

# BIOCHRONOLOGY OF LARGE MAMMALS IN THE EARLY AND MIDDLE PLEISTOCENE OF THE ITALIAN PENINSULA

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**ABSTRACT** - During the Plio-Pleistocene, sharp important changes in the large mammal assemblages of the Italian Peninsula are not clearly recognizable. Sometimes, a progressive and gradual renewal can be observed, either due to local evolution of pre-existing forms or by recurrent immigrations from Asia or Central Europe. The renewal phases are probably related to climatic fluctuations. An acceleration of this phenomenon may be noticed in concurrence to the major climatic crises. Under these conditions, and taking into account that the response of single taxa to climatic and environmental variations is neither uniform nor contemporary, it is very difficult, if not impossible, to fix a limit between two faunal units. In the case of the "Villafranchian"/"Galcrian" faunal transition in Italy, there are at least three possible hypotheses: a) the transition can be considered to have happened more or less at the lower Pleistocene/Middle Pleistocene boundary; b) institution of the new Mammal Age, the Protogalerian, which covers the Early Pleistocene before the Great Glacial. It is characterized by the progressive appearance of "Galcrian" taxa and by persistence of the arvicolids of the *Microtus (Allophaiomys)* subgenus; c) the transition between Villafranchian and Galcrian faunas can be established conventionally e.g. at the first appearance in Italy of *Megaceroides verticornis*.

*Key words:* Biochronology, Mammalia, Early and Middle Pleistocene, Italy.

## INTRODUCTION

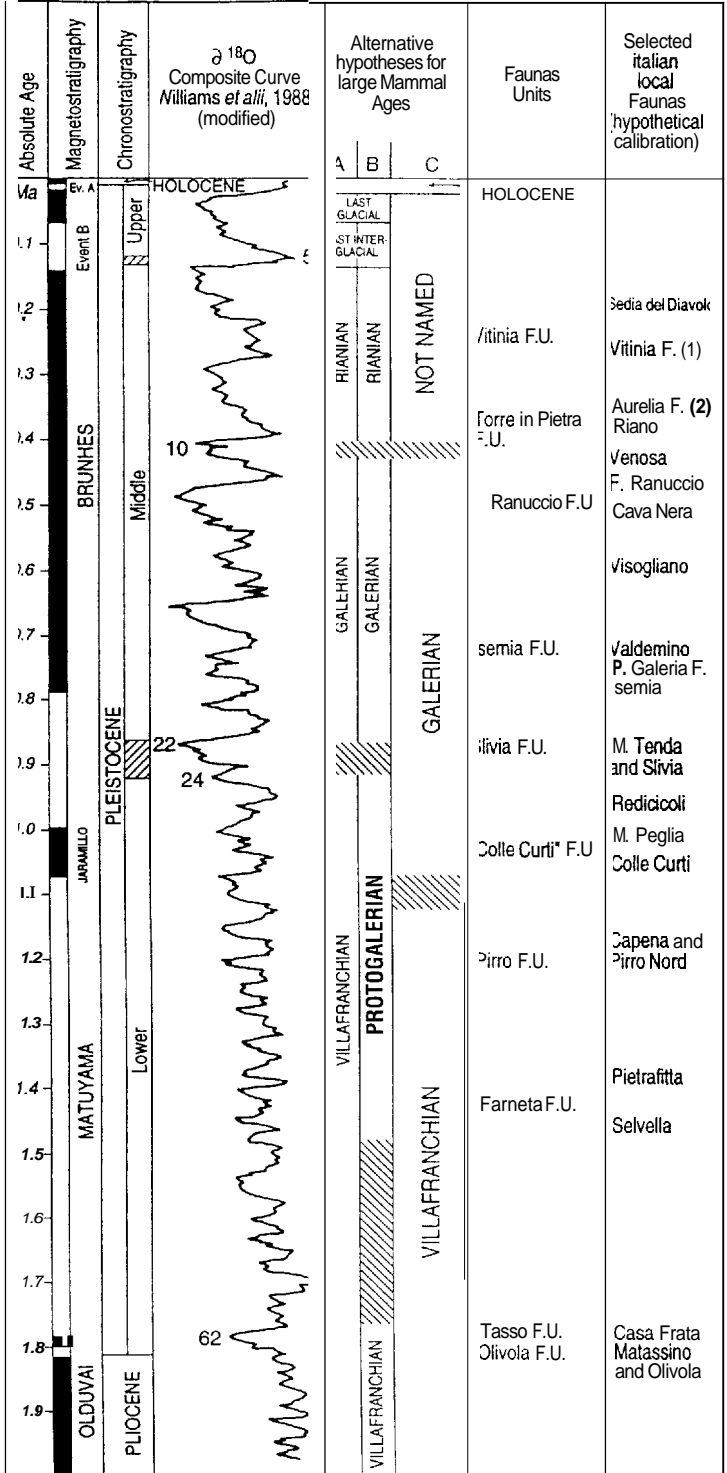
The biochronology of the mammalofaunas of the Early and Middle Pleistocene is based on recognition of bioevents which determine a progressive renewal of the assemblages either by evolution of pre-existent taxa or by the appearance of immigrants. The subdivision in Mammal Ages and Faunal Units is made on the grounds of turnover phases, which should include a lot of bioevents. However, the increase in data and the discovery of new faunas tend to emphasize how in Italy, in the course of the Pleistocene, the pronounced faunal turnovers which involved a great number of taxa were not frequent. This increase in data also demonstrates that single bioevents are more or less separated

