Natural and cultural landscape of the Neolithic settlement of Dispilió: palynological results *

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ABSTRACT: Pollen diagrams of Lake Orestiás, Kastoria, show strong evidence of intensive anthropogenic influence in the landscape, synchronous to the Neolithic occupation of Dispilió lake settlement. Two cores from the southern part of the lake were analyzed for their palynological contentin order to achieve the reconstruction of the past vegetation and to estimate the impact of the lake settlement on natural vegetation.

Pollen analysis resulted in the identification of 7 local pollen assemblage zones (namely Di I-VII), each of them corresponding to a different kind or intensity of exploitation of natural resources by prehistoric man. The anthropogenic impact in the area is the major feature of Di-II, Di-IV and Di-VI pollen zones, corresponding to dif-ferent settlement facies described during the archaeological study of the lake settlement.

Key-words: *pollen analysis, human impact, Holocene, Greece.*

ΠΕΡΙΛΗΨΗ: Στόχος της παλυνολογικής έρευνας στη λίμνη Ορεστιάδα της Καστοριάς είναι η διερεύνηση και αναπαράσταση του φυσικού περιβάλλοντος του νεολιθικού λιμναίου οικισμού του Δισπηλιού καθώς και η εκτίμηση της επιρροής του οικισμού στη βλάστηση. Μελετήθηκαν δείγματα δύο πυρήνων (Γ25 και Γ26) από το νότιο τμήμα της λίμνης Ορεστιάδας ως προς το ποσοτικό και ποιοτικό τους περιεχόμενο σε γυρεόκοκκους και άλλα παλυνόμορφα. Τα παλυνολογικά διαγράμματα που προέκυψαν από την μικροσκοπική ανάλυση εμφανίζουν ισχυρά στοιχεία για έντονη ανθρωπογενή επιρροή στο φυσικό περιβάλλον, η οποία συμπίπτει χρονικά με τη νεολιθική κατοίκηση στην περιοχή. Προσδιορίσθηκαν επτά τοπικές βιοζώνες συγκέντρωσης γυρεοκόκκων (Di-I έως Di-VII), οι οποίες αντιστοιχούν σε διαφορετικές μορφές εκμετάλλευσης των φυσικών πόρων από τον προϊστορικό άνθρωπο. Από αυτές οι τρεις (Di-II, Di-IV και Di-VI) αντιστοιχούν σε περιόδους έντονης διαταραχής της φυσικής βλάστησης από τον άνθρωπο και συσχετίζονται με τις τρεις διαφορετικές φάσεις κατοίκησης που περιγράφηκαν κατά τη μελέτη του παραλίμνιου οικισμού.

Λέξεις-κλειδιά: *παλυνολογική ανάλυση, ανθρωπογενής επίδραση, Ολόκαινο, Ελλάδα.*

INTRODUCTION

Palynomorph analysis has long (IVERSEN, 1941; BEHRE 1990; KONIGSSON, 1989) been used as an aid in investigating the interactions of prehistoric man and his natural environment (KOULI & DERMITZAKIS, 2002), especially after the spread of agriculture in the Neolithic. For south-eastern Europe and particularly Greece a big discussion has started (WILLIS & BENNETT, 1994; 1996; MAGRI, 1996; EDWARDS *et al.*, 1996) on whether early human impact on vegetation can be traced by means of pollen analysis. However the majority of the so far published Holocene pollen diagrams from Greece provide little evidence for extensive agriculture before ~ 6000 BP (BOTTEMA, 1974; 1979; WILLIS, 1994). In addition the impact of Neolithic man on vegetation was previously considered to be of local importance attributed to low population densities and/or primitive farming techniques (WILLIS & BENNETT, 1994).

Recent research (HATZITOULOUSIS *et al.*, in press) suggests that the big number of Neolithic settlements discovered in northern Greece leaves no doubt that there was intensive human activity (agriculture-grazing) in the area. The question that rises refers to whether the available data are inadequate to trace the human impact on vegetation, as the resolution of pollen spectra appears low (EDWARDS *et al.*, 1996), most of the sites used are not close to known settlements (JANSSEN, 1986; BOS & JANSSEN, 1996) and the sediments analyzed are not suitable for tracing the influence of early farming upon vegetation (BOTTEMA, 1979). Still pollen diagrams from Argolid (JAHNS, 1993) and Kleonai (ATHERDEN *et al.*, 1993) in Peloponnese and Rezina (WILLIS, 1997) in Epirus show vegetation patterns than can be attributed to early human influence.

Palynological investigations around the area of Dispilió lake settlement aim to investigate and reconstruct the vegetation patterns of the area at the time of the Neolithic occupation of the site trying to elucidate the relations between natural environment influence and prehistoric human impact.

* Φυσικό και ανθρωπογενές τοπίο του λιμναίου οικισμού του Δισπηλιού: τα αποτελέσματα της παλυνολογικής έρευνας.

AREA SETTING

Lake Orestiás is situated in Kastoria basin, (Northwestern Greece), at an altitude of 630 m and is surrounded by the Trikalario (1749 m), Verno (2128 m) and Askion mountains (1703 m). The basin is drained through a low hill area by Aliakmon river to the south. Lake Orestiás is a remnant of a larger lake system formed in Macedonia during the Neogene (PANAGOS *et al.*, 1989) and covers an area of about 32.4 Km^2. It's maximum depth reaches 9.1 m in the northern part of the lake while its mean depth is 4.45 m (VAFEIADIS, 1983). Various streams discharge into the eastern, northern and western part of the lake and the overflow discharges in Aliakmon River through Gioli Channel. The regional geology consists of a crystalline basement (with igneous and metamorphic rocks), topped by Mesozoic sedimentary formations (mainly limestones and dolomites) of the Pelagonian Zone (Fig. 1). These are in turn overlain by younger (Neogene to Quaternary) continental, largely lacustrine, sediments (VAFEIADIS, 1983). The area belongs to an intermediate zone between Mediterranean and European Continental climatic region. The annual precipitation is 750-1000 mm showing a double fluctuation within the year (maxima in December and May), while mean annual temperature is 12.46 ^{o}C. Mean January temperature is 2.39 ^{o}C and mean July temperature is 22.81 ^{o}C.

