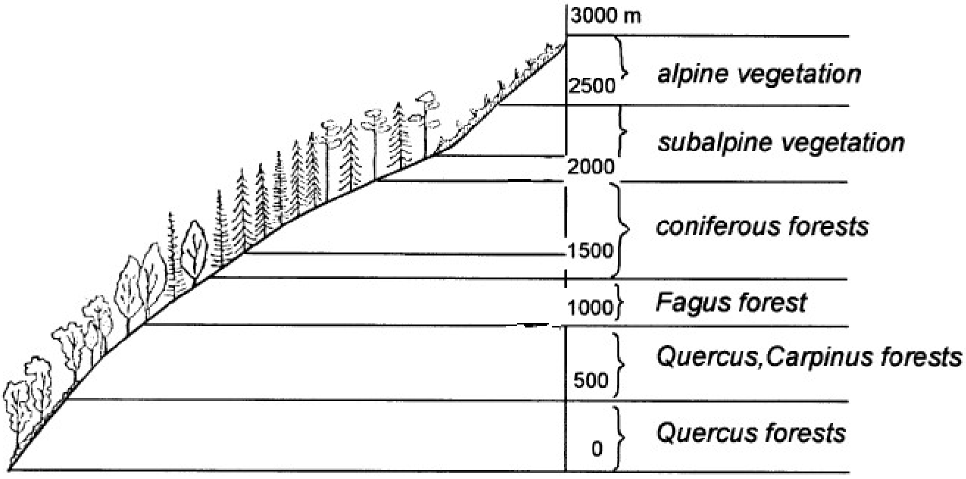

Fig. 3: Schema of the altitudinal vegetation belts in the Rila Mountains (after TONKOV et al. 2001).

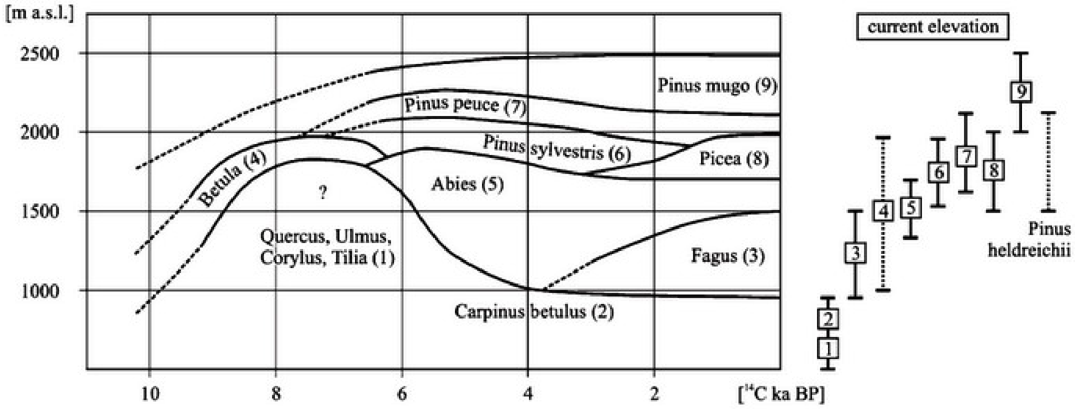

Fig. 4: Elevation gradient of major tree species in the Pirin Mountains during the Holocene (after GRUNEWALD – SCHEITHAUER 2010).

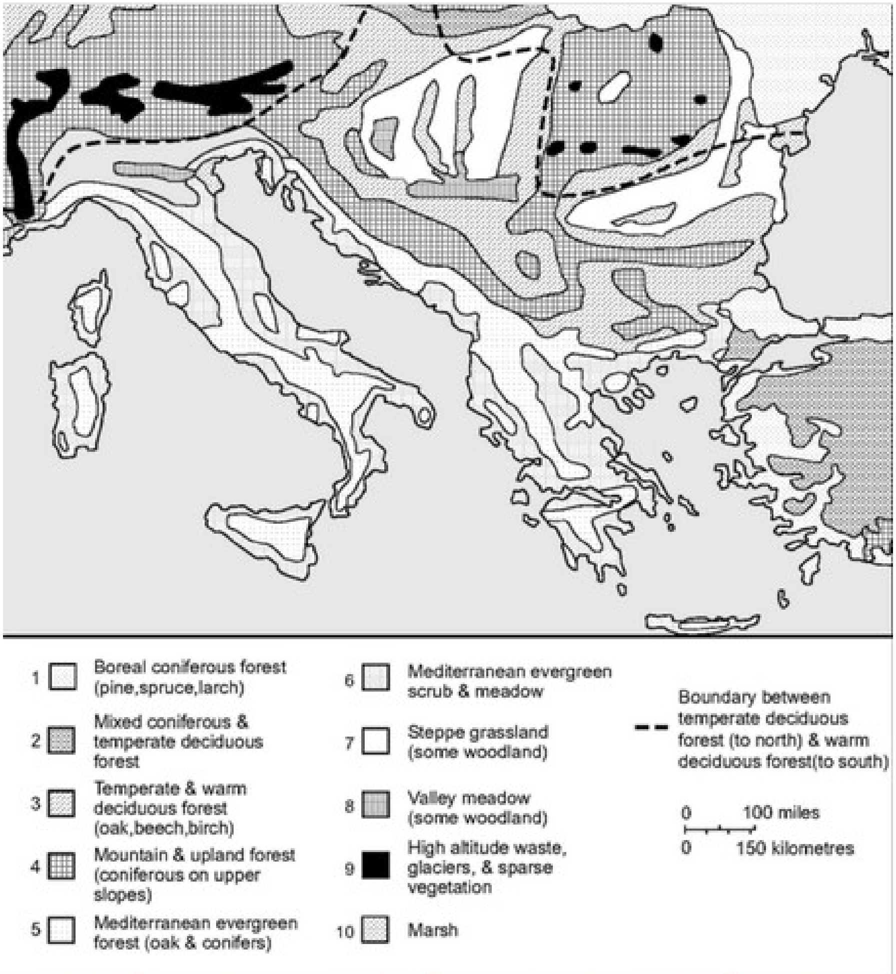

Fig. 5: Simplified map of modern vegetation cover in Southeastern Europe (after EASTWOOD 2004).

3. Economic interactions between Ancient Thrace and Greece

3.1. Interrelationship between the Thracians and the Greeks

The period between the twelfth and sixth century BC in the territory of Ancient Thrace is characterized by remarkable internal changes and gradual development in the socio-cultural system which laid the foundation for the subsequent growth of Thrace during the Archaic and especially the Classical period (Fig. 6). At that time, the Thracians and the Greeks long lived side by side as neighbors considering numerous finds of the Mycenaean pottery in Thrace proven close and frequent pre-colonial contacts since the Late Bronze Age (XYDOPOULOS 2006, 188; BOZHINOVA 2012, 62).

Increasing number of the Greek settlements began to emerge in northern fringe of the Greek world by the end of the seventh century BC. More intensive colonization continued through the sixth and fifth century BC (TEODOSSIEV 2011). Unambiguously, the Greek colonization of the North Aegean coast stimulated a new phase of coexistence and trade relations.

The nature and intensity of connection between newcomers and native population varied in accordance with the geographical position (ILIEVA 2007, 212). The first colonists arrived in several waves on the islands of Thasos and Samothrace and then the Thracian mainland (DAMYANOV 2015, 297). The attractive land along the North Aegean Sea attracted attention of the Greeks, who saw that as new opportunities for self improvement strategies and, in principal, the access to natural resources. On the basis of this strategic interest, the Greeks intentionally preferred the earliest location near the river mouths or lakes situated in the vicinity of the seashore. In this area, the Struma, the Mesta and the Maritsa Rivers connecting the Aegean Thrace with the inland emptied into the sea near the colonies of Argilus, Abdera and Aenos, for instance. In the case of Abdera, active exploitation of favorable fertile alluvial plain between the coastline and adjacent Lake Bistonis is well visible (ISAAC 1986, 73).

Colonial activities in the area bordered by the Strymon River in the west and the Mesta Rivers in the east, called Thasian peraia, profited from the local plains, valleys, brooks and marshy bed surrounding Lake Tahinos and Butkovo (ISAAC 1986, 1). The

Greek occupation in the coastal area was under the control of the Mediterranean climate regime which supported widespread of, apart from crop fields, vineyards, fruit orchards and horticulture. New settlers always chose primarily those sites located in the alluvial plains which were naturally protected and strengthened. The other decisive factor consisted of a proximity to the trade routes or preferably the trade crossroads (BARALIS 2008, 114).

Considering the need to acquire metal and mineral resources, along with promising geographical location, natural richness and occurrence of mines in the surroundings determined position of settlements, too. Similar factors played an important role in the Thracian occupation system development. Despite the long-running evolution and differentiation of the Thracian settlements during the whole first millennium BC, major changes in settlement pattern linked the socio-economic situation were more evident since the sixth century BC, followed by urbanization and centralization processes during the Classical and Hellenistic periods (GOTZEV 1997, 416; POPOV 2015, 109).

Further to the north, the terrain rises from the Strymonic Plain to wooded hill slopes of the southwestern Thracian mountains. In these river valleys crossing multifarious mountains, the Early Iron Age Thracian settlements flourished on account of close contacts with the North Aegean centers. According to the archaeological finds evidenced through the surface, the settlement sites in southwestern Thrace show marks of early urbanization process around the half of the first millennium BC (DELEV 2014, 8). In the adjacent region of the middle Mesta, the agglomeration at Koprivlen and the other surrounding settlements (at Sadovo and Hadzhidimovo) clearly attested the inner structure development, including pottery manufacture, monumental architecture and intensive commercial relations with the seashore (VULCHEVA et al. 2000, 146; POPOV 2015, 115).

Although the Greeks penetrated into the Thracian hinterland, it was only for the commercial purpose, during the Archaic period, the Greek colonial occupation was limited merely to the coastal area (Fig. 7). However, some exceptional settlements situated deeper inland are known from the Serres Plain (northern Greece), where at the end of the sixth century BC, e.g. towns of Tragilos and Berge were founded less remote from the Aegean coast (TIVERIOS 2008, 70). Further to the east, the Maritsa River enabled easy penetration of the Greeks into the Upper Thracian Plain. Later, in the course of the fifth century BC, they established the emporion of Pistiros in the heart of Ancient Thrace.

Additionally, in the Archaic necropolis discovered near the Tragilos settlement, a presence of the mixed Greek and Thracian populations have been revealed, which illustratively demonstrates the interactions among them and their traditions (BARALIS 2008, 116–117). In consequence of the Greek colonization, an influence on ethnic, political, cultural and economic aspects of the Thracian society lead to the gradual hellenisation of the certain native tribes, primarily the local aristocratic families living in the larger urban centers (XYDOPOULOS 2006, 194). Simultaneously, economic interrelationship between the Thracians and the Greek colonies can be observed as well.

3.2. Trade

The Greek colonial economic organization was based partly on agriculture, including cultivation of fruits, cereals and other crops together with fishing and stock-breeding, and above all trade. Archaeological investigation of the trade relations and long-distance distribution of commodities across the Eastern Mediterranean area and inland Thrace relies mainly on the evidenced imports, transport amphorae[12] and coins.

Various food stuff, raw resources and processed products are the most usually discovered traces of marketable articles. While common goods export from Thrace comprised grains, wine, timber, charcoals, tar, ores, metal, slaves, livestock, honey, beeswax etc., commodities such as Attic black- and red-figure pottery, gold and silver vessels and jewellery, luxurious bronze tableware (fine metal objects), wine, olive oil, weapons etc. were imported from Greece to Thrace (TEODOSSIEV 2011; TZOCHEV 2015, 420–1).

From this perspective, southwestern part of Thrace with fertile soils, rich forests and mineral resources, especially abundant deposits of precious metals, seemed to be an ideal environment for economic activities. The main motive why the Greeks were interested in the region of the western Rhodopes (namely Mount Pangaion) was the extensive gold- and silver- bearing mines. In accordance with written sources (Hérodotos VI, 46–47; VII, 112; Thúkydides IV, 105), in the southwestern territory, some of the local mines were controlled by the Thracians, some by the Greeks and presumably, both population participated in well-organized obtaining and trading of these materials (ISSAC 1986, 28–29; TZOCHEV 2015, 421).

[12] A large amount of transport amphorae present in Ancient Thrace documents regular commercial contacts with the production centers in the Greek territory. Only in brief, according to stamps, majority of amphorae originate from Thasos, Rhodes, Lesbos, Chios, Cnidus, Kos, Ainos, Herakleia Pontica, Corinth and others (TUŠLOVÁ – WEISSOVÁ 2013; TEODOSSIEV 2011).

Although the ancient historical evidences inform us primarily about extracting gold, silver and copper in Mount Pangaion together with the other areas of mines in the Strymon and Nestos valleys, archaeological researches have detected other important gold and silver mines in the Sredna Gora which were availed as early as the pre-Roman period onward. In the proximity of rich mineral localities, dense settlement network near the modern villages of Kolio Marinovo, Bezovo and Medovo can be related to intensive activities during the Late Iron Age, as confirmed by rich graves, hoards of coins and especially the Thracian sanctuary of goddnes Kybele, however, direct evidences of mining in this area are dated to the Roman Age (TONKOVA 2008, 267–268).

Well-elaborate route network was the substantial component of stable commercial exchange with the Thracian hinterland. The Greek colonies in Aegean Thrace were situated so as to able to supervise on the main communications leading deep into the inland of the Thracian territory. Essentially, the known ancient road system throughout the Balkan inland can be divided into the river trade and overland trade. Later, the Roman road network[13] partially followed the earlier phases and together with literature sources (Hérodotos VII, 108–113; Thúkydides II, 97.1–2), it was possible to reconstruct some major and most used routes (BOUZEK – GRANINGER 2015, 17).

All commercial routes had to intersect the economic centers, trade stations and strategic sites (ISSAC 1986, 3). The major inland north-south and west-east road system was determined by topographical features, like river valleys and mountain ranges. One of the most frequent corridors linking the coastline and the interior passed through the Thasian peraia in the area of the Strymon River, continued to the Nestos River, traversed western Rhodopes heading to the Upper Thracian River (POPOV 2015, 116). On this path, among others, sites of Koprivlen and Pistiros became the key centers for traders.

The second way to reach the central Thrace from Maroneia was the Maritsa River (BARALIS 2008, 119). Concerning the river trade, success depended on whether the local rivers were navigable or not. In contrast to the Greek rivers most of which belonged to neglected water streams, all mentioned Thracian rivers were navigable (DE BOER 2010, 176). The Maritsa River running through eastern Rhodope Mountains to the Thracian lowland crossed Philippolis[14] (modern Plovdiv) and Pistiros (BOUZEK 1996, 221–222).

[13] The most important well-known Roman routes were Via Egnatia following the North Aegean coast; Via Pontica along the Black Sea coast and Via Diagonalis connecting (alongside the Maritsa River) ancient Singidunum (modern Belgrade, Serbia) with Constantinopol (BOUZEK – GRANINGER 2015, 17)

[14] Long-term settlement activity around Plovdiv (site of Nebet Tepe) reflects the pre-Hellenistic importance, however, as Philippolis founded by Philip of Macedon became a larger agglomeration integrated into the

A fundamental role and essential purpose of the Greek emporia as trading posts was to facilitate connection with the other commercial centers or nodes integrated into the regional (or supra-regional) network in order to ensure prosperity of the local trade. Emporia, whose wide variety related primarily with the origin (settled population), lifetime and function in the network, was simultaneously influenced by relations with the indigenous population which might have affected wealth of emporia as well (TIVERIOS 2008, 86). The Greeks established numerous colonies and emporia in the area of Aegean Thrace but they did not inhabit far inland. Notwithstanding, the settlement on the Maritsa River deep in the interior of the non-Greek land have been interpreted as the Greek emporion Pistiros (GRANINGER 2012, 186).