and that renewal tended to be progressive. The settings of precise limits of the biochrons is still impossible. At best, faunal complexes can be characterized only on the basis of their global composition and evolutive degree and within a certain timespan. In fact it is impossible to define the precise moment of the transition between them. Ten Faunal Units can be identified in the large mammal faunas of the Early and Middle Italian Pleistocene: Olivola, Tasso, Farneta, Pirro and Colle Curti for the Early Pleistocene; Slivia, Isernia and Fontana Ranuccio for the middle Early Pleistocene, Torre in Pietra and Vitinia for the middle Late Pleistocene (Table 1) (cf. Caloi and Palombo, 1995 with bibliography; in press; Caloi *et al.* in press).

Table 1 - Tentative correlation chart of stratigraphic, paleomagnetic and isotopic data with subdivision for the Italian peninsula mammalian faunas of the Early and Middle Pleistocene.

(1) sites of Vitinia F. and correlatable ones: Vitinia (beds e), Torre in Pietra (upper beds), Sedia del Diavolo, Monte delle Gioie, via Flaminia etc. ( Caloi et al. in press)

(2) sites of Aurelia F. and correlatable ones: Torre in Pietra (lower beds), Malagrotta, La Polledrara, Castel di Guido, Riano etc. ( Caloi et al. in press)



## DISCUSSION

With the associations of the Olivola F.U. (Table 1) (bottom of the Pleistocene, paleomagnetic calibration of the Matassino fauna with a short reversal at the top of Olduvai subchron. Torre et al., 1993 and personal communication), a considerable faunistic renewal took place both for the number of new forms and extinctions (Table 2), in correspondence with the transition between Middle and Late Villafranchian. However, the modality and time of realization of this renewal are unknown, because there are no calibrations for the assemblage of Costa S. Giacomo (Biddittu et al., 1979) (1), which biochronologically preceded it, whose elements from the Middle Villafranchian are present, as well as taxa which characterize the Late Villafranchian. A truly rapid renewal, characterised by a still more intense faunistic change, took place with the transition to local fauna of Casa Frata (Tasso F.U.) (Table 1) (Borselli et al., 1980), calibrated paleomagnetically with the top of Olduvai subchron (Torre et al., 1993), and thus more recent than the local fauna of Matassino by a few thousand years. Considering the two units, the main extinctions (at least 13, 4 for Olivola and 9 for Tasso) and new appearances (at least 16, 7 and 9 respectively) relative to the bioevents, which lead to the constitution of the associations of the Olivola and Tasso F.U., determine a considerable change in the world of large mammals, which more or less coincides with peaks in arid, relatively cold climate, probably relatable to the end of the Tiglian and the early phases of the Eburonian (Bertini, 1990; Zagwin, 1992). The faunistic variations which characterise the Tasso F.U. could be connected up with the spread of steppes with *Artemisia* in Southern Italy (Combourieu-Nebout and Vergnaud Grazzini, 1991, stages 62 - 50). The passage to the following F.U. (Farneta F.U.) (Table 1) is characterized not only by a large number of extinctions but also by the