Lake settlement Dispilió is placed on the south margin of Lake Orestiás (Fig. 1), Kastoria basin. The settlement is being excavated since 1992 from the archaeological team of Aristotle University of Thessaloniki. This happens to be the first excavation of prehistoric lake settlement in Greece. The site was occupied continuously from the middle Neolithic, ~5500 BC, until the first stages of Early Chalcolithic, ~3500 BC. At that time the settlement was peacefully abandoned by its inhabitants, who took with them all their household commodities (HOURMOUZIADIS, 1996; 2002).

METHOD AND MATERIAL

Two cores (namely G25 and G26) were obtained from the southwestern part of the lake (Fig. 1) and sampled at a 4 cm interval for the needs of pollen analysis (Fig. 2). G25 (550 cm) consists of lake muds intercalated with layers of fine sand and *Congeria* shell fragments in its lower part and gray lake mud in its upper part. G26 (560 cm) consists of lake muds with *Congeria* shell fragments in its lower part, while its upper part consists of anthropogenic deposits. Pottery recovered from the later strongly correlates with pottery recovered during the excavation of the neolithic lake settlement, supporting a similar age for the deposits of G26.

Samples of 2 cm^3 were processed using standard preparation methods (FAEGRI & IVERSEN, 1989) and sieved using a 10 μm sieve. During microscopic analysis of

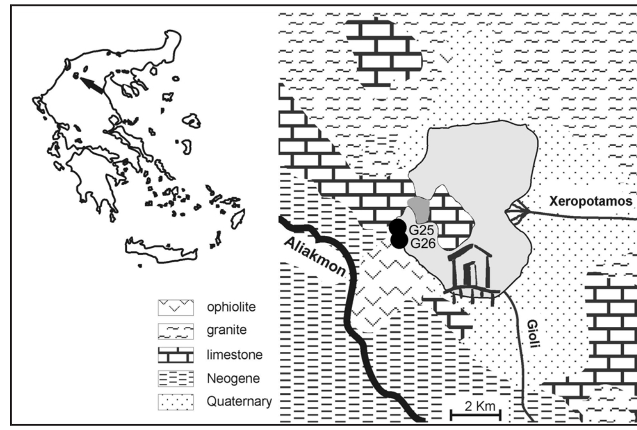

Fig.1. Location map of the area of Lake Orestiás (after VAFEIADIS 1983).

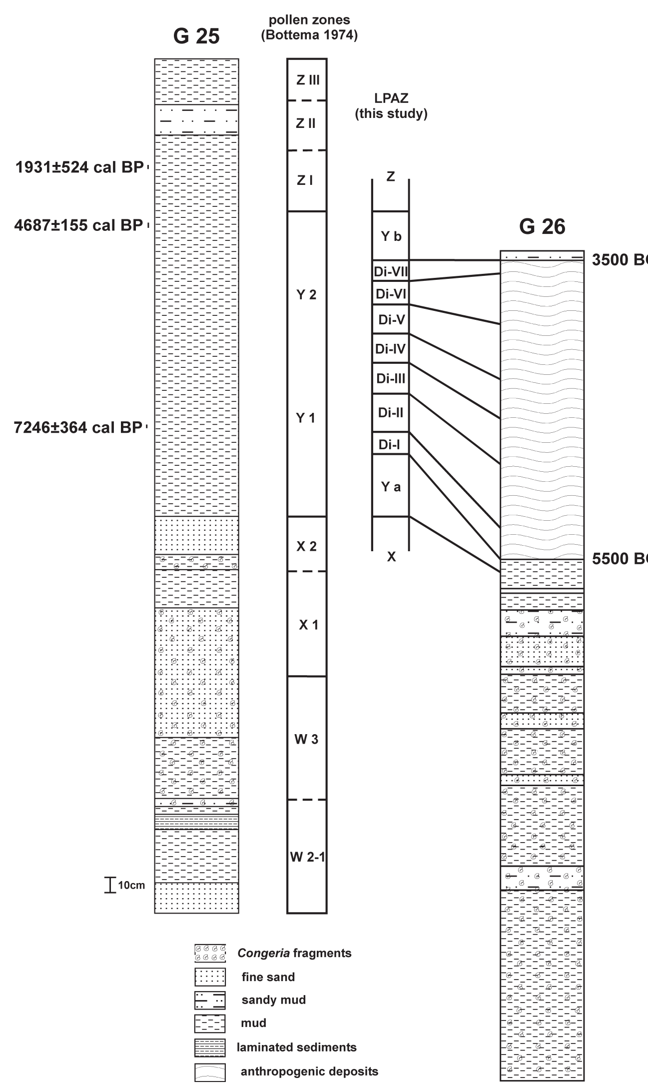

Fig. 2. Lithology and dating of cores G25 and G26. Correlation with pollen zones is after BOTTEMA (1974). A refinement of this zonal scheme has resulted to the establishment of LPAZ Ya, Di-I to Di-VII and Yb.

both cores a rich pollen flora was recovered (Figs 3, 5) revealing the vegetation history of the area since the late-glacial (KOULI *et al.*, 2001; KOULI, 2002) and allowing the correlation with established pollen assemblage zones for NW Greece (BOTTEMA, 1974). Pollen diagrams constructed represent percentages based on pollen sum of more than 300 terrestrial pollen and spores, excluding pollen and spores of aquatic plants. Zonation of the diagrams has been cross-checked with cluster analysis, using CONISS (GRIMM, 1987).