A comprehensive view on the relationship between Greek traders and native inhabitants is described in the unique written document discovered in 1990 near Vetren called Pistiros (or Vetren) Inscription. The text preserved on the granite block dated about 350 BC deals with the rights of merchants and the rules of business in the emporion. Archaeological evidences and this document clearly attest co-existence between the Greeks and the Thracians and protection of the emporion by the Odrysian rulers (ARCHIBALD 2000-2001; GRANINGER 2012, 101–102).

Economically, the external interference in the local trade system and incorporation into the regional exchange network positively affected the Thracian economy. During the Archaic and Classical period, this process gave rise to the densely populated, economic and cultural centers which maintained connection with the Mediterranean territory. In conjunction with monitoring changes in the long-term settlements together with definition of new ones, including new techniques, new plants and other aspects of agricultural life, it is possible to assume how this direction of the economy was reflected in the local land-use and environmental conditions.

Balkan road network in the course of the fourth century BC and under the Roman control, it served as the capitol of the province of Thrace (ARCHIBALD 2013).

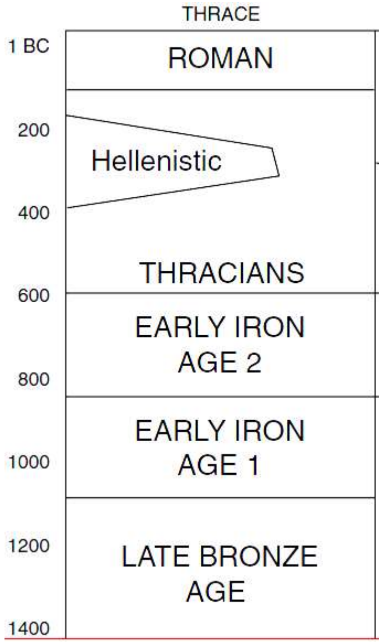

Fig. 6: Absolute chronology of archaeological periods in southeastern Bulgaria (after CHAPMAN et al. 2009)

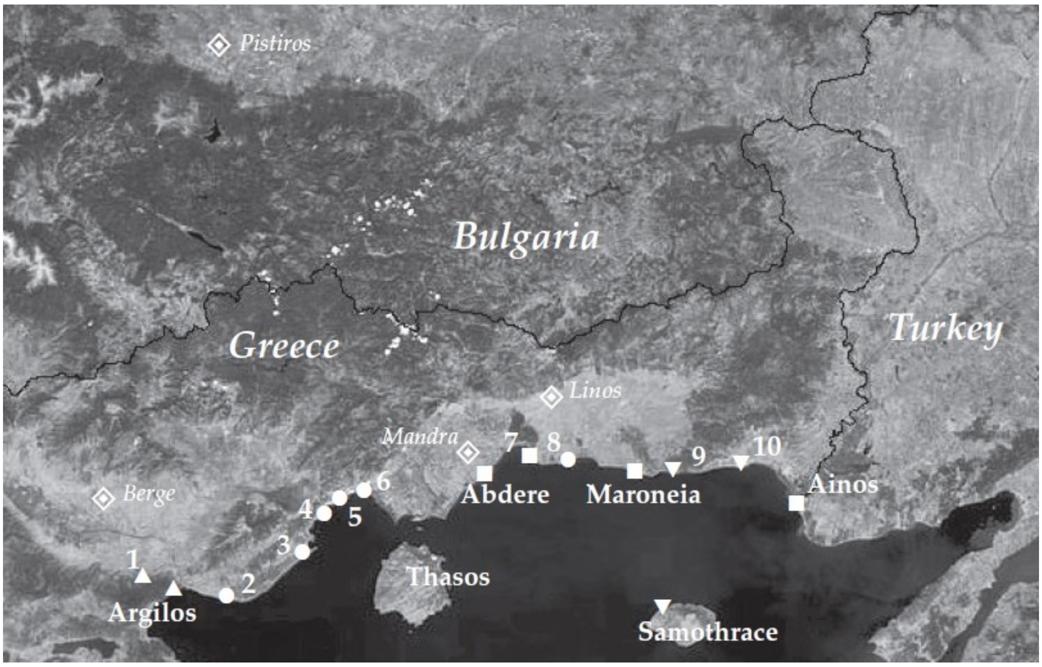

Fig. 7: The Greek colonies in the North Aegean coast: 1. Tragilos, 2. Galepsos, 3. Oisyme, 4. Antisara, 5. Neapolis, 6. Ankontisma, 7. Dikaia, 8. Stryme, 9. Zone, 10. Sale (after BARALIS 2008).

4. Plant economy and land-use in Ancient Thrace during the Iron Age

4.1 Palaeoenvironmental knowledge in Bulgaria

4.1.1 A brief history of archaeobotanical research in Bulgaria

A complex view on the current state of archaeobotanical research in the territory of modern Bulgaria clearly predicates which role the area of Ancient Thrace played in the past. A knowledge base of archaeobotany in Bulgaria has developed since the thirties of the twentieth century, however, a crucial phase of progress in interdisciplinary cooperation in the field of survey started in the mid- seventies of the last century (POPOVA 1995, 193).

According to the catalogue of the archaeobotanical data obtained from the archaeological sites in Bulgaria between 1980 and 2008 made by Tzvetlana Popova (POPOVA 2009), it can be assumed that the first wave of interest of the Bulgarian archaeobotanists was focused in principal on the multilayer (from the Neolithic to the Bronze Age) tell settlements. The earliest archaeobotanical datasets were analyzed by e.g. Jane Renfrew, Robin Dennell and Eva Hajnalová. By combining archaeological excavations with palaeoenvironmental methods, they studied the adaptation process of the Neolithic agriculture on the specific environmental conditions of Southeastern Europe which has always been seen as a transitional zone between the Near East agricultural tradition and central Europe (MARINOVA 2006, 187).

Due to different intensity of the archaeological researches, neither all regions of Bulgaria nor all past periods were explored equally[15] (POPOVA 2009, 72). In comparison with the earlier or later periods, our information about the Early Iron Age settlement pattern, subsistence behavior or economic use of space comes from the relatively few excavations. Rural settlements of this period have been long underestimated among scientists for principal emphasis has been placed on the following "golden age" of the Thracian history (CHAPMAN et al. 2009, 156). In the Archaic, Classical and Hellenistic era,

[15] Apart from the Aegean Thracian, in terms of archaeobotanical studies, the Upper Thracian Plain belongs to the most investigated regions of the Thracian hinterland. On the contrary, until now, the southwestern Bulgaria has been less explored (POPOVA – MARINOVA 2007, 499).

founded archaeobotanical evidences of the Thracian agriculture can be compared with the rich archaeological material and the well-known ancient written records.

However, it is further supposed that an attested decline in settlement activity in the Bulgarian territory during the transition between the Late Bronze Age and the Early Iron Age (around 1200-900 BC), is one of the reasons why our knowledge on the Early Iron Age agriculture does not reach the same level as the Neolithic or Bronze Age (Popova 2009; HRISTOVA et al. 2016, 1–2).

The Bulgarian archaeobotany has continued and expanded after 1990 together with increasing number of explored archaeological sites, including those that are dated to the Early or Late Iron Age. A significant advance in palaeoecological and archaeobotanical techniques during the last decades has brought a lot of opportunities to study even those data regarding human occupation and land-use indicators that are not directly connected with a settlement. This means, primarily, various storage or ritual pits. In addition, archaeobotanical off-site data acquired by palynological methods represent an important source of information as well (MARINOVA 2006, 188; HRISTOVA et al. 2016, 2).

The group of current archaeobotanists in Bulgaria participating in numerous archaeological or palaeovegetation investigations throughout the country consists of, namely T. Popova, E. Marinova, S. Tonkov, E. Bozilova, M. Filipova-Marinova, E. Bozhinova, E. Chakalova, E. Sarbinska, J. Atanassova, I. Hristova, M. Lazarova and many others.

4.1.2 Methods and approach

Notwithstanding the relatively high amount of incomplete archaeological researches or inconsistent data concerning the Early or Late Iron Age rural settlements (CHAPMAN et al. 2009, 173), complex interdisciplinary approach, including palaeoenvironmental and archaeobotanical analyses, has become an integral part of every archaeological excavation or palaeoecological study.

The major aim of this thesis is to investigate impact of the human land-use on the landscape. In the absence of written records, our understanding of relationship between culture and nature depends primarily on cultural interpretation of plant macroremains, pollen and phytoliths[16] founded in the archaeological contexts. Therefore palaeoethnobotany deserves special attention, as this approach comprises both the archaeobotanical and archaeological material. Richard Ford (FORD 1979) defined palaeoethnobotany as "…analysis and interpretation of the direct interrelationship between humans and plants for whatever purpose as manifested in the archaeological research" (WATSON 1997, 14; Zapata 2014, 16).

In terms of archaeology and history of Ancient Thrace, the archaeobotanical residues are relevant source of information about the development of local crop husbandry, cultivation practices and agricultural techniques, likewise the Greek influence on the Thracian economy and society (POPOVA – MARINOVA 2000, 49). Furthermore they assist as a useful instrument of palaeoeconomy studying population and economic growth or reduction as well as commercial relations with adjacent regions. In much the same way, archaeozoology, regarding primarily faunal remains at the archaeological site, contributes to more complete reconstruction of the ancient agricultural system.

In botanical perspective, attested presence of trees, wild herbs and weeds allows to characterize palaeoenvironmental conditions in the surroundings and evolution of the cultural landscape as well. Large-scale palaeoecological studies, which use much wider range of methods than archaeobotany and anthracology, describe changing face of landscape under either human or climatic influence.

4.2 Land-use and subsistence strategies through the Iron Age

4.2.1 Agriculture and human impact on the landscape

Roots of the agro-pastoral subsistence system lie deep in the traditions of the settled population in the Thracian land. A combination of the archaeobotanical and the archaeozoological evidence has been used to reconstruct the environment together with the local principal faunal and plant elements as source of nourishment.

[16] Phytolith analyses are not included in this thesis.

4.2.1.1 Crop and plant cultivation

In the course of the Iron Age, arable farming remained basis of livelihood. The actual state of our knowledge on agricultural practices in Ancient Thrace, including crop fields and crop diversification, comes from several principal types of archaeological contexts. Due to traditional approach of the Bulgarian archaeologist, by far the most attention has been paid to the general superstructure, comprising architecture of the Thracian (or Greek) settlements including floors as well as tumuli and sanctuary complexes. Apart from these, recent archaeological excavations have been focused on another significant phenomenon in the Bulgarian archaeology, pits.

Thousands of pit complexes have been revealed so far across the Thracian territory. They are dated to all periods since the Neolithic, however, most of the them were created during the first millennium BC (HRISTOVA et al. 2016, 2). From this point of view, specific pit deposits have become one of the most essential subjects of the archaeological and archaeobotanical survey. Results of the archaeobotanical analyses of content material reflect local plant-use pattern, which allows observing not only plant species produced by local farmers, but also trade connection with adjacent provinces since a number of imported plant remains have been found as well.

Defining a function of these contexts depends on further classification. Pits, differing in shape and size, can be discovered individually or in groups (pit fields), within a settlement, within a sanctuary or under a tumulus (NEKHRIZOV – TZVETKOVA 2012, 178). Containing fragments of vessels (or complete vessels), coins, ceramic and metal objects, cereals, pulses, fruits and seeds, wild growing herbs and weed species, wood charcoal, animal bones and human bones (GEORGIEVA 2015, 151; HRISTOVA et al. 2016, 10), they may be assigned to grain storage pits, waste pits, hoard, burial or ritual pits, albeit, the similar content and soil filling a pit space makes more difficult to accurately determine a role. In the case of ritual pits, deposits provide rich information about offering food (foodstuff or meal residues), drink and other plants connected with ritual activities, like feasting or ritual burning (HRISTOVA 2015, 121). Clay coating and charred remains as a trace of lighting fire can be regarded as an indicator of storage pits (NEKHRIZOV – TZVETKOVA 2012, 190; HRISTOVA et al. 2016, 9).

In order to discuss plant-based subsistence strategy in Ancient Thrace, a wide spectrum of the principal cultivated taxa belonging to the Iron Age has to be introduced.

These are cereals, pulses, cultivated or gathered fruits, nuts and other crops. Although this is the list representing the most frequent annual crop species appearing at the archaeological sites throughout the interior of Bulgaria, not all mentioned archaeobotanical remains are present in all archaeological contexts.

Generally, cereals belong to by far the most widespread type. The first archaeobotanical evidences in Bulgaria are connected with number of the Early Neolithic settlements (e.g. Azmak, Karnaovo I, Chevdar, Kazanluk). The significant predominance of **wheat** einkorn (*Triticum monococcum*) and emmer wheat (*T. dicoccum*) in the archaeobotanical samples clearly suggests that the agricultural economy of the first farmers was based on wheat with smaller portion of barley and pulses (DENNELL 2006, 77; MARINOVA – VALAMOTI 2014, 66). These tendencies continued through the Late Neolithic till the Late Bronze Age.

While hulled wheat grains were dominant in the earlier periods, during the Late Bronze and especially the Iron Age, the free-threshing varieties of wheat, namely bread and hard wheat (T. *aestivum/durum*), began to replace emmer, or it was becoming more important in the diet. The same trends can be observed in the neighboring regions (POPOVA 2013, 263; MARINOVA – VALAMOTI 2014, 68). Besides naked wheat, emmer and einkorn are still ubiquitous in the archaeological records, however, in smaller quantities (HRISTOVA et al. 2016, 2).

Grains of **barley** (*Hordeum vulgare*), both varieties (naked and hulled, two-row or six-row have been identified), have accompanied wheat crop throughout all of the periods. In Antiquity, barley gained greater importance due to its unique ability to grow on less fertile soils. It was used for example as a principal component for production of beer and easily prepared porridge and gruels (POPOVA 2013, 263) as well as cultivated as fodder.

Along with barley and wheat, **millet** (*Panicum miliaceum*) was one of the staple crop plants in the Eastern Mediterranean since the Late Bronze Age onward. Millet grows well on various little farmed soils and it tolerates warm as well as colder climatic conditions. According to the identified secondary plant species present inside the harvested crops, it is considered that barley and millet were sown in spring and harvested in autumn. These fast-growing crops have become very important and desirable (CHAPMAN et al. 2009, 175). Increasing amount of finds in the cultural layers indicates, apart from low range of ecological requirements, more substantial role in the Thracian diet. Flat loaves and gruels were favourite kind of common nourishment, which confirms millet presence in all regions of the inland Thrace (POPOVA 2013, 263; HRISTOVA et al. 2016, 11).

Some rare traces of pollen of **rye** (*Secale*-type) and **oat** (*Avena*-type) are known from the pre-Roman period, nevertheless, they figured in the pollen diagram as wild-growing ancestors. Domesticated species of *Secale cereale* and *Avena sativa* have been cultivated primarily in the Late Iron Age and in particular the Roman times (MARINOVA et al. 2012a, 418).

Among leguminous plants, **lentil** (*Lens culinaris*), **pea** (*Pisum sativum*), **grass pea** (*Lathyrus sativus*) and **bitter vetch** (*Vicia ervilia*) were the most popular as an important protein-rich part of the local diet. Pulse species, mostly in carbonized form, have been found in the archaeological deposits already since the Bulgarian Early Neolithic (MARINOVA 2006, 189). Bitter vetch, usually used for forage and human food, did not occur in abundance in the archaeological contexts. The exception is the discovery of a higher concentration of non-carbonized vetch seeds (*Vicia cf. sativa*) found during the excavations (2004–2005) of the Iron Age burial mounds near Svilengrad (POPOVA 2006, 518-520).

