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ORIGINAL

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A late Holocene pollen diagram from the Megaris, Greece, giving possible evidence for cultivation of *Ceratonia siliqua* L. during the last 2000 years

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Abstract A late Holocene pollen profile from the Megaris on the eastern Gulf of Corinth shows a vegetation which was strongly influenced by human impact throughout. A *Pistacia-Phillyrea* maquis, which is reflected in the older parts of the profile, changed later to a more degraded vegetation type. In the uppermost part *Pinus* dominates the pollen spectrum. A continuous record of *Ceratonia siliqua* pollen older than cal A.D. 100 is of special interest.

Keywords *Ceratonia siliqua* · Vegetation history · Late Holocene · Greece · Human impact

Introduction

Until now, only a few palynological investigations have been carried out in the coastal area of Greece, as pollen-preserving conditions are scarce in the dry Mediterranean climate. Radiocarbon dated pollen profiles are especially rare. This paper presents a pollen-analytical study on a core from a little marsh at Psatha, eastern Gulf of Corinth (Fig. 1). Two radiocarbon dates allow a chronological classification. The conditions were not ideal for a palynological investigation, either, as the older sediments were barren of pollen. Nevertheless, the results provide interesting information about the vegetation development in the coastal area of the Megaris during the last two thousand years.

The study area

Psatha is situated in one of the easternmost bays of the Gulf of Corinth, ca. 30 km from the Isthmus of Corinth, which connects the Peloponnese peninsula with the Greek mainland (Fig. 1). The bay is surrounded by limestone rocks. 80 m from the modern beach barrier and approximately 40 m from the former shoreline a small marsh is found, which is bordered by a talus fan coming from the surrounding hills.

The climate is typically Mediterranean, and most rain falls during the winter, while in summer 1–2 months are almost without precipitation. The vegetation around Psatha is classified as part of the Oleo-Ceratonion alliance (Fig. 1), which is given as potential natural vegetation in the driest areas of southeastern Greece, also those with least frost (Horvat et al. 1974). Only a few kilometres from the coast the vegetation changes to the Quercion ilicis and the Quercion frainetto alliances, which are separated from the Oleo-Ceratonion by the absence of species that are best adapted to a hot and dry climate like

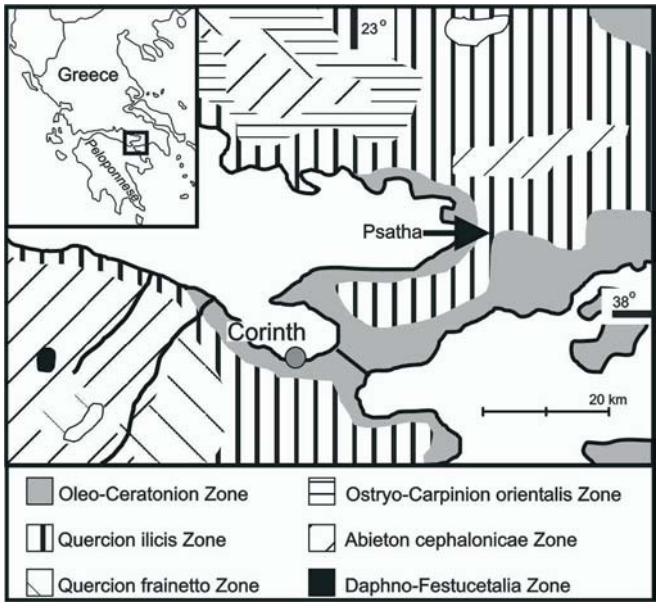

Fig. 1 Location of the study area and potential natural vegetation after Horvat et al. (1974)

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Ceratonia siliqua and *Euphorbia dendroides*. In the higher elevations of the Peloponnese and the mountains north and east of the Gulf of Corinth, deciduous woodland of the Ostryo-Carpinion alliance grows. In the highest parts of the mountain range *Abies cephalonica* woodland is found.

Today *Pinus halepensis* (Aleppo pine) grows on the rocks around Psatha Bay. On the slopes towards the marsh are terraces with an old olive grove. At the coring site the local vegetation is formed mainly by *Phragmites australis* and in the drier spots by *Juncus* species.

The area around Psatha was inhabited in prehistoric times. A tower compound from the 4th/3rd century B.C., which was described by Muller (1983), lies only 300 m away from the modern shoreline.

Material and methods

On 4./5.8.1990 a 3.6 m core was taken from the little marsh with an Eijkelkamp corer. It shows a sediment stratigraphy with alternating layers of peat, loam, clay and sand (Fig. 2). Samples of about 2 cm^3 were taken and successively treated with conc. HCl and 70% HF, acetolysed and cleaned by ultrasonic sieving (5 μm). According to the pollen concentration, pollen counts range from 240 to 500 arboreal pollen grains.