For the present study the intermediate part of core G25 (approx.110-300 cm) has been selected, as it covers the time of occupation of the lake settlement. Core G26 is used in order to establish a secure correlation between lake deposits and archaeological layers. The chronological pattern of the cores (Fig. 2) is provided by 3 AMS ^{14}C datings on core G25, correlation with pollen zones of BOTTEMA (1974) established in the Quaternary of northern Greece and second order correlation with ^{14}C dated layers of the settlement itself (FAKORELLIS & MANIATIS, 2002). The AMS ^{14}C dating on core G25 was performed on Pinus pollen grains, in GeoForschungs Zentrum of Potsdam (Table 1).

RESULTS

The pollen diagram of core G25 (Fig. 3) exhibits a sequence typical for the late glacial-Holocene vegetation development in Northern Greece (e.g. BOTTEMA, 1974; 1979; WILLIS, 1994). Pollen assemblage zone W corresponds to the late glacial and is mainly characterized by open vegetation with *Artemisia* and Chenopodiaceae. The confined presence of *Quercus*, *Pinus*, *Ulmus*, *Salix* and *Juniperus* indicates the occurrence of restriced forest in favourable areas (BENNETT *et al.*, 1991). The upper part of zone W (W3) reflects the early expansion of coniferous forest already observed in Ioannina (BOTTEMA, 1974) and Xinias (BOTTEMA, 1979; DIGERFELDT *et al.*, 2000; KOULI, 2002), just before the begining of the Holocene. Early Holocene (zone X) is characterized by the establishment of open deciduous *Quercus* forests, as a respond to the climatic amelioration at the onset of the Holocene (BOTTEMA, 1994; KOULI, 2002).

The time of human presence in the lake border fall under pollen assemblage zone Y (c.a. 8250 BP-5000 BP; BOTTEMA, 1974), a period characterized in natural environments by the maximum expansion of woodland in the vegetation history of the Balkans (WILLIS, 1994). The concurrent presence of Neolithic man in Dispilió lake settlement (c.a. 5500 BC-3500 BC, HOURMOUZIADIS, 1996) marks the natural vegetation. On the basis of arboreal/non arboreal pollen ratio (AP/NAP), as well as evaluation of indicator species (BEHRE, 1990; BOTTEMA & WOLDRING, 1990; VERMOERE *et al.*, 2002), that period was divided into 7 Local Pollen Assemblage Zones (LPAZ), namely LPAZ Di-I to Di-VII (Figs 4, 5).

TABLE 1
Radicarbon dating results form core G25.

Lab No	Sample depth (cm)	yrs BP	±	yrs Cal BP	±
Pto 2516	75	1988,75	213,36	1931	524
Pto 2573	110	4182,04	62,64	4687	155
Pto 2373	242	6422,57	189,76	7246	364

LPAZ Ya: It represents the lower part of zone Y before the establishment of the Dispilió lake settlement. Pollen spectra are characterized by high arboreal pollen percentages. *Pinus* and *Quercus* reach values around 50.6 % and 24.2 % respectively, while important is the presence of *Abies* (3.8 %), *Fagus* (3.1 %), *Carpinus/Ostrya* type (2.6 %), *Ulmus* and *Juniperus*. The entry of *Juglans* marks the upper spectra; ever since it is continuously present in pollen flora as a component of the natural mixed forest (KOULI & DERMITZAKIS, 1999). Non arboreal pollen presence is extremely low with Poaceae reaching its lowest values (4.9 %) for the whole sequence.

LPAZ Di-I: Arboreal pollen asseblages are deceasing, with *Pinus* (21.7 %) and *Abies* (0.5 %) being the first affected, followed by *Quercus* and *Fagus*. *Juglans* reaches percentages up to 1.4 %. Non arboreal pollen become more important in the spectra with Poaceae, Compositae, *Ranunculus acris* and *Cerealia* type reaching values up to 20 %, 2.5 %,1.8 % and 2 % respectively.

LPAZ Di-II: The fall in the assemblages of *Pinus* and *Quercus* observed during LPAZ Di-I keeps on during this interval, while *Alnus* abundance drop dramatically and almost disappears from the spectra. Most other tree taxa remain unaffected. Pollen percentages of Poaceae are constantly high (up to 20.6 %) and the case is similar for most of other non arboreal taxa like *Cerealia*-type, Compositae, Chenopodiaceae, *Rannunculus acris*, Brassicaceae, Apiaceae, Leguminosae and Caryophylaceae. The presence of abundant fungal remains in the spectra ia notable. More characteristic is the presence of members of the coprophilous family of Sordariaceae, type 207 and *Brachysporium* (VAN GEEL *et al*., 1989; VAN GEEL *et al.*, 1980/81; VAN GEEL *et al.*, 2003).

LPAZ Di-III: An increase of *Pinus* and *Quercus* percentages (23.6 % and 34.9 % respectively) is observed. Poaceae percentages drop to 11.9 % followed by *Ranunculus acris*, Compositae, Caryophyllaceae and most non arboreal taxa. Exceptionally *Cerealia* type and Brassicaceae assemblages increase (both reach values up to 3.3 %).