In comparison with the quantity of cereals, an amount of gathered or possibly cultivated fruits and seeds are not characteristic content within the archaeological pit contexts (HRISTOVA et al. 2016, 11), however, these have been already found in the archaeobotanical assemblage from numerous Neolithic sites (e.g. Kovačevo, Kapitan Dimitrievo) and this trend has continuously occurred through the whole periods of the Iron Age onward. Variety of the natural sources, including **wild grape vine** (*Vitis vinifera* ssp. *sylvestris*), together with **cornelian cherry** (*Cornus mas*), **elder** (*Sambucus* sp./*nigra*), **plums** (*Prunus avium*), **blackberry/raspberry** (*Rubus* sp.), **acorns** (Quercus sp.) and **fruit stones** have been collected for consumption. In Antiquity, oil stones of **bush terebinth** (*Pistacia terebinthus*) were exploited to gain oil for lamps (MARINOVA 2006, 191; POPOVA – MARINOVA 2007, 505).

Besides wild growing grape seeds, cultivated **grape** (*Vitis vinifera*) seeds as well as **walnut** (*Juglans regia*) and **chestnut** (*Castanea sativa*) are dispersal throughout the Ancient Thrace during the Iron Age. Nevertheless, finds of the individual fruits and grape pips in the cultural layers do not have to prove either existence of orchard and vineyards or wine production in the study area. Along with plentiful plant macroremains buried in the archaeological contexts, traceable increase of their values in pollen diagrams indicate flourishing viticulture and arboriculture in the late phase of the Iron Age and especially during the Roman Age (MARINOVA et al. 2012a, 423; HRISTOVA et al. 2016, 11).

Although some typical Mediterranean plants, e.g. **figs** (*Ficus carica*), **olive stones** (*Olea europeana*), **stone pine seeds** (*Pinus pinea*), **date** (*Phoenix dactilifera*) and **pistachio** (*Pistacia vera*) were present in the Thracian land during the Iron Age, they could not grow in the inland of Ancient Thrace because of the unfavourable sub-Mediterranean environmental conditions. These clearly imported fruits from the Eastern Mediterranean and Egypt directly testify a close commercial connection with the Aegean and the Black Sea area. Higher amount increase has been recorded during the Late Iron Age onward, or more precisely since the Hellenistic period and the Roman times (HRISTOVA 2015, 123).

Rarely, only in small quantities, these types of imported and exotic goods attended in the ritual and burial material have been dated to the Early Iron Age or to the transition period between the Early and Late Iron Age, as attested by the plant remains found at several archaeological sites in southeastern Bulgaria, such as Kapitan Andrevo (tenth to sixth century BC), Malenovo (twelfth to eighth century BC) or e.g. Dana Bunar (sixth to forth century BC) (HRISTOVA et al. 2016, 6). The research of the cultural layers at the site of Sveshtari (Golyama Sveshtarska Mogila) in the Razgrad district has revealed one of the earliest finds of pistachio attributed to the Hellenistic period (POPOVA 2009). Likewise, an occurrence of the vegetable represented by **muskmelon** (*Cucumis melo/sativus*) at Dana Bunar indicates that Ancient Thrace was an important part of the supra-regional trade network in the Eastern Mediterranean (HRISTOVA et al. 2016, 11).

4.2.1.2 Animal husbandry

Agricultural practices of breeding and raising of domestic animals have been an important aspect of the Thracian economy.

The vast majority of well-preserved animal osteological remains belong to domestic cattle, sheep and goats. Bones from these typical domestic livestock commonly occurred in the cultural layers in Bulgaria as early as the Neolithic (LAZAROVA et al. 2015, 8). The abundant archaeozoological material dated to the Iron Age comes mostly from settlements and pit deposits (ritual, waste or storage function). Almost all explored pits are filled with high quantity of animal bones fragments, sometimes the whole faunal skeletons (VULCHEVA 2002; NEKHRIZOV – TZVETKOVA 2012, 181; HRISTOVA et al. 2016; 2).

Most of them have been assigned to the grazing animals, bovines, ruminants, pigs, following by dogs and horses, domestic fowl, geese (domestic or wild) were also quite common. Besides domestic animals, very limited record of wild species has been documented as well. Based on morphological criteria, a large number of faunal materials have been identified as big birds (crane, stork), hare, or deer remains. Also fish and mussels have been found (STALLIBRASS 2007, 266; 2010, 62; CHIVERRELL – ARCHIBALD 2009, 297). Considering a fairly slight amount of the archaeozoological finds of game and fish among the osteological material, presumably, hunting and fishing was not ordinary activity.

According to taphonomic modification in skeletal remains, it is supposed that some of the enumerated animal species were significant dietary components. At the site of Pistiros, the analysis of cut marks on bones clearly indicates direct evidence of butchery activities. The uncovered faunal remains, mainly head and foot bones of the larger animals like cattle, scattered in the vicinity of the settlement put forward a hypothesis that the certain domestic animals were slaughtered outside the walled town. However, plentiful finds of waste pits contenting these kinds of bones at the interior of the sites are found as well (VULCHEVA 2002; STALLIBRASS 2007, 268).

Species discovered in the Iron Age archaeological contexts yield valuable evidence of the local pastoral activity.The impact of grazing on the landscape can be observed through the archaeobotanical analysis of vegetation. The following plant species as the secondary anthropogenic indicators, namely *Artemisia, Cirsium-type, Plantago lanceolata, Rumex, Scleranthus, Centaurea, Urtica* and *Juniperus*, usually document forest clearance and the subsequent colonization by the synanthropic weeds, herbs and trees in the same area (MARINOVA et al. 2012a, 419).

Furthermore, analyses of non-pollen palynomorphs needed to be pointed out, too. Spores of fungi or remains of algae (notably *Chaetomium, Cercophora, Coniochaeta, Pedophora*-type, *Sordaria*-type) are excellent indicator of dung connected with pasture activity (MARINOVA – ATANASSOVA 2006, 175).

Agro-pastoral society of the Thracians exploited extensive mountains slopes for cattle-breeding. Similar composition of archaeobotanical samples has been found in the higher altitudes of the mountains as well as near the agro-pastoral villages in the lowland.

It is considered as an attestation of the seasonal sub-alpine pastoral meadows where the pastoralists groups and their livestock migrated from the winter pastures in the lowlands during summers (BOZILOVA et al. 2004, 245). In this way, shepherds took advantage of the local favorable climatic conditions. The transhumant tradition has maintained in Bulgaria till the half of the twentieth century but in some places (the Stara Planina, the Rhodopes), it is still surviving today (RAKSHIEVA 2011, 9–16; DELEV 2014, 5; BOUZEK – GRANINGER 2015, 15).

4.2.1.3 Woodland clearance

Anthropogenic interference in the vegetation has a long history. Low agricultural activity during the Early Neolithic (since the Mesolithic) had a very small scale of impact on the forest vegetation, compared to the later periods (MARINOVA – THIEBAULT 2008 229). Various pollen diagrams from different parts of Bulgaria clearly show that the man has been affecting the natural vegetation significantly more intensively since the Late Bronze Age (around 3200–3000 BP, 1200–1050 cal. BC) (CONNOR et al. 2013, 211–212; MARINOVA 2013, 469). A major factor of change in the land-use pattern throughout Ancient Thrace has been a rapid extension of woodland clearance. In the time of increasing population, stronger destruction of native vegetation was visible as a result of stronger economic and social pressure.

The principal Iron Age land-use strategies related to the disturbance of forest comprised agricultural activities, like establishing cultivated fields and grazing meadows, collecting fruits (cultivated and wild-growing) and fodder (MARINOVA et al. 2012a, 422) as well as ore-mining[17] and timber felling for the purpose of construction[18] and fuel (HARRIS 2013, 177).

In the course of the later phase of the Early Iron Age and especially in the second half of the first millennium BC, due to sharp increase in settlements and forming urban centers in the inland of Thrace, it was necessary to ensure a stable economy which demanded large amount of wood material. Wood was multipurpose and well available

[17] Rich sources of metals (mainly copper, iron and gold) were found in the southwestern part (Mt. Pangaion), in the central Thrace (the Rhodopes, Valley of the Roses) as well as in the northeastern region of Dobrudzka (TONKOVA 2008, BOUZEK – GRANINGER 2015, 15).
[18] In connection with the fall of Amphipolis, Thúkydides described an interest of the Athenians in timber used for shipbuilding (Thúkydides IV, 108.1–2).

matter in entire Thrace. Timber belongs to the primary goods exported from Thrace to Greece (BOUZEK – GRANINGER 2015, 15; HRISTOVA et al. 2016, 2). The timberline was shifted into the higher altitudes. Oak and pine were used by man the most.

The archaeological deposits filling e.g. the pits have revealed fragments of charred oak wood accompanied by other rare charcoal particles of other deciduous trees like elm, maple, hornbeam (NEKHRIZOV – TZVETKOVA 2012, 181; HRISTOVA et al. 2016, 2). These finds of identified macroremains, including acorns fragments, in the archaeological contexts coincide with results of palynological analyses from the surrounding uplands. The pollen diagrams from the Pirin Mountains, the Rila Mountains (Southwestern Bulgaria) and the Sredna Gora (central Bulgaria) demonstrate decline of arboreal pollen after 900–800 cal. BC and steep increase in the anthropogenic indicators in the same time (STANCEVA – LAZAROVA 2006, 119; MARINOVA et al. 2012a, 423).

More substantial and large-scale deforestation led to the rising stress of soils. The strategy of controlled slash-and-burn agriculture (BEHRE 1988, 652) has modified landscape and has artificially created ruderal environment where expansion of beech (*Fagus sylvatica*) was favoured[19]. The secondary xerothermic vegetation (*Carpinus orientalis, Quercus pubescens, Juniperus*) has replaced destroyed, mixed oak forests with abundant *Ulmus, Tilia,* and *Corylus* species. Among non-arboreal pollen taxa, successive stages, after woodland clearance by fire, include in most respects ruderal weed and herb species, such as *Artemisia*, representatives of Poaceae, Chenopodiaceae, Cichorioideae, *Plantago major/media-type, Scleranthus, Cirsium, Urtica* etc. (MARINOVA et al. 2012a, 419).

4.2.2 Role of the anthropogenic indicators

Natural vegetation cover has developed under anthropogenic influence which may stimulate some changes in composition, e.g. occurrence of new plant species or plant communities, and overall, it affects major ecological features in landscape, whether intentionally or not. Along with the archaeological material documenting the human presence in Thracian Bulgaria, monitoring of anthropogenic disturbance of the Iron Age

[19] Registered increase in pollen of *Fagus* can be associated with the climate change as well. More humid climatic conditions during the Late Bronze Age-Early Iron Age transition supported expansion formation of numerous peat bogs in the same area (STANCEVA – LAZAROVA 2006, 119).

ecological system bring a valuable insight into the occupation phases and subsistence strategies of local people.

Palaeoecological studies on the history of vegetation deal with archives of all visible reversals in the environment. These signals highly sensitive to human activities should be clearly detectable in archaeobotanical assemblages but not necessarily, all of the changes have to be connected only with human impact. Essentially, plant taxa representing a wide range of anthropogenic indicators are divided into two groups: primary and secondary indicators.

4.2.2.1 Primary anthropogenic indicators in pollen diagrams

According to the generally accepted definition, this group usually includes all plant and tree species that were domesticated and cultivated in fields and orchards for the purpose of harvesting of edible parts (BEHRE 1990, 221). It concerns foremost agricultural crops, such as cereals and pulses as well as nuts, grape vine and other fruit tree species, as discussed in the previous subchapter.

At the archaeological sites, pollen of harvesting crops[20] together with fragments in a form of carbonized grains and seeds of crop plants yield one of the most accurate information on increasing human impact and changes in land-use in the region. The primary indicators in pollen diagrams which capture a key response to human actions in the environment also record presence of arable land or grazing meadows in the vicinity of studied area.

Among the results of archaeobotanical investigations, exceptional attention needs to be given to distinguish between cultivated grass species (for food, fodder etc.) and wild growing taxa connected with the natural vegetation cover (BEHRE 1990, 221). Considering this, species like *Cerealia*-type, *Hordeum*-type, *Avena*-type and *Secale*, whose domestication process in the inland part of Ancient Thrace is studied in details, may appear in the archaeobotanical records dated to the periods before their domestication. These species are interpreted as the wild growing ancestors (MARINOVA et al. 2012a, 418; TONKOV et al. 2013a, 280). The interpretation of their present in the area depends on

[20] A presence of the plant or tree species does not necessarily demonstrate its cultivation in the studied region, as is the case of olive stone found at Iron Age site of Kapitan Andreevo (HRISTOVA et al. 2016).

whether the other anthropogenic signals of potential arable fields are documented in pollen diagrams.

Similarly, **walnut tree** (*Juglans regia*) and **chestnut** (*Castanea sativa*) are main representatives of tree species that have been known in pollen diagrams in the Bulgarian area since the Middle Holocene, however, very low amount of these taxa suggests that they originated from the native environment without human interference (TONKOV – POSSNERT 2014, 314). The second phase of their occurrence arose during the Late Bronze Age when abrupt and extensive increase in pollen records has been registered. While more tolerant Castanea is capable to colonize wide range of environments, walnut trees prioritize temperate climatic conditions, humid places and soils with high humus content. Edible seeds became very popular foodstuff in the Thracian population. Both trees prove the existence of settlements as primary indicators because since the Classical times, they have been cultivated in orchards (MARINOVA – ATANASSOVA 2006, 165).

4.2.2.2 Secondary anthropogenic indicators in pollen diagrams

Intensive human activities have modified the landscape since the Neolithic. In consequences of broad changes in environmental conditions, such as geological and pedological properties, some specific plant species have spread to these places influenced by man. The secondary anthropogenic indicators are referred to as the plants that are not intentionally cultivated, nevertheless, human presence and its economy inadvertently contribute to growth and distribution of this ruderal and other synanthropic vegetation in artificial habitats (BEHRE 1990, 223).

On the basis of evaluation of the archaeobotanical records, the secondary signals of human impact coincide with occupation and ruderalization phases in the area and usually, they are connected with various agricultural contexts (arable land, pasture). Their occurrence indirectly confirms human presence in such places where no ancient settlement has been detected (BOZILOVA et al. 2004, 245; STANCHEVA – LAZAROVA 2009, 116).

The second stage of ecological succession include ruderal plants, or so-called apophytes, taxa of native in origin, or anthropophytes, taxa of a foreign origin. The invasive plant communities thrive on light acidic soils or exhausted ground caused by intensive activity. They grow in active crop fields and pastoral meadows as well as they colonize abandoned agricultural land or land disturbed and damaged after woodland clearance.

The following list of the herbs and weeds represents the major collection of the secondary indicators registered in Thracian Bulgaria through the Iron Age:

Chenopodiaceae (or **Amarathaceae**) family. Most of these annual species are widespread in all kinds of ruderal habitats (active fields, abandoned fields, gardens, waste areas, pits, along routes, settled sites etc.). They are very tolerant to all types of ecological environment, growing on drier places or even salty soils. **Fat hen** (*Chenopodium album*) belongs to the most frequent taxa appearing in the pollen diagrams in archaeological contexts through the Iron Age (OSBORNOVÁ 1990, 19; TONKOV et al. 2013a, 283). A high value of these grasses in the pollen spectrum from cultural contexts is explained that such weeds were unintentionally mixed with the crop during harvesting (POPOVA 2013, 264).

Poaceae/Gramineae family. Ubiquitous grass species (e.g. Cerealia-type), indicate existence of grazing meadows and cultivated grassland. They are used mainly as feed for livestock and other domesticated animals. Poaceae species are also a dominant component of natural open steppe vegetation accompanied by Chenopodiaceae and *Artemisia* (MARINOVA et al. 2012a, 419; TONKOV et al. 2013a, 280).