From 55–214 cm 15 samples could be investigated. From 220–360 cm the pollen was too poorly preserved for analysis. The pollen diagram (Fig. 2) shows the results as percentages of the sum of the arboreal pollen (AP).

Table 1 Conventional radiocarbon dates, calibrated after Stuiver et al. (19981998)

Depth (cm)	(uncal) B.P.	(cal) A.D. (1σ)
62–66	420±20	1442–1473
150–153	1870±55	76–234

Conventional ^{14}C dates on plant macrofossils and peat were obtained from the ^{14}C laboratory of the University of Heidelberg (Table 1)

Results and discussion

Evergreen vegetation strongly influenced by human impact dominates the whole pollen record. In the older part of the diagram (214–120 cm) a *Phillyrea-Pistacia* maquis with *Erica* and Cistaceae prevailed. Deciduous oaks, which played an important role in the coastal area of Greece during the middle Holocene (Sheehan 1979; Bottema 1990; Jahns 1992, 1993, and unpubl.; Zangger et al. 1997; Herking, unpubl.) are represented in the record from Psatha with such low values only, that stands in the vicinity of the coring site must not necessarily be assumed. If deciduous oak woodland also grew in the Megaris in the past, it had already been destroyed by human impact in the investigated period. *Pinus* displays high values. From 195 cm the *Sarcopoterium*-type shows a continuous record. This pollen type represents the spiny scrub *Sarcopoterium spinosum* and the herbaceous *Sanguisorba minor*. However, an expansion of *Sarcopoterium*

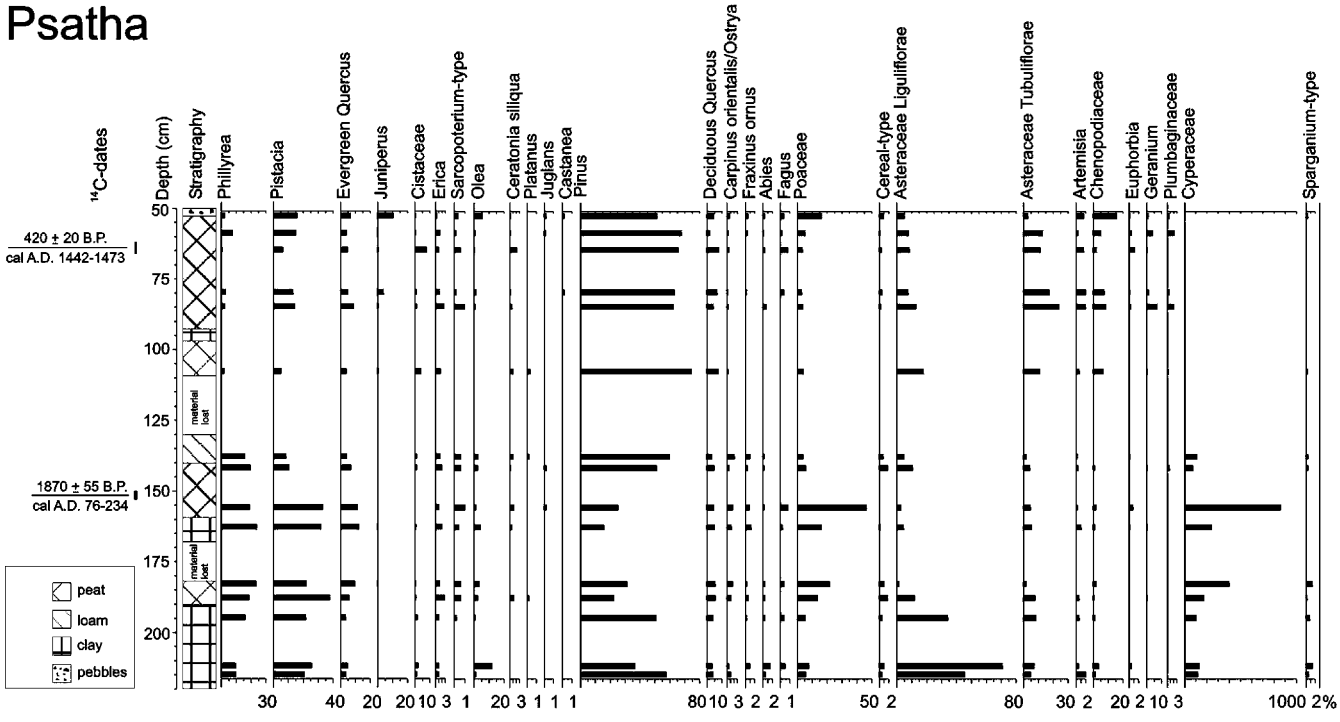

Fig. 2 Pollen diagram of Psatha, selected taxa are presented as percentage values of the sum of AP

seems more likely in the coastal area of Greece, indicating further degradation of the maquis to a Phrygana vegetation (see Horvat et al. 1974).