LPAZ Di-IV: This interval is characterized by the lowest arboreal pollen values during zone Y, with *Quercus* percentages dropping to 26.4 %. The only tree taxa remained unaffected were *Juglans* and *Fagus*. An increase is observed in most non arboreal taxa with more characteristic Poaceae (30.4 %), *Cerealia* type (up to 5.6 %), Compositae (5.1 %), *Ranunculus acris* (up to 3 %), Brassicaceae (up to 2.8 %) and Leguminosae (up to 1.3 %). The curves of Sordariaceae and fungal spore type 207

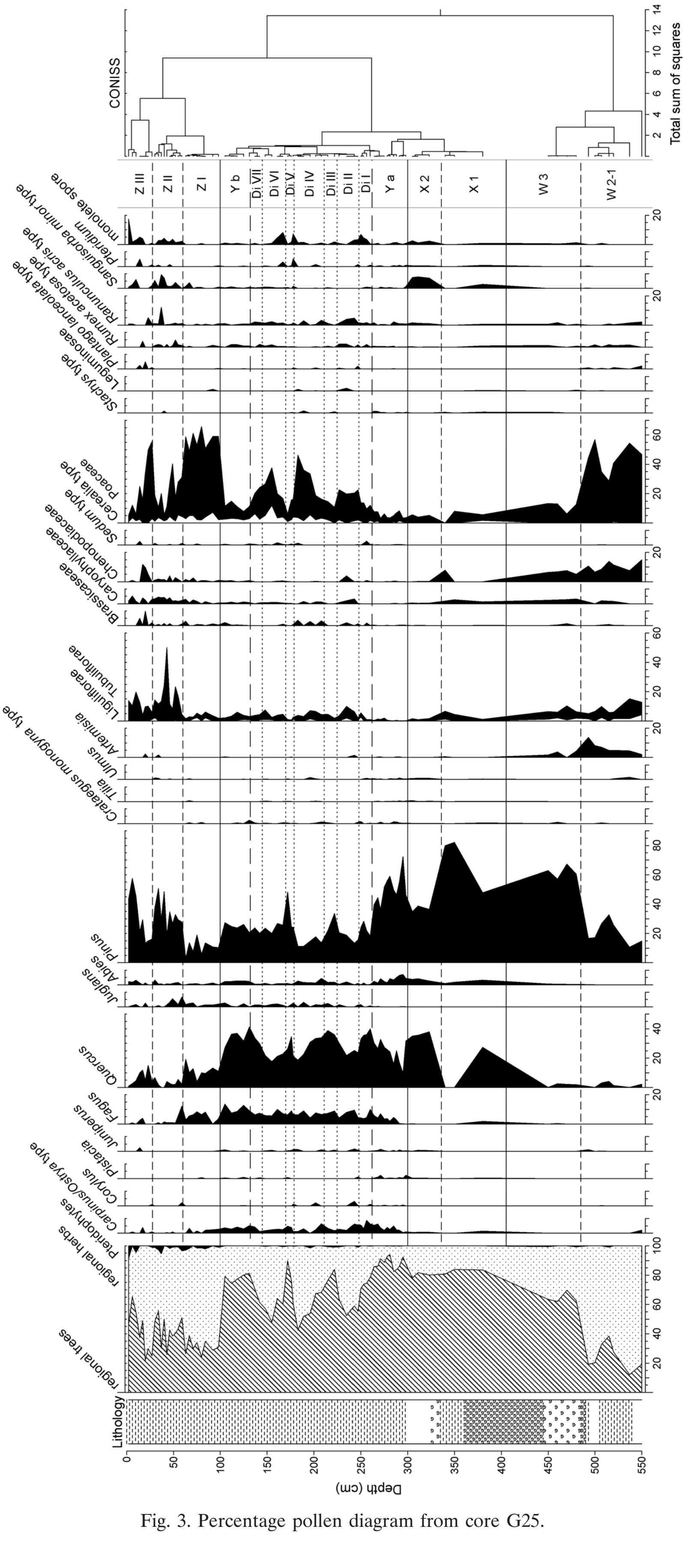

Fig. 3. Percentage pollen diagram from core G25.