Daisy family (*Asteraceae* or *Compositae*) comprises economically important herbs used in medicine for their healing properties, further as oil and flavor admixture (culinary herbs). As the secondary indicators, since the Late Bronze Age, a high pollen amount has signified primarily pastoralism in the surroundings (CHAPMAN et al. 2009, 165).
Among them, **sagebrush** (*Artemisia*), **yarrow** (*Achillea*), **cocklebur** (*Xanthium*) and **cornflower** (*Centaurea*) represent common appearance of terrestrial ruderal herbs in pollen diagrams, which most clearly describe, apart from the primary anthropogenic indicators, agricultural variety of converted habitat, like meadows and fields or other disturbed land (TONKOV et al. 2008, 189).
Artemisia vulgaris belongs to the successive plants which colonize cultural lands earlier than the other herbaceous perennials. Along with *Achillea*, they also grow, in a native origin, on grassy banks along rivers (OSBORNOVÁ 1990, 18–19). Cereal crop weeds

Centaurea cyanus appeared in the records later than weeds like Chenopodiaceae or some species of Asteraceae family, more typically on rye fields during the Late Antiquity and the Middle Age (MARINOVA – ATANASSOVA 2006, 168).

Corn cockl (*Agrostemma githago*) pollen is occasionally found in the prehistoric contexts, however, this ruderal plant can be perceived as anthropogenic indicator since the Late Iron Age/Roman Age when it began to occur more frequently among another crop weeds in open arable fields (MARINOVA et al. 2012a, 418).

Ribwort plantain (*Plantago lanceolata*-type; *P. major/media*-type) was connected with agricultural land in the course of the Neolithic. Since the Late Bronze Age onward, this species have well-documented human land-use (mainly livestock-grazing) in lowland of Lake Durankulak (Northeastern Bulgaria) (MARINOVA – ATANASSOVA 2006, 168) as well as in the subalpine meadows of the Pirin Mountains (Southwestern Bulgaria) (BOZILOVA et al. 2004, 243; TONKOV et al. 2013a, 281).

Knotgrass (*Polygonum aviculare*) tolerates humid as well as drier climatic conditions but requires nitrogen-rich soils which are prostrate by cultivated crops in the arable land. It is very invasive weed species which form a dense layer on the fields. Pollen traces are known from lowland to mountains (BOZILOVA et al. 2004, 242; TONKOV – POSSNERT 2014, 314). Abrupt increase in archaeobotanical records corresponds with the Bronze Age deposits.

Sorrel (*Rumex acetosa*) is the ruderal herb indicating permanent human presence. Some parts, mainly leaves, were used as a complementary food (POPOVA 2013, 264; HRISTOVA et al. 2016, 11).

Buttercup (*Ranunculus*) can be found near river streams, flood plains, also wet meadows. It prefers environment with strong eutrophic conditions. Since the Bronze Age, as one of the most common anthropophytes, seeds of this weed species in archaeobotanical samples are connected with moist and nitrogenous ground of the crop fields. (OSBORNOVÁ 1990, 19; MARINOVA – ATANASSOVA 2006, 148).

Furthermore, in the pollen diagrams, more abundant species of synanthropic weed and herb species, such as **cocklebur** (Xanthium), **knawel** (*Scleranthus*), **greater celandine** (*Chelidonium*), **bedstraw** (*Galium*), **nettle** (*Urtica*), **creeping thistle** (*Cirsium*), **fields brom** (*Bromus sterilis/tectorum*), **Vervain** (*Verbena officinalis*) etc., can be recognized during the Iron Age (POPOVA 2013, 262–263; TONKOV et al. 2013a, 280). All of these secondary indicators have to be considered as the important elements of the full plant spectrum on the basis of which the assumption and resulting reconstruction of human activities and the impact on the landscape can be made.

Some of the mentioned plants are not confined only to the ecosystems of disturbed grounds. In the Bulgarian territory, documented wild weeds or herbs, in principle *Artemisia, Cirsium, Urtica, Plantago major/media-type*, and some of the taxa of Asteraceae, Apiaceae, Poaceae or Chenopodiaceae, spontaneously expanded into the natural open steppe vegetation during the earlier periods (Late Glacial/Early Holocene) (CONNOR et al. 2013, 210). With increasing land-use by man (since the Bronze Age), majority of these plants have demonstrated a human presence. However, in certain regions (namely region of Dobrudza along the Black Sea), grasses have still represented a rich flouristic composition of preserved relict steppe and forest-steppe formation (BEHRE 1988, 661; MARINOVA – ATANASSOVA 2006, TZONEV et al. 2006, 13; 168; MARINOVA et al. 2012a, 419).

To sum up, only the presence of the primary anthropogenic indicators provides a definite evidence of the human presence in the area. The other plant species have to be interpreted very carefully (BEHRE 1990, 222).

5. Four case studies: Iron Age settlements in the Thracian inland

Regions in Thrace had high agricultural land-use and crop production potentials. The archaeobotanical evidences on the anthropological changes of the environment are summarized for different sites and sub-regions of Bulgaria (Fig. 8).

5.1 Ezero, Central Bulgaria

The mound settlement near the village of Ezero (or Dipsis) belongs to the most important archaeological sites in Bulgaria (Fig. 8). It is situated in the spacious wetland of the northern Thracian Plain adjacent to the Sredna Gora Mountains in the north and the Svetiiliyski Hills in the south-east. To this day, the entire region is considered as the most fertile area of Bulgaria and it can be assumed that this lowland already was very attractive place for the earliest farmers. The Thracian Plain and the Nova Zagora district have received a lot of attention from archaeologists and other scientists during the first half of the twentieth century. Systematic excavation of the multilayered mound has been carried out since 1960s under the control of the Bulgarian and Russian cooperation (GEORGIEV – MERPERT 1966).

Currently, the waterlogged terrain with reed-swamp affords an opportunity to investigate a large amount of sedimental records rich in organic material which contains detailed information about the Holocene vegetation history as well as the subsistence strategy changes. Long-continuing interdisciplinary research has revealed that the densely occupied landscape was broadly exploited by local, settled inhabitants since the Neolithic Age (DENNELL 2002, 88; CHAPMAN et al. 2009, 165). Although the period of the greatest expansion and flourishing settlement economy of the tell at Ezero[21], including the Ezero culture, took place during the Bronze Age (WENINGER 1995), evidences of the occupation have been dated also to the Early Iron Age. Focusing on the data regarding the potential for land-use and growing prosperity, the tell was surrounded by wet meadows and highly

[21] Archaeological excavations have revealed the partly urban settlement with rectangular or apsidal buildings of wood-mudbrick construction. The interior space was fortified by the stone wall in the course of the Early Bronze Age (WENINGER 1995, 445).

arable soils that mark suitable conditions for stock-breeding and intensive agricultural activities (Fig. 9).

The gently wavy relief does not exceed 150 m a.s.l. along the Azmaka River but further from the alluvial plain, the elevation rises to ca. 1500 m a.s.l. in the nearby Sredna Gora Mountains and ca. 500 m a.s.l. near the Svetiiliyski Hills. These lowland and eventually low uplands were fully farmed as illustrated in various pollen diagrams (MAGYARI et al. 2007, 869). The pollen-based reconstruction of the natural vegetation suggests that the vicinity of the tell was covered by xero-mesophilous oak woodland but by the Late Bronze Age, dramatic decline in arboreal pollen was documented, which is explained partly by drier climate and partly by deforestation for the purpose of agriculture.

According to the pollen sequence (Fig. 10) from the Late Bronze to the Early Iron Age, the climate shift towards increasing moisture[22] and decreasing temperature during summer months around 850 cal. BC supported distribution of the woody taxa that require wetter climate conditions, such as oak (*Quercus*), hornbeam (*Carpinus betulus*), beech (*Fagus* sp.) and fir (*Abies* sp.). In comparison with the Bronze Age largely open landscape, partial reafforestation took place in the region around 1000–800 BC (CHAPMAN et al. 178), in spite of the increasing disturbed surface evidences.

Despite the aforementioned afforestation at the onset of the first millennium BC, woodland clearance is more apparent in the Early Iron Age. Oak wood was highly demanded due to its properties and therefore the pollen curve rapidly dropped. Afterwards, the areas under human interference were reinhabited by different tree, shrub and herb species. Defying the changes in pollen frequency in consequence with human activities in the course of the Iron Age, it can be deduced that the majority of the wetland surrounding the tell settlement was converted into arable fields and grazing meadows. Overall, the pollen spectrum presents a brief description of major organic elements of the Ezero wetland that are relevant to understanding its ecological characteristic and economic utilization.

A wide range of human indicator plants, such as crops (*Cerealia*-type, *Triticum* sp., *Secale*) enriched with numerous weed and ruderal communities (Gramineae, *Centaurea, Artemisia*, Chenopodiaceae, *Plantago lanceolata, Rumex acetosa/acetosella* and

[22] Chronologically, studies on Ezero Lake level fluctuation have pointed out significant changes in water depth around 1000-850 BC. The proxydata in the lacustrine sediments (more abundant presence of e.g. ostracods, aquatic mollusks, bivalves) have confirmed palynological suggestions (CHAPMAN et al. 2009, 164).

Fig. 8: Map of the study area: location of case studies mentioned in the presented thesis: Ezero, Lake Durankulak, Koprivlen, Pistiros (Google Earth).

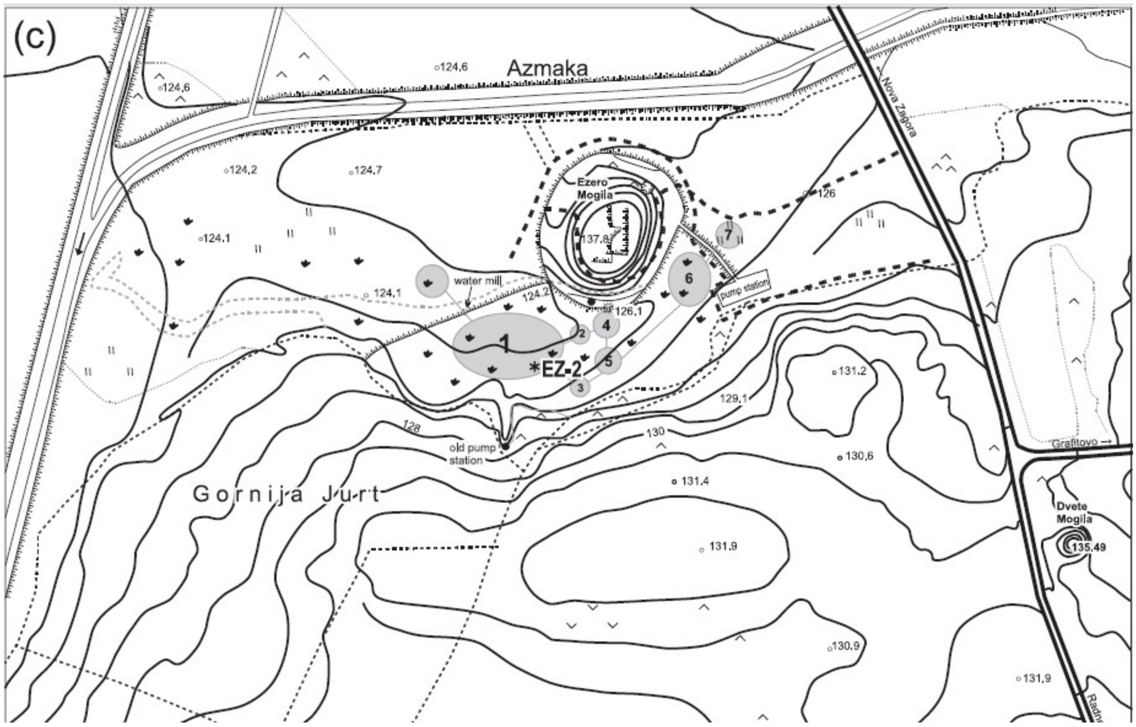

Fig. 9: Ezero wetland: plan of the study area with the location of the tell settlement, the springs and the coring sites (core EZ-2) (after MAGYARI 2013).

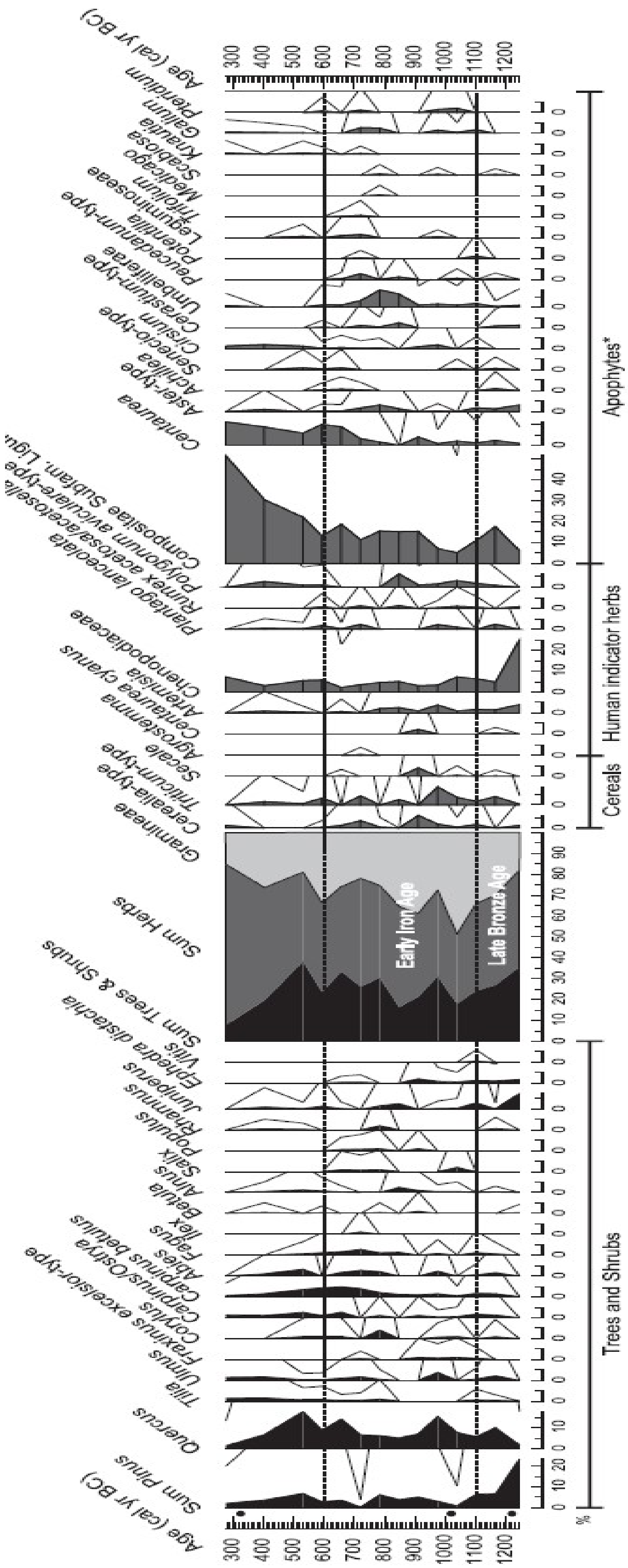

Fig. 10: Ezero wetland, Thracian Plain (core EZ-2): pollen frequency diagram of selected pollen types (after CHAPMAN et al. 2009).

Polygonum aviculare) (TONKOV et al. 2008, 189), has been detected, and in terms of radiocarbon dating of the deposits, archaeobotanical analyses have found a gradual increase in these anthropogenic signals towards 600 BC (CHAPMAN et al. 2009, 165).

Similar plant composition occurring on the ruderal sites at Ezero was known already during the Late Bronze Age, however, some advanced modifications of the pollen spectrum associated with interruption of occupation coincide with more severe spreading of synanthropic species. Terrestrial plants like *Sambucus ebulus* (MAGYARI et al. 2013, 4), *Rubus*, *Verbena officinalis* became more predominant. Especially, Asteraceae family (Liguliflorae Subfamily) was more abundant than before (POPOVA 2009, 119). Archaeobotanical finds of these seed fragments have proven that the settlement was abandoned and subsequently resettled.

