

EARLY TO MIDDLE PLEISTOCENE DYNAMICS OF MEDITERRANEAN PLANT AND MAMMAL COMMUNITIES

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ABSTRACT: Magri D. & Palombo M.R., *Early to Middle Pleistocene dynamics of Mediterranean plant and mammal communities*. (IT ISSN 0394-3356, 2011)

The Mediterranean paleontological record (pollen and large mammals) shows the disappearance of several tree taxa and the development of the modern mixed oak forest from 1.3 to 0.5 Ma, while a major turnover at end of the Early Pleistocene promoted gradual changes in composition and structure of faunal complexes.

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I dati relativi alla vegetazione e alle faune del Mediterraneo indicano che, nel periodo tra circa 1.3 e 0.5 Ma, varie piante si estinsero con il deterioramento climatico dei MIS 22 e 16, mentre si svilupparono i moderni querceti misti. Il cambiamento più significativo nella composizione e struttura della fauna si attuò alla fine del Pleistocene inferiore.

Key words: pollen, mammal fauna, Early Pleistocene, Middle Pleistocene, Mediterranean Basin

Parole chiave: polline, mammalofauna, Pleistocene inferiore, Pleistocene medio, Bacino mediterraneo

It is well known that the transition Early to Middle Pleistocene (Mid-Pleistocene Revolution, MPR, 1.2-0.6 Ma) marks a fundamental change in the Earth's climate system: 41-ka cycles were progressively superseded by a 100-ka rhythm, accompanied by increased amplitude of the climatic oscillations. The cycles were characterized by an asymmetric structure (slow ice build-up, fast melting) thought to be associated with the precessional cycle. Precession had an important control on seasonality, in turn affecting the vegetation cover.

A number of review papers have recently reported the floristic and vegetational characters of the southern European peninsulas during the Early and Middle Pleistocene (e.g. TZEDAKIS *et al.*, 2006; GONZÁLEZ-SAMPÉRIZ *et al.*, 2010; BERTINI, 2010; MANZI *et al.*, 2010). Several Spanish, Italian and Greek pollen records indicate the possibility of a local persistence of taxa since at least 2 Ma BP. In spite of this long-term persistence of plant taxa, clear differences in the composition of vegetation are recorded between the Early and Middle Pleistocene, partly caused by the disappearance of tree taxa, such as *Tsuga*, *Cathaya*, *Cedrus*, *Parrotia*, and *Carya*, and partly by replacements of the dominant taxa. In particular, large portions of subtropical ecosystems disappeared from the Mediterranean area by the end of the Early Pleistocene, and were replaced by forests, dominated by deciduous *Quercus*. However the accompanying trees were rather different from region to region: mostly evergreen *Quercus* in the

Iberian peninsula (RODRÍGUEZ *et al.*, 2010), *Abies*, *Carpinus*, and *Fagus* in the Italian peninsula (MANZI *et al.*, 2010), and *Carpinus* in Greece (TZEDAKIS *et al.*, 2006). At the same time, glacial periods were characterized by increasingly open environments, dominated by Poaceae, chenopods and *Artemisia*. The vegetational change of the MPR appears as a progressive process spanning the interval 1.2-0.6 Ma, even though the extreme climate conditions of Marine Isotope Stage (MIS) 16, and most likely also of MIS 22, determined the disappearance of several taxa and the development of the modern mixed oak forest.

Vegetation changes on land were reflected in the assemblages and diversity of mammals. The responses of biota were regionally different, sometimes synchronous but often diachronous. For instance, in Europe since at least 1.3 Ma BP scattered bioevents (dispersal of large herbivores, which also persisted throughout the Middle Pleistocene and turnover phases) led to a progressive reconstruction of mammalian faunal complexes that came to an end during the early Middle Pleistocene (PALOMBO, 2009 and references therein; KAHLKE *et al.* 2010). Data from taxonomically revised lists of large mammal species from selected Spanish, French, Italian and Greek local faunal assemblages (LFAs, i.e., ranging in age ca. 1.3 to 0.5 Ma: KOSTOPOULOS & KOUFOS 2007; KOSTOPOULOS *et al.*, 2007; PALOMBO 2007, 2009 and references therein; BERGER *et al.* 2008; CARBONELL *et al.*, 2008; MADURELL-MALAPEIRA *et al.*, 2010; BERTINI *et al.*,

2009; KAHLKE *et al.*, 2010; MARTINEZ *et al.*, 2010; TORO *et al.*, 2010; PALOMBO & MILLI, in press) show that this “faunal revolution” was a quite long renewal phase.

In the Mediterranean regions the MPR period marks a major faunal reconstruction (see e.g. PALOMBO & VALLI 2005; KOSTOPOULOS *et al.* 2007; PALOMBO, 2007 and references therein). After the Early Pleistocene “pseudoextinction” phase, large herbivores began to spread across Europe with the opening of the forested landscape. Several migrations routes from Asia and Africa, turned out into the Italian and Iberian peninsulas, whereas faunal interchanges with central Europe concerned the French territories, although the time of large mammals was most likely diachronous in the different regions. The late early Pleistocene LFAs ranging in age ca. 1.3 to 0.9 Ma, include both the last representatives of Villafranchian lineages at their highest evolutionary stage and representatives, sometimes archaic, of the so-called “Galerian” taxa (e.g. *Stephanorhinus hundsheimensis*, *Praemegaceros verticornis*, *Bison shoetensacki*), as well as species recorded only in this period (e.g. *Ammotragus mediterraneus*). Such a framework of “mixed faunal elements” suggested to several authors that such faunal complex should be a ‘transitional fauna’ (BONIFAY, 1978, AZZAROLI *et al.* 1988), or a peculiar phase of the Villafranchian European Land Mammal Age (ELMA) (“end-Villafranchian event”, AZZAROLI 1995; latest Villafranchian’, KOUFOS 2001, or ‘Final Villafranchian’ SPASSOV 2003) or even a distinct biochron (e.g. Protogalerian, CALOI & PALOMBO 1995; Epivillafranchian, *cfr.* KAHLKE, 2007). The LFAs dated 1.3 to 0.9 Ma show a peculiar composition that make them different from typical late Villafranchian and Galerian LFAs. However, the progressive and diachronous changing of faunal composition and structure, as well the scattered presence of the so-called Epivillafranchian taxa in the Mediterranean LFAs, make it difficult to clearly define any firmly characterised biochron. At the end of the Early Pleistocene, a number of large mammals appeared, which lasted during the early Middle Pleistocene, or even later, while few late Villafranchian taxa survived in Italy in the middle (e.g. *Pachicrocuta brevirostris*, *Panthera gombazsoegensis*), or even late Galerian (e.g. *Equus altidens*, *Equus suessenbornensis*).

All in all, scattered dispersal bioevents and a few extinctions characterized the time span from about 1.3 to 0.9 Ma, while a major turnover occurred at end of the Early Pleistocene likely triggered by the change in climate system from 41 ka to about 100 ka cycles. Intrinsic biotic control (changes in inter-intra-specific competition) and resilience of pre-existing taxa promoted gradual changes in

composition and structure of faunal complexes.

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