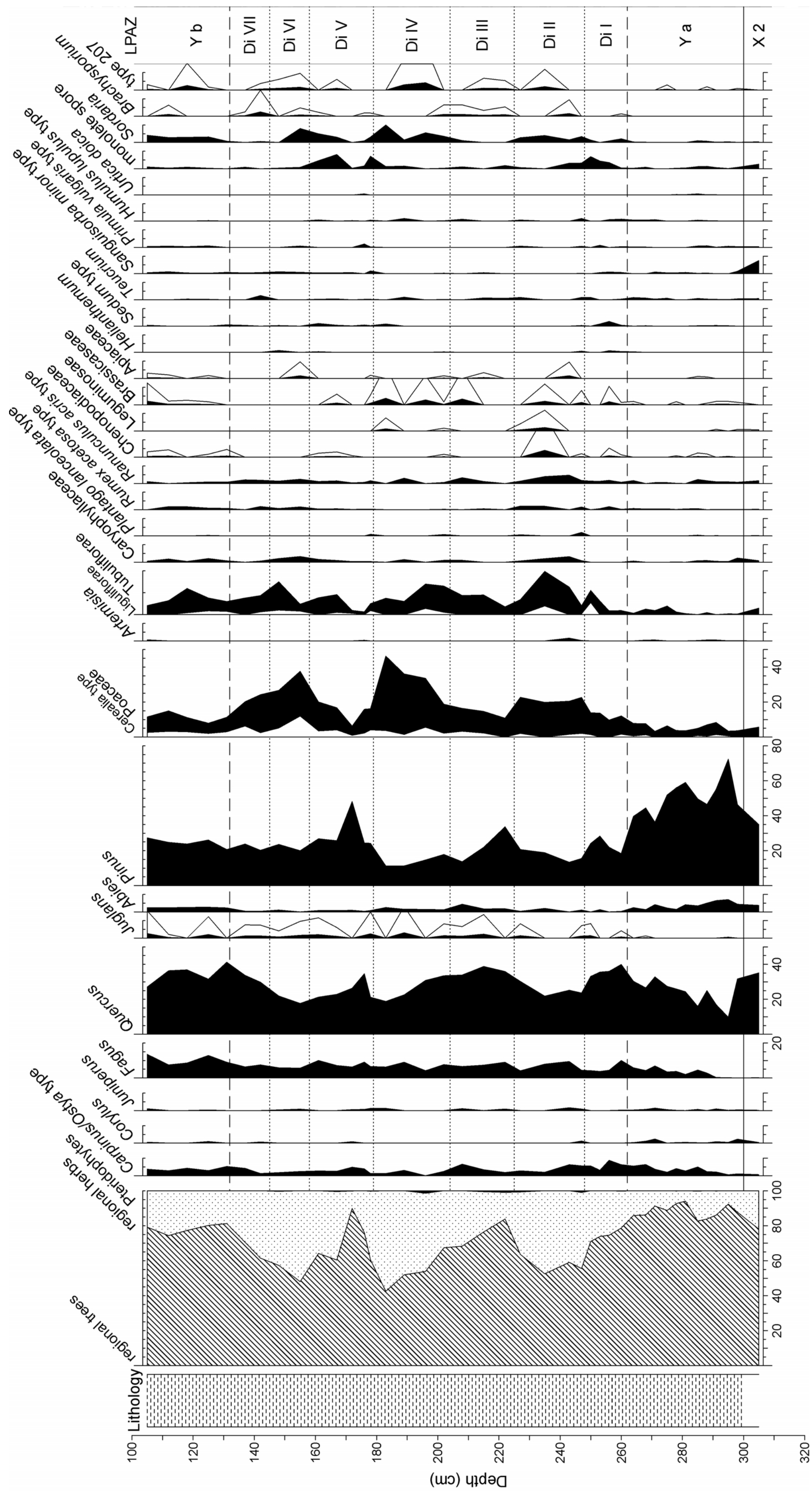

Fig. 4. Percentage pollen diagram of the intermediate part of core G25.

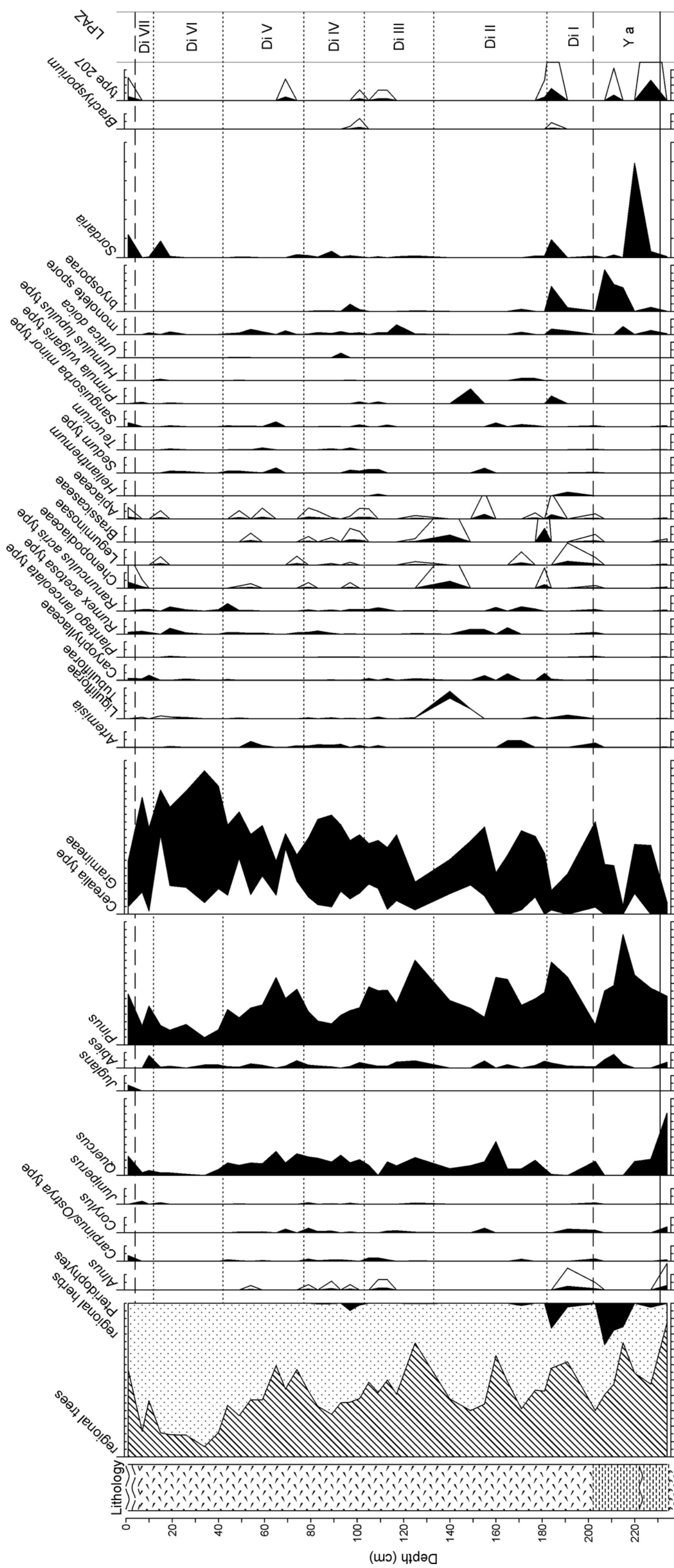

Fig. 5. Percentage pollen diagram of the upper part of core G26.

that has been connected with soil erosion (VAN GEEL *et al.*, 1989) show remarkable peak during the LPAZ Di-IV.