5.2 Lake Durankulak, Northeastern Bulgaria

The second equally important site dated to the earlier period is called Durankulak situated in the northeastern part of Bulgaria (Fig. 8). More than the current village of Durankulak, the neighboring lake is more essential for a research of land-use changes during the Holocene. The habitat just like Ezero is surrounded by the extensive wetland, nevertheless, in contrast to the environmental conditions at Ezero, this fundamental waterlogging background is sustained by connection with the large lake and immediate vicinity to the sea.

Lake Durankulak occupies water area of 3,4 km^2 and it is separated from the Black Sea coast by the approximately 200 m wide sand dune. According to the geologists, this short ridge was probably formed in the Late Pleistocene or the Early Holocene. This fact also strongly affects the surrounding ecosystem and the body of water itself. Although the lake is commonly considered as freshwater, a measure of salinity rather responds to the slight brackish water (salinity of 2%–4%) caused by its location (MARINOVA 2003, 280). Along the Black Sea coast, Lake Durankulak is not the only one. The entire Bulgarian northeastern region, respectively, to be more precise the Dobrudza-Varna subregion, is relatively affluent in natural water reservoirs of this kind[23], which creates a spectacular landscape.

The lake is fairly shallow, it reaches a maximum depth of 4 m, and there are two islands, both utilized for settlement. This crucial position has become a resort for local people since the Neolithic times (at the end of the sixth millennium B.C.), as evidenced in the archaeological finds (BOZILOVA – TONKOV 1998, 143). The first archaeological excavation of the southwestern shore, including the Great Island, was initiated in 1974 and led by Henrieta Todorova (Fig. 11). At this complex archaeological site, the first marks of occupation dated to the Late Neolithic–Early Chalcolithic transition period[24] (5250/5300–4450/4750 BC) were recorded (MARINOVA – ATANASSOVA 2006, 167; TONKOV et al. 2013a, 279). During this first phase of occupation, abundant archaeobotanical finds show a well-developed oldest agricultural society[25].

During the Early Bronze to Late Bronze Age (the thirteenth to twelfth century BC), no archaeological evidences of human activity have been discovered so far. Such a decline of human occupation was also reflected in the archaeobotanical records by very weak signal of anthropological indicators (MARINOVA 2003, 283). This long hiatus lasted about 1000 years without any clear explanation of a cause. The following documented occupation phase on the Great Island is dated to the time interval of the Late Bronze and the Early Iron Age. A fortified Thracian settlement was built on the south side of the island, probably inhabited by Gethic tribes just like the whole territory of Dobrudza (TONKOV et al. 2013a, 279).

Economic importance of the area associated with the proximity to the sea has increased after the Greeks had commenced colonizing the western Black Sea coast (700–600 BC) (BOZILOVA – TONKOV 1998, 143). Near the Early Iron Age village, a Hellenistic cave-sanctuary of goddess Cybele was built in the third century BC. The Thracian cultural layers continued throughout the subsequent Roman period (45 BC–284 AD) to the Medieval Times.

[23] Besides Lake Durankulak which is the northernmost lake in Bulgaria, several other coastal lakes exist along the Bulgarian Black Sea, such as Shabla-Ezerets Lake system, Lake Bolata and e.g. Varna-Beloslav Lake system.

[24] Our knowledge of the prehistoric archeological cultures comes from the settlement and a very large necropolis along the shore of the lake and on the island. In the territory, only archaeological material related to the Late Chalcolithic and Early Bronze Age is represented by some burials that were found submerged between the island and the shore of the lake (TONKOV et al. 2013a, 279).

[25] It is attested a cultivation of wheat (*Triticum* sp., *T. monococcum, T. discoccum, T. spelta*), barley (*Hordeum* sp., *Hordeum vulgare*), millet (*Panicum miliaceum*), and lentil (*Lens esculenta*). Secondary bioindicators (*Polygonum* sp., *Rumex acetosella, Sapponaria officinalis, Setaria viridis*) are documented as well (BOZILOVA – TONKOV 1998, 143).

Despite of the long and wealthy development of the landscape, the wetland environment has preserved its natural character (Fig. 12). Water level is only about 40 cm higher than the Black Sea surface. The local area is characterized as almost flat karst terrain. Organic-rich lacustrine sediments embedded in the two Miocene limestone depressions of Lake Durankulak support eutrophication development of water (meso- to eutrophic conditions) (MARINOVA 2003, 280). Also carbonic-rich soils around the lake with predominance of eroded chernozems give the environment positive agricultural impression (TONKOV et al. 2013a, 278). The Durankulak area belongs to the Black Sea climatic zone as well as the northeastern continental climatic regime which affects particularly the inland part. Mean annual precipitation is around 400–450 mm.

Palynological and palaeoecological studies carried out in the phytogeographical region of Dobrudza have shown successive change of natural vegetation during the Holocene (Fig. 13). Xerothermic steppe plants (*Artemisia*, Chenopodiaceae, Asteraceae and Poaceae species) were dominant through the Early Holocene. Subsequently, with respect to the climate change during the Holocene climate optimum, higher arboreal pollen values prove a shift to forest-steppe phase (more intensive distribution of deciduous trees, namely *Quercus, Carpinus, Corylus, Ulmus, Tilia,* and *Acer*) (TONKOV et al. 2011, 31).

Since the Late Holocene, xerothermic herbaceous communities have started prevailing. Besides grass groups, xerothermic oak forests (*Quercus pubescens, Q. cerris, Tilia argentea, Fraxinus excelsior, Acer campestre, Carpinus betulus*) with patches of riparian forests[26] (*Salix, Alnus, Fraxinus*) have appeared near moister ravines. Hydrophyllous swamp vegetation (mainly *Phragmites australis, Typha latipholia, Alisma plantago-aquatica, Sparganium erectum, Calystegia sepium* etc.) grow on edges of the lake. In addition, a presence of some halophytic plants (e.g. *Puccinellia convulata, Limonium gmelinii, Salicornia europaea*) demonstrates brackish water conditions (BOZILOVA – TONKOV 1998, 142; MARINOVA – ATANASSOVA 2006, 167). Due to drier conditions around 3000 BC, reduction of forest vegetation and increase in steppe plants has been recorded in the pollen profiles throughout the western Black Sea region (TONKOV et al. 2013a, 281). In the southern part of the lake, small remains of steppe vegetation have been preserved till the present time.

However, after 6000 BC, especially since the Chalcolithic period, local vegetation cover has been continuously depleted and modified by intensification of human activities,

[26] In the Varna Lake region, the first signal of the riparian forest formations appeared around 1410-1000 BC (BOZILOVA – BEUG 1994; CHAPMAN et al. 2009, 174).

especially stock-breeding and arable farming. Archaeobotanical analyses of sediment cores from Lake Durankulak, confirmed by radiocarbon dates, have been conducted in the southwestern part of the inland area and on the Great Island. The results indicate similar tendencies across the region.

In the vicinity of the Late Bronze–Early Iron Age settlement, more humid conditions assisted to partial reforestation. Regardless of advanced land-use strategies, including wood clearance, the tree vegetation (*Carpinus betulus, C. orientalis, Quercus robur, Q. cerris* and *Fagus*) expanded to larger areas around the lake. Arboreal pollen values reached up to 60% (MARINOVA 2003, 286; MARINOVA – ATANASSOVA 2006, 175), which is noticeably higher than in the previous period. Perceptible traces of intentional deforestation caused by man appeared during the Hellenistic and the Roman period.

The rapidly rising activity of the local Thracian inhabitants during the Late Bronze and Early Iron Age has been monitored by numerous anthropogenic indicators. A visible increase in cultivated plants has been evidenced by acquiring a broad assemblage of charred plant macrofossils and palynological data. The primary indicators have revealed a presence of Cerealia-types (*Triticum dicoccum, T. monococcum, T. cf. spelta, T. aestivum, Hordeum vulgare*), millet (*Panicum miliaceum*) and bitter vetch (*Vicia ervilia*). Together with fragments of *Prunus* cf. *avium*, *Vitis*, *Sorbus*-type, these finds illustrate well-developed agriculture including arboriculture. Remains of wild species of *Sambucus nigra* and *Cornus mas*, connected with settlement, served as supplementary food or for medicine purposes (MARINOVA – ATANASSOVA 2006, 175; TONKOV et al. 2013a, 280–281). For the first time at the site, an occurrence of domesticated walnut-tree (*Juglans*) has been registered (TONKOV et al. 2011, 33).

In connection with the primarily cultivated and collected crops, also growing value of secondary indicators, like *Polygonum aviculare, Rumex, Chelidonium* and *Plantago lanceolata* (MARINOVA 2003, 286), signify notably disturbed landscape, especially replacing of natural vegetation cover by arable land and pastoral meadows. All these archaeobotanical data provide valuable information about the Thracian occupation phase as well as the local subsistence strategies around the lake.

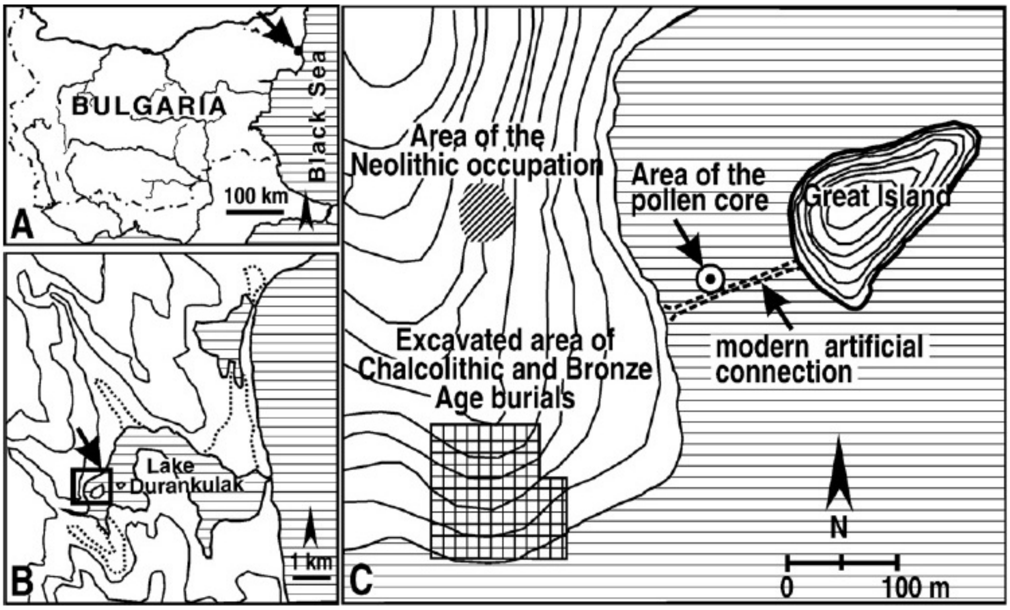

Fig. 11: Lake Durankulak: location of the archaeological sites (after MARINOVA – ATANASSOVA 2006).

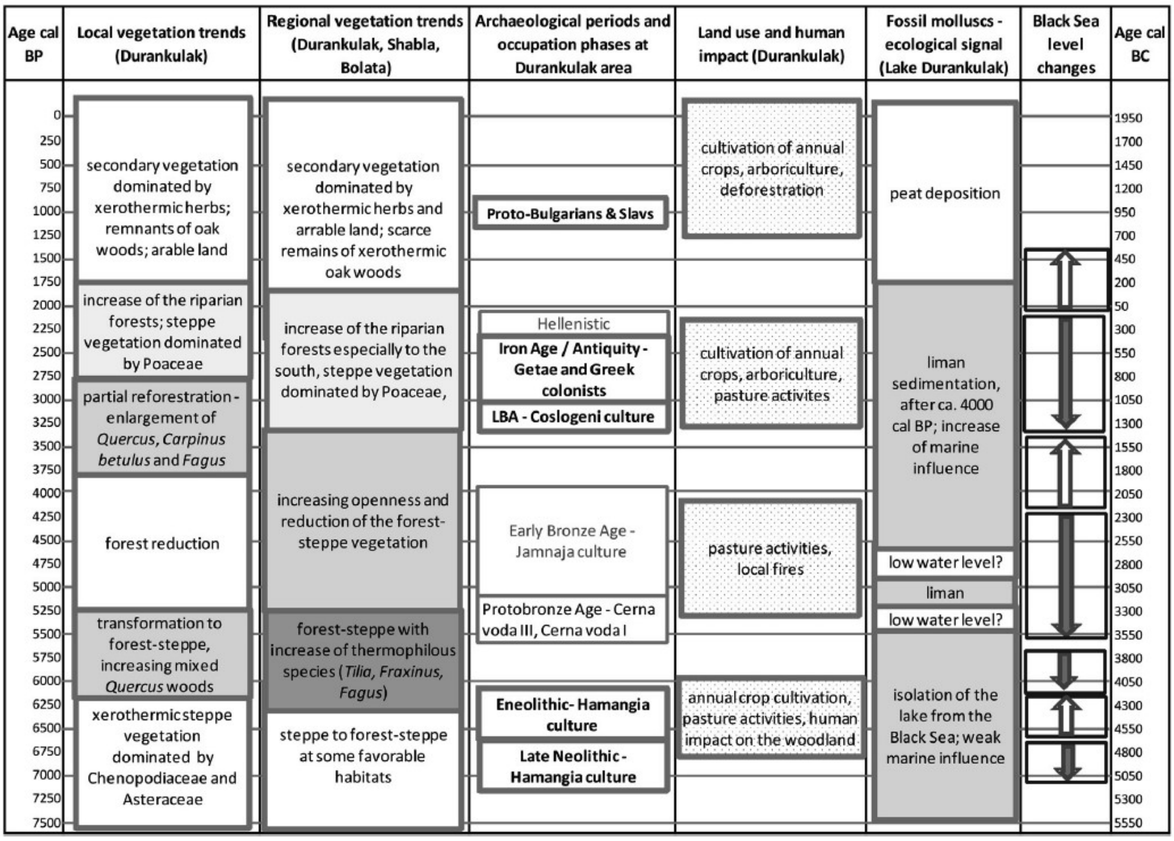

Fig. 12: Lake Durankulak: Correlation scheme of the vegetation development, land-use and human impact (after TONKOV et al. 2013a)

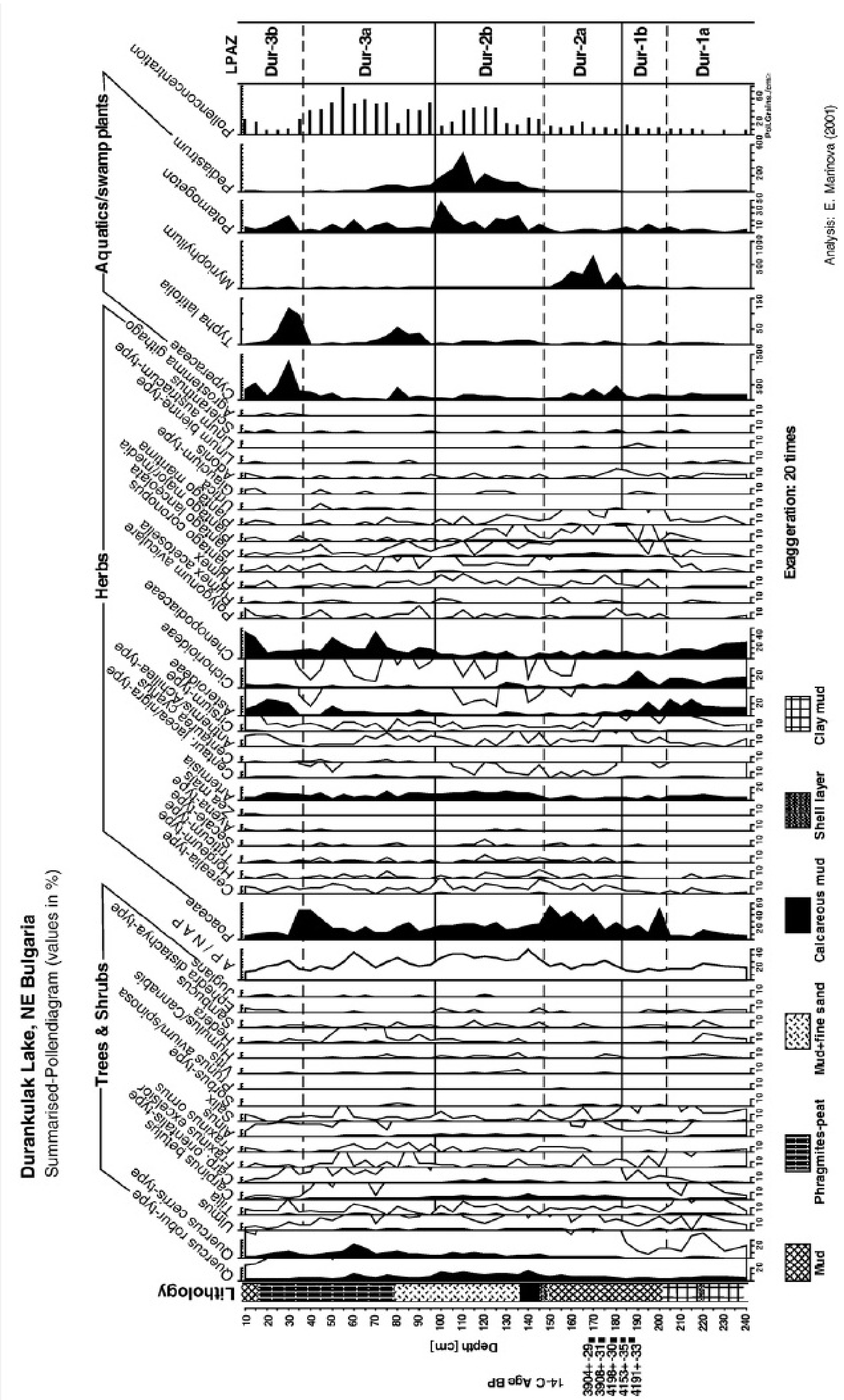

Fig. 13: Lake Durankulak (core Durankulak-3): simplified pollen diagram. Cultural period of the Thracian occupation corresponds to sub-zone Dur 2b (after MARINOVA – ATANASSOVA 2006).