Pollen grains of *Abies* and *Fagus* certainly derive from the upper mountain range. The high amounts of Poaceae could be either due to the open vegetation, or to the occurrence of *Phragmites* in the marsh. The partly very high Cyperaceae values certainly have their source in wetland plant communities rich in sedges near the coring site. *Olea* is represented in the whole profile, partly with values >12%, indicating olive cultivation. Cereal-type (*Triticum*, *Hordeum* and *Avena* type, after Beug 1961) is present with values around 2%, however, one has to keep in mind that the evidence of these large Poaceae pollen grains may also include wild grasses in the eastern Mediterranean area (Behre 1990). *Juglans* and *Platanus*, trees, which were distributed in Greece by people since ca. 1230 cal B.C. (Bottema 1980a) are present.

Of special interest is the record of *Ceratonia siliqua*. Although this species is underrepresented in fossil pollen spectra (see Weinstein 1981), it is already present in the profile from Psatha at 187 cm, earlier than ca. cal A.D. 100, and appears subsequently continuously, reaching values >2%. In other pollen profiles from the coastal area of south-eastern Europe *Ceratonia siliqua* appears, if at all, as single grains only (Bottema 1980b; Jahns 1992; Zangger et al. 1997; Jahns and van den Bogaard 1998; Herking, unpubl.). So far, Psatha is the only pollen diagram which shows a continuous record of *Ceratonia siliqua*. Apparently, at that location a vegetation with *Ceratonia siliqua* was already present earlier than cal A.D. 100 as the result of human activities. The oldest pollen grains of *Ceratonia siliqua* so far have been found in Israel, in early Würm period deposits (Weinstein-Evron 1983) and in a late Palaeolithic layer (Weinstein-Evron 1994), so the tree is certainly native in the Near East. Little is known about how *Ceratonia siliqua* was favoured and used by people in prehistoric times. Most of the macrofossil finds of the carob (*C. siliqua*) have also been recovered at archaeological excavations in Israel and Egypt, from the early Neolithic onwards (for example Galili and Schick 1990; Galili et al. 1993, 1997; Hopf and Germer 1998; Cappers 1999a, 1999b). A very early use of the pods, which are very sugary (the syrup may contain >50% of sugar) should not be out of the question. The Talmud mentions them as food (Zohary 1983). Theophrastus (370–287 B.C.) described their shape. The Roman authors Columella (4 B.C.–A.D. 65) and Pliny the Elder (A.D. 23–79) wrote about their use as fodder for pigs. The dried seeds were used as the first Karat-cartage (in Greek: kerátion) by goldsmiths (Encke 1958). According to Zohary (2002) the carob has been cultivated in the Mediterranean basin only since the Roman period. Baumann (1993) assumes that it was introduced from Asia Minor to Greece in ancient times. Unfortunately, there are no macrofossil remains of *Ceratonia siliqua* from archaeological sites in Greece to specify the time of its appearance.

From 137 cm onwards the profile is dominated by pine. This may indicate an expansion of *Pinus halepensis* woods at Psatha Bay at this time, as well as the pollen precipitation of an almost treeless vegetation, where *Pinus* pollen transported over a long distance prevailed (see Jahns 1992). Surface samples, which were collected at Psatha Bay, are also mostly dominated by *Pinus* pollen. In the uppermost spectra of the profile, which date to medieval times, *Castanea* appears. The values of *Juniperus* and Cistaceae increase, indicating further degradation, most probably as a result of grazing and fire.

Conclusion

The pollen profile from Psatha shows that the vegetation in the coastal area of the Megaris was already strongly influenced by human impact ca. 2,000 years ago. In the older part of the diagram a *Pistacia-Phillyrea* maquis prevailed. Later it changed to further degraded Phrygana. Simultaneously, very high values of *Pinus* indicate either an expansion of pine woods or an almost treeless vegetation. *Ceratonia siliqua* was already present before cal. A.D. 100 and was continuously present afterwards, thus providing probable evidence for the cultivation of this tree.