appearance of new immigrants, among which an early nucleus of "Galerian" forms. Some of the pre-existent taxa are represented by more advanced forms (Table 2). Due to the lack of absolute chronological data or paleomagnetical calibrations, modalities and times cannot be defined exactly. Considering the composition of the single assemblages of the Farneta F.U., it is, however, possible to observe how the local fauna of Selvella (Azzaroli and Mazza, 1992; De Giuli, 1987; Masini et al., 1994) appears to be less renewed than that of Pietrafitta (Ambrosetti et al., 1987; Ambrosetti et al., in preparation; Rustioni and Mazza, 1991), in which an arcaic megacerine of the group of *Megaceroides verticornis*, *M. obscurus* (2), is present and among micromammals, *Microtus chalinei*, *Mimomys pusillus* and arvicolids related to *M. (Allophaiomys) ruffoi* are reported. Within the Farneta F.U. an example of renewal could thus be found, with bioevents being not wholly synchronous. The end of this F.U. is characterized by a large number of extinctions.

A long period follows, in which changes in the faunal associations, though not very numerically significant, lead to an increase in "Galerian" forms. The change that characterizes the local faunas of Pirro (whose exact chronostratigraphical position is unknown) (De Giuli and Torre, 1984; De Giuli et al., 1987; De Giuli et al., 1990; Masini and Santini, 1991; Masini and Torre, 1990) and of Colle Curti (Table 1), calibrated with the bottom of the Jaramillo event (Albianelli et al., 1993) (Borselli et al., 1988; Ficarelli and Mazza, 1990; Ficarelli et al., 1990; Ficarelli and Silvestrini, 1991; Masini et al., 1994), is of lesser entity: four new forms occur and the extinctions prevail (Table 2). This could be related to a different type of environmental stimulus. In this period, as a matter of fact, the fluctuations of the glacial delta  $^{18}\text{O}$  have lower values than the preceding ones and are characterized by short and uniform glacial/inter-

glacial cycles (about 50,000 years) (stages 63-25; Williams et al., 1988). Furthermore, according to Vergnaud Grazzini et al. (1990), in stage 28 there is already a tendency to increase the glacial delta  $^{18}\text{O}$  value and thus a colder climatic fluctuation than the preceding ones appeared around the time of the Jaramillo event. As we have seen, it is in this lapse of time that the nucleus of the so-called "Galcrion Fauna" begins to take shape. Therefore, it could be hypothesized that the progressive settling to relatively arid and cooler climatic conditions, which happened during all the lower Pleistocene, favoured the southward spread of the forms suited to open spaces. These forms reached our peninsula at different times.

The considerable faunal renewal that can be recognized in the Slivia F. U. (Table 1) may well coincide with the climatic crisis of the Great Glacial Age (stages 24/22), which was accompanied by a variation in the type of cycles. They became more irregular in duration and intensity (Williams et al., 1988). In the local faunas of Slivia and Monte Tenda (Ambrosetti et al., 1979; Masini et al., 1994); Di Stefano and Petronio, 1992), more or less correlatable to each other, the appearance of a consistent number of forms can be noticed (12 new occurrences) (Table 2), which are generally characterized, in the case of large herbivores, by the large size and advanced characters. In the case of the large mammals, this renewal is accompanied by a low number of extinctions. Among the micromammals, the replacement of *Allophaiomys* by *Microtus* and the appearance of *Allocretus bursae* are also significant. The renewal of the faunas may have been completed during a 200,000-250,000 year span, as indicated by the associations of the Isernia F. U. (dated at over 736,000 years, Coltorti et al., 1982), which is characterized by a thriving contingent of new forms (11 new occurrences), but by few extinctions between Slivia and Isernia F. U.,