5.3 Koprivlen, Southeastern Bulgaria

The archaeological site was discovered in 1995 near the modern village of Koprivlen (Fig. 8), south to the town of Gotse Delchev also known as the Roman fortified town called Nicopolis Ad Nestum. Since the end of nineties of the twentieth century, archaeological investigations have focused on the southwestern Bulgarian area between Gotse Delchev (TSVETKOVA 2002, 46) and the northern Greek Drama Plain including the Thracian settlement at Koprivlen because the Middle Mesta Valley (Fig. 14) played a very important role of the key corridor[27] for the ancient trade network[28] (DE BOER 2010, 178; DAMYANOV 2015, 297).

The systematic excavations have detected an existence of the well-organized settlement and adjacent necropolis in the valley of the Mesta (ancient Nestos) River. The stratigraphic subsequence has attested uninterrupted continuity in occupation from the Late Bronze Age through the Iron Age till the Middle Ages, which allows thoroughly studying a development of the settlement and all the aspects that affected this process (BOUZEK – GRANINGER 2015, 16). During the Late Iron Age, Koprivlen became one of the most economically important regional Thrace center as suggested by various discoveries, i.e. remains of stone architectures, rich grave contexts, ritual pits and traces of local metal-working and agricultural activities (BOZKOVA 2002, 9–12; DELEV 2002a, 91–99).

The settlement was found on the right bank of the Mesta River. The slanting slopes of the nearby Pirin Mountains surround the valley with the altitude around 540 m a.s.l. (VULCHEVA et al. 2000, 145). The specific slightly mountainous character of the landscape is affected by the mild transitional Mediterranean or sub-Mediterranean climatic regime. This warm air penetrating from the south favorably influences ecological and economic development (STANEV 2002, 33–34)

Many palaeoecological and archaeobotanical studies have been conducted in the territory of Southwestern Bulgaria and especially the Middle Mesta Valley has become very attractive site for exploring the history of vegetation. Due to the location of Koprivlen in the foothills, the vegetation development as well as the subsistence strategies changes has always been closely associated with the climatic situation in the entire region. In this

[27] The ancient road system in the southwestern Bulgaria was the significant junction between the Eastern Mediterranean and the Thracian inland. Roads crossing Koprivlen were directed toward the Upper Thracian Plain, the western Rhodopes as well as to the south, the North Aegean coast (DELEV – POPOV 2002).

[28] Very intensive contacts with the Aegean region before 600 BC are evidenced by numerous imported objects, e.g. Mycenaean pottery (BOUZEK – GRANINGER 2015, 16; TZOCHEV 2015, 412) .

area, archeobotanists have primarily focused attention on the Neolithic agricultural traces because the valley between the Struma and the Mesta River is considered as one of the possible ways of the Neolithisation into the Balkan Peninsula (MARINOVA et al. 2012a, 415). However, human impact on the landscape can be observed since the Neolithic farming to the present day with the archaeobotanical results at Koprivlen as the proof.

Firstly, researches of the natural vegetation on a broader regional scale, as described in the chapter 2, have pointed out to some major changes in a composition during the Late Bronze Age (BOZILOVA et al. 2004, 245). Focusing only on monitoring of the anthropogenic indicators, the pollen diagrams have shown the first maximum in human activity. Palynological data derived from the different archives of sediments (lakes, peat-bogs, slopes of hills etc.) across the Pirin Mountains register decline of conifer forests (*Pinus, Abies alba*) and expansion of *Fagus* and *Picea abies*. Along with a high value of the palaeofire indicators, this transformation of landscape is interpreted as intensive exploitation of land for stock-breeding and crop cultivation. The forest served as an immediately available natural source of wood for fuel and as building material (LAZAROVA et al. 2015, 7–8), as is also confirmed by discovered residues of white pine, hornbeam and beech at the Late Bronze Age site. A well-developed agriculture is demonstrated by numerous archaeobotanical finds[29] as well (POPOVA 2002, 280).

Subsequently, the Late Iron Age occupation period in the Middle Mesta Valley is characterized by high economic prosperity of Koprivlen, partially due to its key position, for the thriving Thracian settlement maintained intensive political, cultural and economic contacts with the North Aegean, the Macedonian territory and the central Thrace (VULCHEVA et al. 2000, 150). With rising population and strong economic pressure influencing the character of the local economy, it was necessary to modify some agricultural techniques and crops. It is evident that preferring soft (or bread) wheat (*Triticum aestivum*) with higher nutrition value rather than einkorn or emmer wheat had not only ecological reasons (meaning primarily climate conditions), but also economic ones (POPOVA 2002, 282).

[29] Tzvetlana Popova studied several archaeobotanical samples obtained from the archaeological structures (e.g. cesspit, wall plaster fragments, fireplace, floor, pottery) of the Late Bronze Age settlement which was constructed on the right bank of the river (ALEXANDROV 2002, 65-69). In brief summary, among the cereal macroremains grains of einkorn (*Triticum monococcum*) unambiguously dominate, in contrast to emmer wheat (*T. dicoccum*) which almost absents in this period. In the organic-rich material from the cesspit, a collection of wheat, barley, millet, grape pips and cherry stones has preserved in strongly carbonized but in good conditions (POPOVA 2002, 280).

Tzvetlana Popova has analyzed archaeobotanical material from ritual pits (Thracian sanctuary) at Koprivlen dated to the seventh to the first century BC (Tab. I). Most of carbonized and friable plant remains have been identified as millet (*Panicum miliaceum*) and barley (*Hordeum* sp., *Hordeum* L. ssp. *vulgare*, *Hordeum* L. ssp. *nudum*) grains, followed by leguminous plants (*Lens culinaris, Pisum sativum, Vicia ervilia*) and small number of weed species (*Chenopodium album, Polygonum aviculare, Agrostema githago, Bromus* sp.). Some of the preserved stones and pips could be determined more accurately (domesticated *Vitis vinifera, Prunus avium, Cornus mas*). Among individual finds, several grains of rye *(Secale cereale*) have been discovered, more probably admixed to another cereal crop and very rare seeds of field poppy (*Papaver rhoeas*) (POPOVA 2002, 283)

Collections of charred wood fragments coming from cultural layers at the site have clarified in a detail which wood was used by local Thracians supposedly for heating purposes considering the context and the high level of fragmentation caused by fire. On the basis of the anthracological analyses, the most prevailing among the coniferous was the Bulgarian white pine (*Pinus sylvestris*). Oak (*Quercus*), hazel (*Corylus*) and hornbeam (*Carpinus*) represented the main representatives of deciduous trees (Tab. II).

The other wood species held substantially small percentage in the anthracological diagram, nevertheless, it is important to mention them because their presence in the settlement has completed the picture of surrounding vegetation and also has provided information on local environmental conditions. It concerns namely beech (*Fagus* sp.), alder (*Alnus* sp.), poplar (*Populus* sp.), elm (*Ulmus* sp.), maple (*Acer* sp.), plane (*Platanus* sp.), ash (*Fraxinus* sp.), juniper (*Juniperus* sp.) and fir (*Abies* sp.) (POPOVA 2002, 284). All these types of tree species inhabited the surface disturbed by deforestation activities or they can be connected with the humid places near the Mesta River as well.

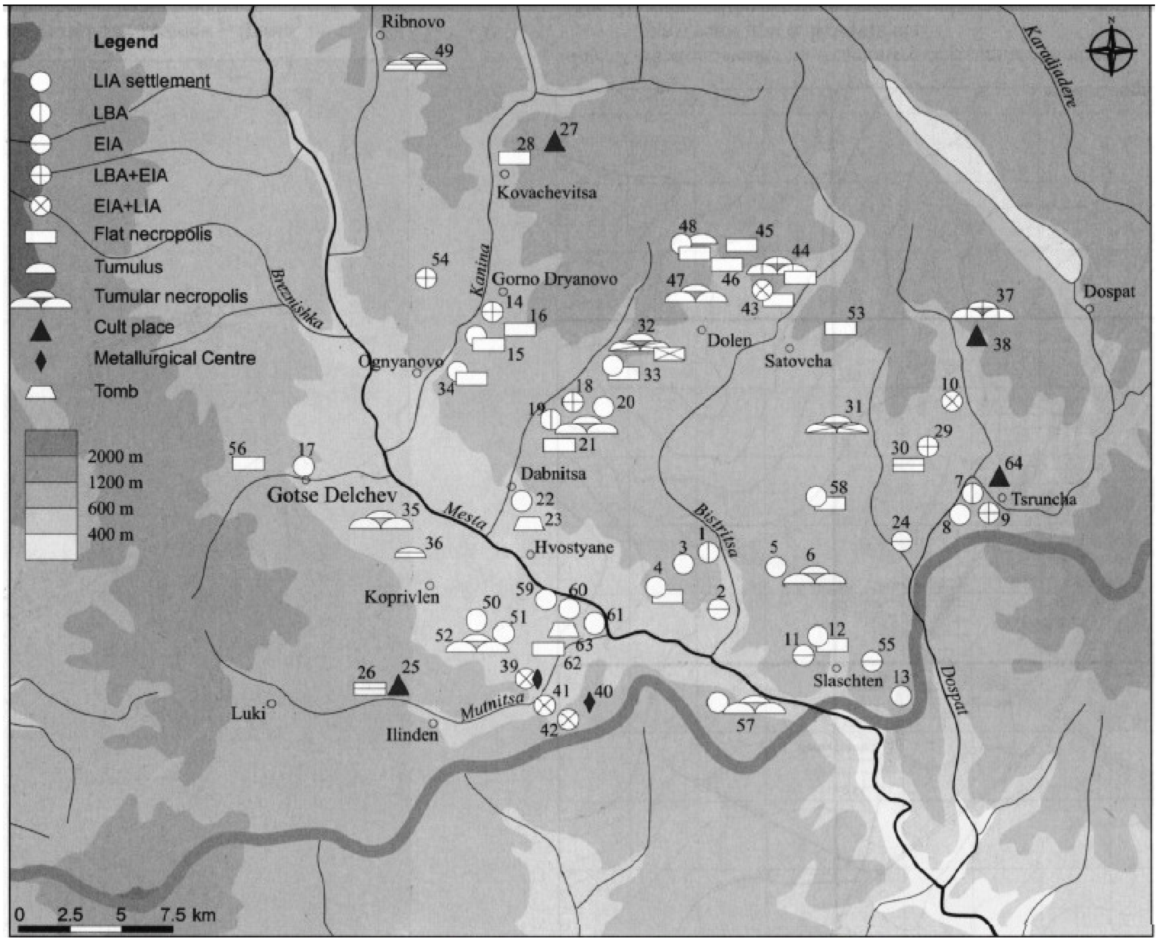

Fig. 14: Map of archaeological site at Koprivlen, the Middle Mesta region (after DELEV – BOZKOVA (eds.) 2002).

SPECIES	Soil No.1	Soil No.2	Soil No.3	Soil No.4	Soil No.5	Soil No.6
Einkorn wheat					1	
Emmer wheat		1				
Soft/compact wheat	2		1			1
Barley	1			1		
Lentil			1		1	
Pea	2					
Millet	3	1	6			
Oats	1				2	
Rye	1					
Domesticated grape	1					

Tab. I: Koprivlen: quantitative distribution of carbonized seeds by layers in Pit S10 (after POPOVA 2000).

	Species															
Pit No.	White pine	Coniferous	Fir	Juniper	Oak	Hazel	Hornbeam	Beech	Elm	Plum/Cherry	Poplar	Maple	Fruit trees	Cornel	Alder	Ident.	TOTAL
8		5			8											3	16
10	16				13	2	2	1	2	1	12	4				8	61
11	1				2												3
18	2			1													3
19	8	7			14		2									2	33
39	10		2		4		3										19
52		1															1
60	14			1	10	29	5	1			2			2	1	30	95
62	5				2	3		1			7	1			1		20
64	8			3	4	1											16
66	54		1		8		4	2							1	7	77
69	8				3	2	1	1				2					17
71	11				5								1	1			18
83	5					1	1								1		8
TOTAL	142	13	3	5	73	38	18	6	2	1	21	7	1	3	4	50	387

Tab. II: Koprivlen: quantitative distribution of carbonized wood fragments from pits in sector South (after POPOVA 2002).

5.4 Greek emporion Pistiros, Southern Bulgaria

More than twenty-five years of successful international cooperation among archaeologists and interdisciplinary scholars has revealed an existence of a very important commercial center with connections in the Thracian and the Aegean region. Systematic archaeological excavations in the territory of Pistiros began in 1988. The international project was led by Polish archaeologist and thracologist Mieczysław Domaradzki. Samples for archaeobotanical analyses collected from the entire area of the site have been undertaken primarily by Tzvetana Popova since 1996 in an effort to reconstruct the paleoenvironmental conditions of the whole territory (POPOVA 1996, 2002a and 2013)

The area under the investigation is situated at present-day Adjiyska Vodenitsa near the Bulgarian town of Vetren in the Septemvri Municipality (Fig. 15). Nowadays, the site is located on a low hill, only 2 m above surrounding terrain, on the left bank of the Maritsa River (BOUZEK et al. 2010, 17). The runoff canal is situated in the transition zone between mountain ranges (the Rhodope Mountains, Rila and Sredna Gora) adjacent to the Kostenets depression which provides regular water from rainfall and snow melting (KENDEROVA et al. 2007, 272). It is necessary to mention that a large area of excavations at Adjiyska Vodenitsa has been lost due to the streambank erosion (Fig. 16).

Location of the future Classical and early Hellenistic trading station and harbor on the Maritsa River, seems to have been suitable and perspective place for economic and political activities of the Greek and Thracian merchants and clients already by the end of the sixth century BC. Although the earliest finds uncovered at the site and its vicinity are dated around 500 BC, the permanent settlement known as Greek emporion Pistiros was established in the third quarter of the fifth century BC by citizens of the Greek poleis Thassos, Maroneia and Apollonia.