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References

Baumann H (1993) Greek wild flowers and plant lore in ancient Greece. Hirmer, München

Behre KE (1990) Some reflections on anthropogenic indicators and the record of prehistoric occupation phases in pollen diagrams of the Near East. In: Bottema S, Entjes-Nieborg G, Zeist W van (eds) Man's role in the shaping of the eastern Mediterranean landscape. Balkema, Rotterdam, pp 219–230

Beug HJ (1961) Leitfaden der Pollenbestimmung für Mitteleuropa und die angrenzenden Gebiete. Lieferung 1, Fischer, Stuttgart

Bottema S (1980a) On the history of the walnut (*Juglans regia* L.) in southeastern Europe. Acta Bot Neerl 29:343–349

Bottema S (1980b) Palynological investigations on Crete. Rev Palaeobot Palynol 31:193–217

Bottema S (1990) Holocene environment of the southern Argolid: a pollen core from Kiladha Bay. In: Wilkinson TJ, Duhon ST (eds) Excavations at Franchthi Cave, Greece 6. Indiana University Press, Bloomington, Indianapolis, pp 117–138

Cappers RTJ (1999a) Chapter sixteen. The archaeobotanical remains. In: Sidebotham ST, Wendrich WZ (eds) Berenike 1997. Report of the 1997 excavations at Berenike and the survey of the Egyptian Eastern Desert, including excavations at Shenshef. Research School of Asian, African and Amerindian Studies (CNWS), Leiden, pp 299–305

Cappers RTJ (1999b) Chapter twenty. Archaeobotanical remains from Shenshef. In: Sidebotham ST, Wendrich WZ (eds) Berenike 1997. Report of the 1997 excavations at Berenike

and the survey of the Egyptian Eastern Desert, including excavations at Shenshef. Research School of Asian, African and Amerindian Studies (CNWS), Leiden, pp 419–426
Encke H (1958) (ed) Pareys Blumengärtnerei. Parey, Berlin
Galili E, Schick T (1990) Basketry and a wooden bowl from the Pottery Neolithic submerged site of Kefar Samir. J Isr Prehist Soc 23:142–151
Galili E, Weinstein-Evron M, Hershkovitz I, Gopher A, Kislev M, Lernau O, Kolska-Horwitz L, Lernau H (1993) Atlit-Yam: A prehistoric site on the sea floor off the Israeli coast. J Field Archaeol 20:133–157
Galili E, Stanley DJ, Sharvit J, Weinstein-Evron M (1997) Evidence for earliest olive-oil production in submerged settlements off the Carmel coast, Israel. J Archaeol Sci 24:1141–1150
Horvat I, Glavač V, Ellenberg H (1974) Vegetation Südosteuropas. Geobotanica Selecta 4, Stuttgart
Hopf M, Germer, R (1998) Pflanzliche Reste aus Nag' el-Scheima. In: Bietak M, Schwarz M (eds), Nag' el-Scheima. Eine befestigte christliche Siedlung und andere christliche Denkmäler in Sayala—Nubien. Österreichische Akademie der Wissenschaften, Philosphisch-Historische Klasse Denkschriften 255. Berichte des Österreichischen Nationalkomitees der Unesco-Aktion für die Rettung Nubischer Altertümer 9, Wien, pp 545–554
Jahns S (1992) Untersuchungen über die holozäne Vegetationsgeschichte von Süddalmatien und Südgriechenland, Cuvillier, Göttingen
Jahns S (1993) On the Holocene vegetation history of the Argive Plain (Peloponnese, southern Greece). Veg Hist Archaeobot 2:187–203
Jahns S, Bogaard C van den (1998) New palynological and tephrostratigraphical investigations of two salt lagoons on the island of Mljet, south Dalmatia, Croatia. Veg Hist Archaeobot 7:219–234
Muller A (1983) Megarika. Bull Corresp Hellén 107:157–179
Sheehan MC (1979) The postglacial vegetational history of the Argolid Peninsula, Greece. PhD Thesis, University of Indiana
Stuiver M, Reimer PJ, Bard E, Beck JW, Burr GS, Hughen KA, Kromer B, McCormac G, Plicht J van den, Spurk M (1998) INTCAL98 Radiocarbon Age Calibration. Radiocarbon 40:1041–1083
Weinstein M (1981) The influence of slope direction on the pollen spectra. Pollen Spores 23:381–387
Weinstein-Evron M (1983) The paleoecology of the early Würm in the Hula basin, Israel. Paléorient 9:5-19
Weinstein-Evron (1994) Biases in archaeological pollen assemblages: case studies from Israel. AASP Contrib Ser 29:193–205
Zangger E, Timpson ME, Yazvenko SB, Kuhnke F, Knauss J (1997) The Pylos regional archaeological project, part II. Landscape evolution and site preservation. Hesperia 66:549–642
Zohary M (1983) Pflanzen der Bibel. Calwer, Stuttgart
Zohary D (2002) Domestication of the Carob (*Ceratonia siliqua* L.) Isr J Plant Sci 50:141–145