LPAZ Di-V: A sharp rise in *Pinus* pollen values (up to 48.1 %) and minor increases in other tree taxa percentages characterize this zone. On the other hand Poaceae values decrease considerably (10.9 %) and a smaller decrease is observed in Compositae (2.2 %), *Ranunculus acris* (up to 2.5 %), *Cerealia* type (up to 4.1 %) and Brassicaceae (up to 1 %).

LPAZ Di-VI: In this zone a decrease of almost all arboreal pollen percentages is observed. The decrease is apparent in *Quercus* that reaches its minima in zone Y (20.2 %), but is also important in *Pinus*, *Abies*, *Carpinus/Ostrya* type and *Fagus*. The most notable feature is the increase of *Juglans* percentages (1.8 %). Raised values are observed in numerous non arboreal pollen like Poaceae (21.2 %), Compositae (4.5 %), Caryophyllaceae (2.3 %), *Ranunculus acris* (1.8 %) and *Rumex acetosa* (1 %). *Cerealia* type reaches to its highest percentages (6.9 %) in the Dispilió lake settlement pollen assemblages.

LPAZ Di-VII: *Quercus* (up to 33.7 %) and *Carpinus/Ostrya* type (up to 4,2 %) pollen are increasing, while percentages of *Pinus*, *Fagus* and *Abies* remain stable. Poaceae percentages decrease to values of 17.8 %. Similar is the decrease of Compositae (4.1 %), *Ranunculus acris* (1.6 %) and *Rumex acetosa* (0.8 %), while the fall of *Cerealia* type percentages (4.4 %) marks the assemblages.

LPAZ Yb: Pollen spectra are characterized by high arboreal pollen percentages *Pinus* and *Quercus* are the dominant taxa, while *Fagus* (10.3 %) and *Juglans* (up to 2.6 %) are the major assemblage components. Poaceae percentages decrease again reaching values of 8.6 %, higher than in LPAZ Ya but still low. Compositae (6 %) and *Ranunculus acris* (0.6 %) display similar patterns.

During zone Z (spanning approximately the last 5000 years) the human impact on vegetation appears pronounce in all sites of northern Greece. Vegetation of zone Z varies from site to site depending on the history of each area and the proximity of settlements (BOTTEMA, 1974). The general vegetation motif is destruction of forest vegetation and establishment of cultural landscapes. In the profile of Lake Orestiás (Fig. 3) grazing seems to be the predominant activity, while cultivations appear to be far from coring site as concluded by the minor presence of cereals and other cultivation indicator species in the spectra.

VEGETATION HISTORY AND HUMAN IMPACT

Pollen assemblage zone Y represents the maximum expansion of woodland in the Balkans (WILLIS, 1994). Paleovegetation of Kastoria basin before the inauguration of Neolithic man in the area (LPAZ Ya, Figs 4-5) is characterized by dense forests. Coniferous forest with *Pinus* and *Abies* and smaller areas with *Fagus* forest existed at the mountains around the basin, while mixed deciduous forests dominated by *Quercus*, covered intermediate and lower altitudes. *Carpinus/Ostrya* type, *Tilia*, *Corylus*, *Crataegus monogyna* and *Ulmus* are some of the trees participating in the mixed forests. Herb vegetation, though restricted to a narrow zone around the lake, demonstrates the remarkable variability characterizing Hellenic vegetation even today (POLUNIN, 1980). Riparian vegetation is poor mainly consisted of *Alnus* trees (Fig. 6).

LPAZ Di-I bears the first signs of disturbance of natural vegetation by man. Forests are retreating while open vegetation is starting to expand (Fig. 6). *Pinus* and *Abies* trees are the first to be affected because their trunks were used for dwelling construction as revealed by the anthracological study of wood remains in the Dispilió lake settlement excavations (NTINOU, 2002). Primary signs of cultivating activities consist of the small presence of cereal pollen and the increase of weed species (Compositae, *Rumex acetoca*, *Rannunculus acris*) as well as the rise in the values of families that catalogue edible species (Brassicaseae, Leguminosae, Chenopodiaceae *Spinacia* type, Apiaceae). In addition the presence of spores of the coprophilous fungus *Sordaria* is suggestive of grazing (VAN GEEL *et al.*, 2003).

Human disturbance of the vegetation appears more intensive during LPAZ Di-II. Forest clearance results to the replacement of mixed oak forests around the lake with a characteristic cultural landscape comprising of meadows, pastures and cultivated areas (Fig. 6). Cultivated areas were located in the close vicinity of the settlement as implied by the remarkably increased values *Cerealia* type in core G26 (Fig. 5). This is in good agreement with the archeobotanic analysis that brought in the cultivation of "garden-like" fields inside the settlement (MANGAFA, 2002). Outside the settlement the meadows were mainly used for grazing, as suggested by the weed flora representatives like Liguliflorae, Ranunculaceae and *Plantago lanceolata* (BEHRE, 1981) and the presence of numerous coprophilous fungi (VAN GEEL *et al.*, 1989; VAN GEEL *et al.*, 2003). The use of *Alnus* trunks for the construction of dwellings reported by the anthracological study (NTINOU, 2002) is considered the main reason of its disappearance from the pollen diagrams. Of great importance is the detection, even in small numbers, of *Spinacia* type (Chenopodiaceae) in pollen spectra. These findings predicate the Balkan origin of this edible plant (MULDER, 1996b).