Pistiros played a significant role in the North Aegean trade network not only as a commercial crossroad but also as the key point of contacts between the Thracian and the Greek world, as undoubtedly confirmed by the Vetren inscription dated to the Classical period (BARALIS 2008, 118–119; DEMETRIOU 2010; GRANINGER 2012, 103). A large amount of archaeological and environmental data that can be represented by some of the most principal trading goods outlines rich potential for agricultural and industrial exploitation of the area (ARCHIBALD 2000–2001).

The cooler phase in the first millennium BC coincides with the decline of silver fir (*Abies*) in the Sredna Gora and Rila mountains (ARCHIBALD 2010, 241) and a spread of oaks and hornbeam forests in lowlands near the river (Tab. III). At higher altitudes, spruce (*Picea excelsa*) dominated but the lower zones of mountains were covered by beech trees (*Fagus*). Occurrence of alder (*Alnus*), poplar (*Populus*), willow (*Salix*), plane tree (*Platanus*) and ash tree (*Fraxinus*) around the area serves as further evidence of humid climate. Species of pine tree (*Pinus sylvestris*, *Pinus nigra*) were very rare and later almost completely disappeared. Mixed forests located up to the elevation of 800 m above the sea level were mostly represented by oak (*Quercus*) and hornbeam (*Carpinus*) trees (POPOVA 2013, 261). The oak taxon variations were present in all strata (*Q. cerris*, *Q. frainetto, Q. pedunculifolia, Q. petraea, Q. robur*).¨

The archaeological records at Pistiros and the vicinity suggest that human activity dramatically increased at the beginning of the fifth- century BC. Greater population density caused great pressure on the landscape which was the one of reasons of gradual reduction of the woodland in the mountains and also nearby the river flanks (CHIVERRELL et al. 2009, 299).

Overall, the palynological and plant macroremains research has shown considerably excessive rise of the water level[30] with expansion of marchlands and peat lands, especially during the fifth to the third century BC (CHIVERRELL et al. 2009, 298; KENDEROVA et al. 2007, 277). Wild growing weed species of the alluvial and meadow landscape were studied as well. The results have clearly proved not only wet conditions and high water level but also a presence of extended arable land, since most of the weed remains are closely associated with wheat fields. Seeds of these species (*Agrostema githago, Rumex Acetosella, Gallium apparine* etc.) were commonly included in harvested wheat crop (POPOVA 2013, 259). It means that they were found among the cultural plants at the site.

The most spread weed taxon is *Chenopodium album* followed by *Polygonum lapatifolium* and *Polygonum persicaria*. In respect of the abundant occurrence of these plants in cultural contexts, for example the clay altar at the site, it is possible that some kinds of leaves, roots and seeds were used as complementary food (POPOVA 2013, 259).

[30] The fluvial plain adjacent to the river was very vulnerable to flooding. At the time of emporion existence, the lowlands were flooded during periodic overflows (BALTAKOVA et al. 2013). In some of archaeological contexts at the site, a fluvial material containing gravel, fine sand, clay and well-smoothed pebbles have been found, and the archaeological material dating to Classical period was buried below layers of floodplain alluvium as well (CHIVERRELL et al. 2009, 296).

The samples taken from the soil within the altar and the vicinity revealed rich well-preserved botanical material (Tab. IV). The most dominant cereals were varieties of wheat-mild/compact, einkorn and emmer (*Triticum aestivo/compactum, T. monococcum, T. dicoccum*). Also barley (*Hordeum vulgare*), and millet (*Panicum miliaceum*) had significant role in nutrition but millet was more typical for the Roman times. Only small quantities of rye (*Secale cereale*) and oat (*Avena sativa*) were found in the samples.

Legumes are represented mainly by bitter vetch (*Vicia ervilia*) and lentil (*Lens culinaris*). Inside the altar several remains of grapes (*Vitis vinifera*) and three fragments of plum (*Prunus* sp.) were recorded (POPOVA 2013, 258). The other collections of archaeobotanical samples contained very similar taxa, together with cereals, legumes and wild growing weed species.

Such a comprehensive overview of macrobotanical remains illustrate a picture of food habits influenced by social and economic aspects. It could also demonstrate agricultural, social and ritual practices in the region of the Maritsa River during the Classical period. Furthermore, the set of crop plants recovered at the emporion can help to understand which organic products were needed to be imported.

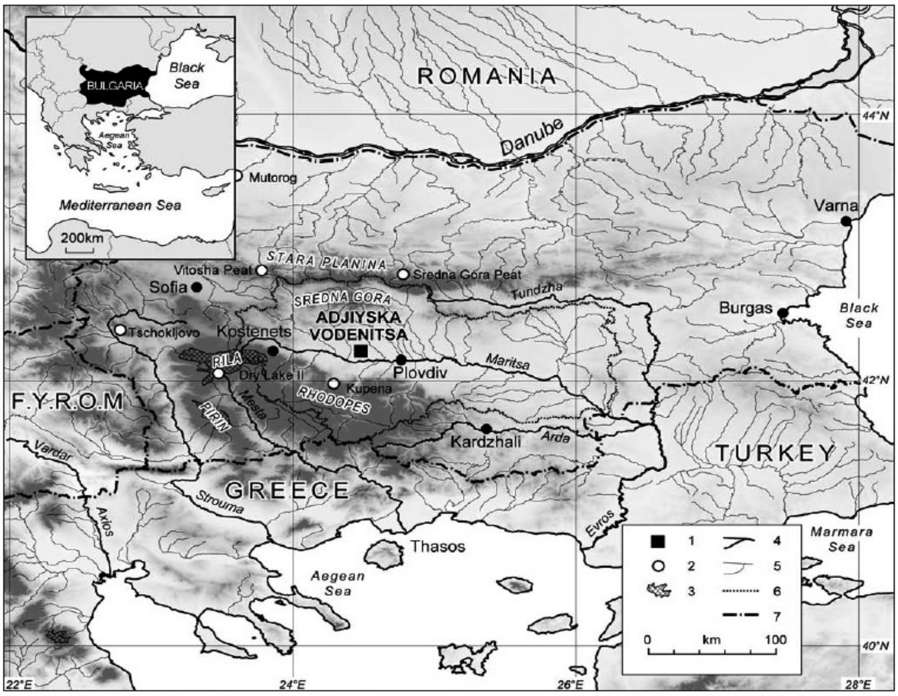

Fig. 15: Map of archaeological site at Pistiros (Adjiyska Vodenitsa) in the Maritsa basin. 1: study site; 2: published pollen sites; ice extent at last glaciál maximum; 4: rivers mentioned in the text; 5: other rivers; 6: limit of the Maritsa basin; 7: international boundaries (after CHIVERRELL – ARCHIBALD 2009).

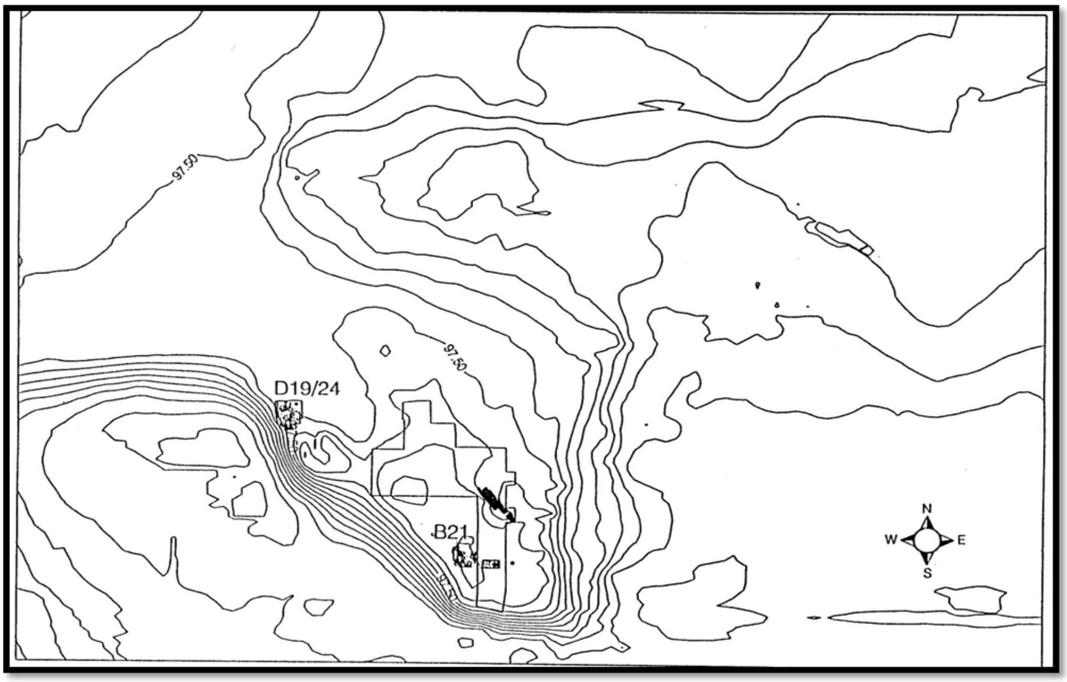

Fig. 16: Situation plan at Adjiyska Vodenitsa. Archaeological site investigated by the British team (BOUZEK – DOMARADZKA – ARCHIBALD (eds.) 2007).

TAXONS	XI	XII	XIII	XIV	XXV	TOTAL
Quercus - oak	101	49	39	31	9	221
Ulmus - elm	2				3	5
Alnus - alder	2					2
Carpinus - hornbeam			12		1	6
Acer - maple	6					13
Fagus - beech			1	2		4
Coniferous wood	1				17	18
Identerminable	4	11	4	3		25

Tab. III: Distribution of charcoal wood fragments from different spit layer in pit in Pistiros (after POPOVA 2002)

Species	**soil No.2**	**soil No.3**	**soil No.4**	**soil No.5**	**soil No.6**	**walled altar space**	**altar´s wall**
Triticum monococcum –eincorn			1	1		1	2
Triticum dicoccum - emmer	2	2					
Triticum aest/comp. - mild/compact wheat		4	4	3	4	12	
Hordeum vulgare - barley		2	2	1	2	2	1
Secale cereale - rye		1					
Panicum miliaceum - common millet		3				1	8
Vicia ervilia - bitter vetch		1					
Lens culinaris - lentils		1				2	
Vitis vitifera - grapes	1					2	
Polygonum aviculare -knotgrass	2					2	
Chenopodium album - fathen	11						
TOTAL	16	14	7	5	6	22	11

Tab. IV: Carbonized plant remains from and around the altar at Pistiros (after POPOVA 2002).

6. Discussion

This chapter will provide a discussion of observable trends of land-use changes in a broader perspective. When we look at the subsistence strategies evidenced in archaeological contexts in Bulgrian Thrace during the Iron Age, we realize certain similarities in the whole Southeastern Europe and close relations to the Eastern Mediterranean region.

The relationship between land-use strategies and transformation of the environment in the Bulgarian region is summarized in Fig. 18 in the line with the main climatic signals, also marked in Fig. 18. From the time of the first millennium BC onwards, the consequencies of strong human activity are reflected in most archaeobotanical records from different sub-regions of Bulgaria. Although the transition period between the Late Bronze Age and the Iron Age (around eleventh century BC) is characterized by lower settlement activity, an abrupt increase in human impact on the environment is dated to the same period (MARINOVA – ATANASSOVA 2006, 176; HRISTOVA et al. 2016, 1).

It is possible that agricultural development and other human activities were positively supported by favourable climate conditions. During the Early Iron Age, around 850 cal. BC, striking rise of some tree taxa clearly recorded in pollen diagrams obtained from the various Bulgarian sites demonstrate increase in humidity. Similar tendencies can be visible in the adjacent regions, however, the spatial pattern of humid conditions differs from place to place (FINNÉ et al. 2011; LAZAROVA et al. 2012).

First and foremost, archaeobotanical analyses of the sites of Ezero and Durankulak represent the most pioneer studies on the human–environment interactions in Bulgaria. Both settlements situated to wetland are very significant centers of the prehistoric occupation with long pollen sequences presenting important results of the environment transformation since the Neolithic to the Roman period.

Around the settlement of Ezero, pollen diagrams in accordance with macrofossil records have revealed significant traces of growing water level, organic-rich sediments and more frequent taxa demanding wetter environment already from ca. 1000 BC onward (CHAPMAN et al. 2009, 160). Despite the intensification of human activity in both areas at the beginning of the Early Iron Age (1100–900 BC), as indicated by an increase in anthropogenic indicators in the pollen diagrams, remarkable woodland expansion in the vicinity of wetland and lakeshore has been recorded in the same period. It is likely that this effect is related to the synchronous climate change, particularly the rising humidity.

In the line with an increase in arboreal pollen frequencies (BOZILOVA et al. 2004, 245), slight change in the composition of local grass vegetation can be observed as well. While some of the warm-requiring grass species like Graminae declined, pollen amount of steppe species of Sagebrush (*Artemisia*), more typical for cold climatic conditions, increased. This ruderal weed playes a role as an anthropogenic indicator documenting traces of human presence, however, it also illustrates the presence of secondary plant communities, which may indicate increasing human activity as well as natural steppe vegetation cover under the influence of cooling trend (CHAPMAN et al. 2009, 174–175; MARINOVA et al. 2012a, 173).

Regarding the plant communities which spread in consequence of the natural vegetation disturbance, attested woodland clearance and the presence of arable fields reflect intensive land-use in direct connection with these settlements in the older epoches. However, in comparison with the situation at Ezero in the Upper Thracian Plain, the archaeobotanical assemblages coinciding with the Early Iron Age occupation phase on the Big Island in Durankulak Lake, as evidenced by discovered Thracian settlement and sanctuary, show lower human activities in the local environement. The pollen curves from the site at Ezero signalize stronger human impact, which is clearly reflected in the vegetation composition of reduced woodland cover and higher amount of the anthropogenic indicators inferring more intensive agricultural acitivites than in the area of Lake Durankulak (CHAPMAN et al. 2009, 175; TONKOV et al. 2013).

It is assumed that the results from Ezero could be interpreted as the evidence of more extensive arable fields, although, it is unlikely that the landscape surrounding Lake Durankulak was less suitable for arable farming than Ezero, since both settlements are situated in the open wetland. The question is whether this interpretation can be misleading due to the unsufficient state of research. Numerous palaeoecological studies on the vegetation history in the area of Lake Durankulak illustrate the phase of the Late Bronze Age and Early Iron Age as the major period of maximum human impact (MARINOVA – ATANASSOVA 2006, 176).

Since the period around 900–800 BC, the rapid cooling with an increase in moisture conditions have been monitored in other Bulgarian locations, including the Sredna Gora

Mountains, the Rhodopes etc. (HRISTOVA et al. 2016, 12). Furthermore, in the case of palynological record from the pollen profile located near Lake Muratovo (2230 m a.s.l.) in the Pirin Mountains (Fig. 17), dynamic change in the vegetation cover has been detected, not only by spreading numerous peat-bog formations but primarily expansion of coniferous forests. The *Picea abies* expansion around 3000 cal. BP (1000 cal. BC) in the coniferous belts of the mountains is directly connected with lower temperatures and higher precipitation likely synchronous with the climatic event around 850 cal. BC (BOZILOVA et al. 2004, 245).

This discussion will also focus on nature of the plant subsistence during the Iron Age. The Thracian settlement at Koprivlen and the Greek emporion Pistiros represent two important centers dated to the same period but situated to the different parts of Thrace. Classification of the archaeobotanical evidences at these mentioned sites (Tab. V) brings a rich source of information about the predominant crop production and commonly used plants in general throughout the whole period.

In the course of the first millennium BC, the cereals including different types of wheat, barley and millet are discovered almost everywhere. We can say that hulled wheat - emmer and einkorn – belonged to the most common and ubiquitous crop plants, however, in the Iron Age archaeobotanical assemblages, it is apparent that naked or free-threshing wheat (bread and hard wheat) gradually started to replace the older types. Besides wheat types, barley and millet became the prevailing staple crops (POPOVA 2000, 263; MARGARITIS 2015, 195; HRISTOVA et al. 2016, 11).

Firstly, it is explained as a reaction to the growing population in Thrace. It was necessary to produce enough food for the local inhabitants as well as quality goods for exports. These crops have a short growing season and higher nutrition values. They are less demanding on the environment and more reliable for safe harvesting, therefore, it was useful to spread these kinds of arable fields.

The comparable features in the development of agricultural habits of the Northern Greece, Bulgaria and Macedonia can also be detectable in the tell settlement at Kastanas in Macedonia. The very important site has been investigated since 1976 and the results have yielded crucial information concerning the main changes in agricultural lifestyle in the transition from the Late Bronze Age to the Iron Age (KROLL 2000, 62). Pioneering work in this topic was conducted by H. Kroll (KROLL 1984).

Among others, he also studies the differencies in agriculture between mainland Greece and the northern regions. In this respect, it should be pointed out the conspicuous question of cultivation of millet. Regarding millet as a typical crop in Thrace during the Iron Age, from Thessaly to the south (concerning mainland Greece), it occurred rarely in the archaeobotanical material and rather as a ruderal weed than the one of main crops. According to Kroll, it served primarily as animal fodder and food easily available to poor people (JONES 1987, 122; KROLL 2000, 64).

Nevertheless, the plant economy in the territory of the Greek emporion at Pistiros and the Thracian settlement at Koprivlen is characterized by similar features, at least as regards the discovered plant remains. Cereals and pulses were the basic types of crops growing in the local fields. Most of the recognized species were cultivated in Bulgaria during the Neolithic or in the course of the following periods. After 500 BC, at the time when human impact on the environment started to be highly noticeable, the cultural and social developments in Thrace under the Greek influence was transferred in to the sphere of agriculture. New techniques and technological innovation together with better organization of farming led to agricultural intensification (CHAPMAN et al. 2009, 181; HRISTOVA et al. 2016, 12).

The other aspect of the Greek influence or the Mediterranean in general, can be observed in Bulgarian Thrace through the presence of some types of plants indigenous only in the Mediterranean region and imported to the Thracian centers. At Pistiros, abundant traces of the *Pinus halepensis* resin indicate the Greek retsina wine. This type of resin was used for unique flavor of the white wine but such pine species did not grow in the Bulgarian region and it must have been imported from Greece or Aegean islands (Thasos, Rhodos) where the retsina was usually produced (STOUT et al. 2003, 86; POPOVA 2013, 262).

One of the rarer flowering plants found in the altar area at Pistiros was the Greek herb Herniaria (*Herniria incana* Lam.). This medical plant could be used as an herbal remedy for hernia (the name of the plant comes from this disease). In Bulgaria it grows plentifully in rocky places (POPOVA 2013, 262).

In addition, a large concentration of plant *Cistus incanus,* called the pink rock rose used for preparation of oil and perfumes was also detected. The resin extracted from its leaves is known as labdanum (ladanum). The mixture of oil with the pink rock rose was flavored with many fragrant plants including jasmine (*Jasminum*), sage (*Salvia*) or conifers of the families *Pinaceae* and *Cupressaceae*. All of these ingredients were found inside the clay altar at Pistiros (STOUT et al. 2003, 87).

Such observation and comparison of the diverse regions or individual sites would greatly enrich our knowledge of the ancient landscape and its development in relation to human impact or climate influence (MARINOVA et al. 2012b). Moreover, studies on the interrelationship between the environment, past climate and human communities deal with the question of how climate changes could have affected the subsistence strategies or how the crop diversity could have been influenced by human choices. It is highly complex and sensitive system formed by local environmental settings and social and cultural traditions together with economic requirements.

Archaeological sites	**Koprivlen**	**Pistiros**
Cereals		
Triticum monococcum	x	x
Triticum dicoccum	x	x
Triticum aestivum/durum	x	x
Tiriticum sp.	x	
Hordeum vulgare	x	x
Panicum miliaceum	x	x
Secale cereale	x	x
Avena sativa	x	x
Sorgum bicolor		x
Pulses		
Lens culinaris	x	x
Pisum sativum	x	
Vicia ervilia	x	x
Fabaceae	x	
Cultivated and gathered fruits		
Cornus mas	x	
Prunus avinum	x	x
Sambucus sp.		x
Vitis vinifera	x	x
Wild growing plants		
Agrostema githago	x	
Bromus sp.	x	x
Chenopodium album		x
Convonvulus arvense		x
Galium apparine		x
Lithospermum arvense		x
Papaver rhoeas	x	
Polygonum aviculare		x
Rumex acetosella		x
Rumex crispis		x
Veronica hederifolia		x

Tab. V: The presence and absence of the most common plant species from the archaeological contexts at the sites of Koprivlen and Pistiros, based on the published archaeobotanical studies (after POPOVA 1996; 2002, 2009, 2013).

Archaeological sites	**Koprivlen**	**Pistiros**
Charred wood		
Abies sp.	x	
Acer sp.	x	x
Coryllus avenala	x	x
Carpinus sp.		x
Fagus sp.	x	
Fraxinus sp.	x	
Juniperus sp.	x	
Pinus sylvestris	x	
Pinus nigra		x
Pomoideae	x	x
Populus sp.	x	
Quercus sp.	x	x
Ulmus sp.		x

Tab. V: (Continued)

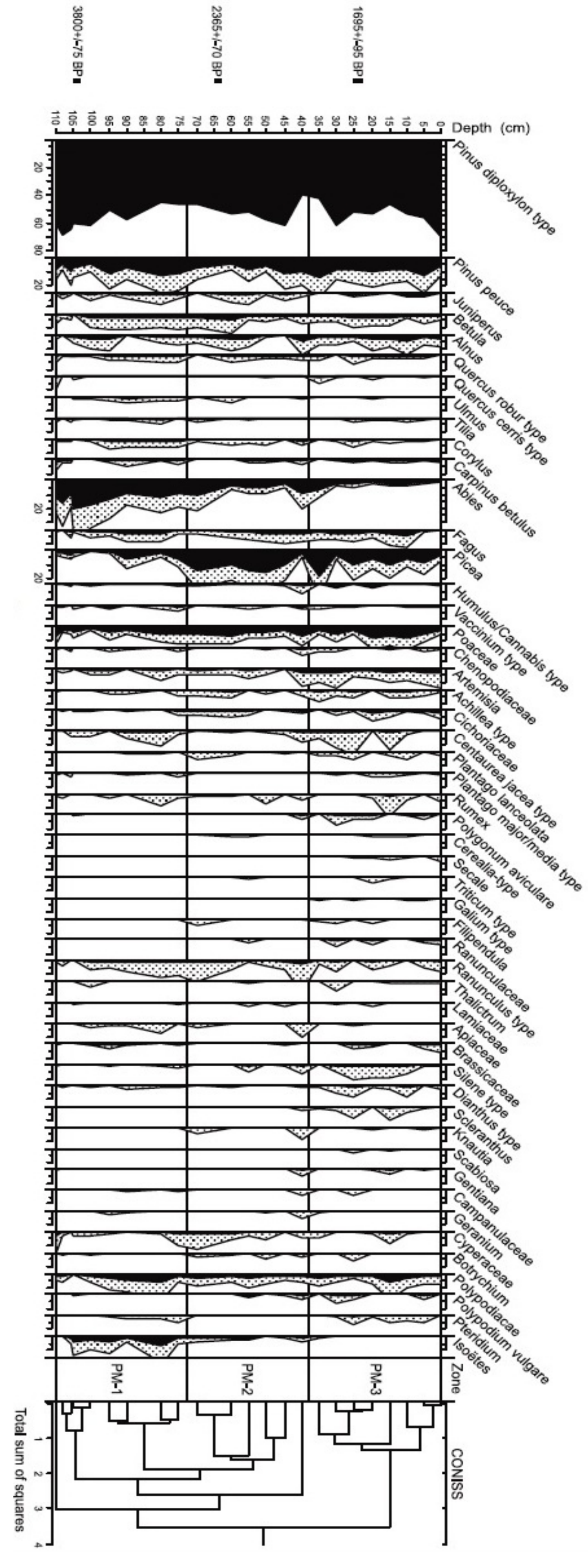

Fig. 17: Percentage pollen diagram of Lake Muratovo, the Pirin Mountains (after BOZILOVA et al. 2004).

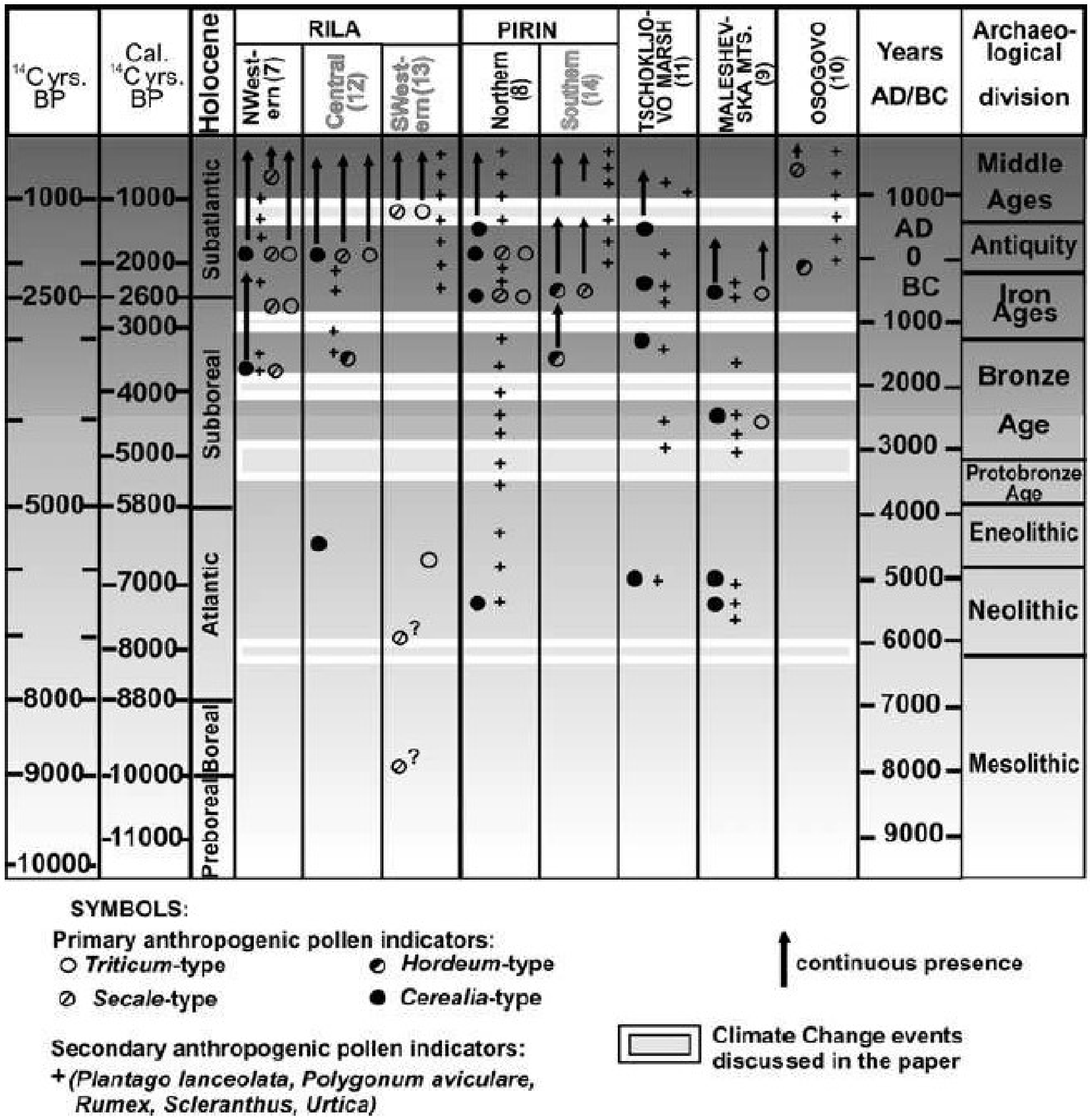

Fig. 18: Summary scheme for presence of the anthropogenic indicators in the pollen diagrams investigated in southwestern Bulgaria, with marked Bond climatic cycles (after MARINOVA et al. 2012)

7. Conclusion

Concluding statements suggest scenarios of human–environment interactions and subsistence strategies during the Iron Age in relation to the economic, social and cultural changes in Ancient Thrace.

1. In comparison with the Neolithic and the Bronze Age data of the Bulgarian archaeology, the archaeobotanical material from very few archaeological sites dated to the Iron Age has been investigated. Although based on the relatively poor and incomplete archaeobotanical material, there seems to be a definite development of subsistence strategies as well as change in agriculture in the course of the Iron Age. In terms of monitoring primary and secondary anthropogenic indicators in pollen diagrams, increase in both agricultural and pastoral practices has been documented throughout whole country. Since the onset of the Iron Age, especially after the fifth century BC, significant agricultural intensification in Thrace led to extension of deforestation area, larger arable fields and broader grazing meadows.

2. The majority of plant remains- grains and seeds- come from pits, whether they have been identified as storage or ritual contexts. A wide spectrum of wild growing and cultivated plants provide remarkable insight into the daily diet of the local population, not only their own crop production but also imported commodities from different parts of the adjacent regions or the Mediterranean. Among annual cereal crops, the dominant types were bread and hard wheat, barley and millet accompanied by einkorn and emmer as admixture. Rye and oat have become more frequent since the Late Iron Age onward. Furthermore, pulses and cultivated fruits belong to the common finds in these archaeological contexts as well, especially grapevine seeds were abudantly recorded in a large amount, which signalizes a progress in local wine production. Archaeobotanical analyses determined the presence of several new cultivated plants (e.g. *Olea europea, Cucumis melo*), however, their occurrence can be explained rather as an import from the Mediterranean region. Identified plant remains from the settlements, Koprivlen and Pistiros, prove close connection with the Greek poleis.

3. The Greek colonization of the North Aegean coast initiated considerably intensive relations between the Mediterranean and the Thracian region. Together with cultural and societal development, steadily increasing economic pressure caused higher requirements for the landscape to gain access to the exchange network in the whole region. Besides exploitation of natural sources (e.g. timber and mining), agricultural intensification has been one of the most reliable ways to become an important part of the Greek world. On the basis of the exported and imported goods, it can be assumed that during the first millennium BC, the Thracian social transformation under the Greek influence also affected the development of pastoralism and arable farming. Furthermore, growing population density contributed to a greater need to enlarge agricultural areas in the country.

4. Most identified plant species represent the natural vegetation cover in the surrounding of the studied area. According to the Bond climatic event around 2850 cal. BP (ca. 850 cal. BC), a shift in climate to colder and wetter conditions is evident in numerous records from various studied sites. This change brought apparent rise of the water level and spread of alder, poplar, plane forests etc. alongside the rivers, nevertheless, the most widespread tree species in the lower altitude were oak accompanied by hornbeam and beech. Although reconstruction of the Bulgarian vegetation history suggests partial afforestation in the lowlands (the Upper Thracian Plain) as well as in the mountaionous areas (southwestern Bulgaria) at the beginning of the Iron Age, continuity in land-use from the Late Bronze Age with constantly increasing intensity of forest clearance and subsequent transformation to pasture and arable land have been reflected in the changes of the vegetation composition.

Finally, this thesis summarized the current state of research on archaeobotanical studies in Ancient Thrace. However, there are still several remaining questions concerning the development of the Thracian agriculture during the Iron Age. For a better understanding of the processes taking place in the territory of Ancient Thrace during the first millennium BC, more intesive interdisciplinary cooperation providing abundant archaeobotanical material is the fundamental element of the future direction.

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