The expansion of mixed deciduous *Quercus* forest observed during LPAZ Di-III (Fig. 6) coincide with signs of intensification of cultivation activities, as pointed out by the increase of *Cerealia* type and Brassicaceae. On the other hand the retreat of grazing indicator species (e.g. *Rumex acetosa*, Chenopodiaceae) and coprophilous *Sordaria*, notify a let-up of pastoral activities. The

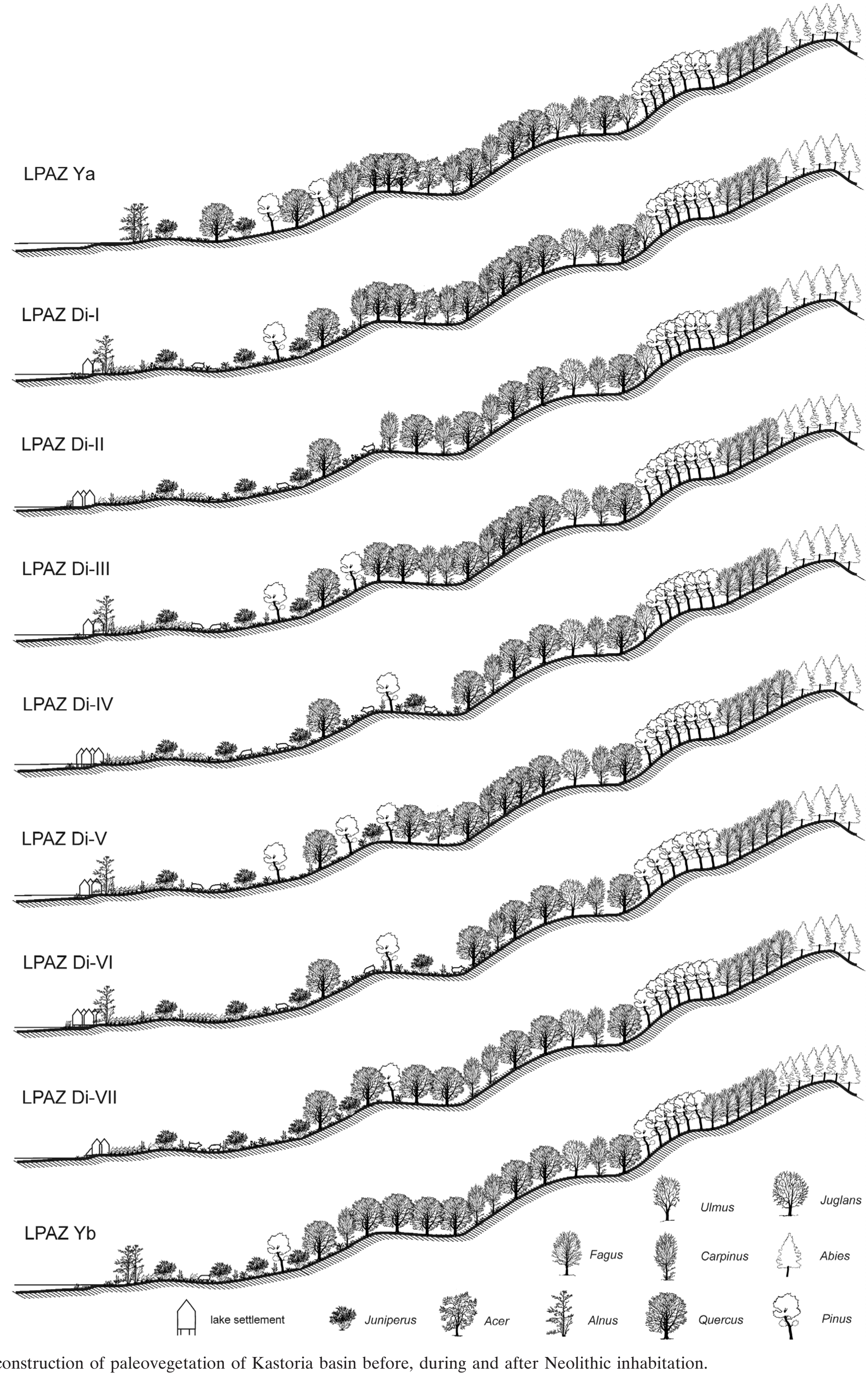

Fig. 6. Reconstruction of paleovegetation of Kastoria basin before, during and after Neolithic inhabitation.

spreading out of woodlands is attributed to environmental reasons that allowed the expansion of forests, or/and to the observed recession of grazing. The tracing of environmental causes is chancy because of the cultural filter of our record. Nevertheless an expansion of woodland has been recorded to many sites of northern Greece between 6500 and 5000 BP and has been related to a rise in summer temperatures (BOTTEMA, 1974; WILLIS, 1994).

LPAZ Di-IV stands for a period of intensive human activity in the area of the lake settlement. Deforestation, grazing and soil erosion are its main characteristics. The regression of woodland observed affects not only the mixed deciduous forest (e.g. *Quercus*, *Carpinus*), but also the coniferous forests in the uplands (Fig. 6). Anthracological analysis featured the use of conifer lumber for the construction and repair of dwelling houses and hardwood for firing (NTINOU, 2002). Cleared areas are used for cereal and legume cultivation (e.g. *Cerealia* type, Brassicaceae, Leguminosae and Apiaceae) and as pastures. The general image of the open vegetation, the indicator species and the increased presence of *Sordaria* points to intensive animal husbandry.

The gradual expansion of forest vegetation, mainly *Pinus* forests, during LPAZ Di-V, shows evidence of the recession of anthropogenic disturbance in the area (Fig. 6). The contemporaneous fall of Sordariaceae and other indicator species, is suggestive of a quasi-abandonment of stock breeding.

The maximum environmental pressure of Neolithic man on natural vegetation is observed during LPAZ Di-VI. Both coniferous and deciduous forests are retreating. All tree taxa (e.g. *Carpinus*, *Acer*, *Abies*, *Fagus*) but *Juglans* are affected by the recession of forests. Cultivation indicator species (e.g. *Cerealia* type, Apiaceae, *Rumex acetosa*) reach their maxima, signifying a period of intensive agriculture. Increase of herding is also concluded by the raised abundances of *Sordaria* spores (Fig. 6).

The upper pollen assemblage zone (LPAZ Di-VII) shows signs of gradual recovery of natural vegetation attributed to gradual abandonment of the settlement. The values of all indicator species of human activity are constantly withdrawing; giving their way to forest vegetation mainly with *Quercus* trees (Fig. 6). Interesting feature is the higher participation of the fungal spore type 359 (*Brachysporium*), a fungus that has been connected with decaying wood (VAN GEEL *et al.*, 1980/81) and is continuously present during the whole period of Neolithic inhabitation. Its increased occurrence in this particular level is attributed to quicker detriment of abandoned dwellings.

After the abandonment of the lake settlement (LPAZ Yb) vegetation patterns show similarities with the image before the Neolithic occupation of the area (Fig. 6). The mixed deciduous *Quercus* forests are advancing, while herb vegetation is restricted around the lake. The main and important difference is the low but constant presence of taxa like *Cerealia* type *Rumex*, *acetoca*, Brassicaceae and Sordariaceae that implies human activity in the vicinity of the lake.

Indicator species values are of great importance in describing the environment of each pollen assemblage zone. The correlation of known presence of prehistoric man in the area with pollen spectra was used to test existing indicator species and trace new ones for Northern Greece (BOTTEMA & WOLDRING, 1990). From primary known indicator species, *Juglans* is not of value in Lake Orestiás pollen diagram as its presence can easier be interpreted as a natural vegetation component (KOULI & DERMITZAKIS, 1999) possibly favored by Neolithic man after forest clearances, than introduced and cultivated taxon (BEUG, 1962; BOTTEMA, 1980). *Cerealia* type includes pollen types that are part of the natural vegetation from the lateglacial but its strong positive correlation to the settlement deposits provides an image of prehistoric cereal cultivation in the area. *Ranunculus acris*, Compositae (Tubuliflorae and Liguliflorae) and Brassicaseae (BEUG, 1990) are found to correlate well with human activity in the area. The positive correlation of the curves of Brassicaceae, Apiaceae and Leguminosae with human activity is noteworthy as several edible taxa appear within those families. Archaeobotanical research on archaeological strata (MANGAFA, 2002) recorded representatives of the family of Leguminosae (e.g. lentil, mange-toout, peas, broad bean), but that is not possible for Apiaceae (celery, dill, fennel) or Brassicaceae (e.g. cauliflower, cabage) that usually do not leave an archeobotanical record. Leguminocae is being considered underrepresented in pollen diagrams (WASYLIKOWA, 1986; MULDER, 1996a), nevertheless the peaks observed in the Local Pollen Assemblage Zones of lake Orestiás may be connected to cultivation by neolithic man. Similar is the case with Brassicaceae and Apiaceae. In conclusion those taxa could be used as cultivation indicator species, especially when linked to simultaneous archeological data of human presence in the area (BOTTEMA & WOLDING, 1990). Finally the curve of Sordariaceae can be used as indicator of animal husbandry VAN GEEL *et al.*, 1989; VAN GEEL *et al.*, 2003). Sordariaceae ascospores thought to be underrepresented in pollen diagrams outside archaeological sites (VAN GEEL *et al.*, 2003), so their presence indicates that herds were kept close to coring site, in the border of the lake, at the close surroundings of the settlement.

CONCLUSIONS

The disturbance of natural vegetation from the Neolithic inhabitant of Dispilió lake settlement is featured in the 7 Local Pollen Assemblage Zones (LPAZ Di-I to Di-VII) identified. First signs of human influence on vegetation appear in LPAZ Di-I. LPAZ Di-II, Di-IV and Di-VI represent three main periods of retreat of the natural vegetation, especially at intermediate altitudes, under the ecological pressure of the lake settlement. They correspond to different kind or intensity of exploitation of the natural resources. LPAZ Di-II and Di-VI show evidence of intensive cultivation activities, while during LPAZ Di-IV the main human activity appears to be animal husbandry. Those periods of major anthropic disturbance can be correlated with the three periods of major constructing activities described by the archaeological study of the Neolithic settlement (HOURMOUZIADI & YAGOULIS, 2002). Expansion of forest vegetation ob-served during LPAZ Di-III and Di-V affects mainly pastures and not cultivated land. The recovery of the natural environment appears slow, possibly as a result of the gradual abandonment of the lake settlement (HOURMOUZIADIS, 1996). The abandonment of the Neolithic site takes away the environmental stress on the natural vegetation but the perpetual presence of man - though not so intensive- in the area marks the rest of the vegetation history of Kastoria basin.

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