while the forms of the Late Villafranchian are at this stage much reduced. All the same, also in this case, data for an exact chronostratigraphical insertion of the associations are lacking. The entity of the timespan between the Colle Curti and Slivia F. U. is unknown (Table 1), because the correlation of the Slivia F. U. at the beginning of the Great Glacial Age is based only on the type of assemblage; besides, the dating of the archeological level of Isernia is yet to be confirmed, since *Arvicola cantiana*, found here, appears later in the rest of Europe (cf. Kolfshoten, 1992). The consistent faunal renewal at the beginning of the mid-Pleistocene, documented by the Slivia and Isernia F. U., could therefore have been realized over a relatively long period of time.

With the local fauna of Fontana Ranuccio (Table 1), dated at 458,000 years (Riddittu et al., 1979), the extinctions lead to the disappearance of the Villafranchian survivors (some following survivals are questionable) (Table 2); the appearances are limited in number but they contribute to the establishment of a more modern fauna. In this period, in which the glacial values accentuate (500,000 - 400,000 years, Thunell et al., 1990), there is a rarification or disappearance of the surviving tertiary flora. Some forms persist on for a little time afterwards as relicts on the Italian peninsula (Follieri et al., 1986; Follieri et al., 1988).

Another faunal renewal characterized the Torre in Pietra and Vitinia F. U. (Table 1). Considering these F. U. together, at least 9 new taxa appear (between species and more advanced subspecies), while 7 forms disappeared in the transition between Fontana Ranuccio and Torre in Pietra F. U. There were only two extinctions in the passage to Torre in Pietra and Vitinia F. U. In the associations of these units, several elements which belong to recent or current Italian fauna are present. The renewal comes about in a period of time (stages 9 and 7) in which, in the Mediterranean environment,

the climatical curve moves towards higher temperatures (Vergnaud Grazzini et al., 1990) and some Senegalese molluscs appear in the Mediterranean, as well as "warm" ostracoda and foraminifera (Gliozzi, 1990). The climatic conditions become milder, with phenomena of deglaciation and climatic conditions which reach their acme in sub-stage 5e.

## CONCLUSIONS

During the Pleistocene, the main renewal phases of mammalofaunas seem to coincide with time periods in which important climatical variations appear. The response of single taxa to the environmental variations is neither contemporaneous nor uniform. However, when new climatic models set in, we can observe a tendency towards an early turnover, followed by a second phase, perhaps due to the stabilization of the new climatic model, of a near completion of the faunal renewal. The faunal variations which correspond to the Olivola and Tasso, Slivia and Isernia, Torre in Pietra and Vitinia F. U. could be an example of this. Relatively stationary periods where appearances and disappearances become rarer are likely to follow.

In the cases in which the appearances of the taxa are diachronical, setting a boundary for the biochrones becomes difficult. For example, in the case of the end of the Villafanchian faunas and the beginning of the Galerian ones, we can see how the appearance of certain taxa, which in time directly or through their descendents make up the nucleus of the so-called "Galerian faunas", appear in the Italian faunas at an early date (e.g. *Equus altidens* and *Equus ex gr. E. bressanus*/*E. siissenbornensis* are already present in the Farneta F. U.). The difficulty in setting the boundary between the Villafanchian and Galerian faunas is further accentuated by the fact that the appearances of the single taxa do not seem to be contemporaneous in each Euro-Asian district.

Limiting the problem to Italy, at least three hypotheses could be proposed (Table 1):

1) the beginning of the Galerian at the same time as the climatical crisis of the Great Glacial Age and therefore with the beginning of the Middle Pleistocene, when the Italian mammalofaunas saw a consistent renewal, as found in the Slivia F. U.;

2) the institution of a new faunal complex, the Protogalerian (Caloi and Palombo, 1995, in press), covering the interval of the lower Pleistocene, preceding the Great Glacial Age, in which changes in the faunistical associations are not numerically significant, but in which a progressive appearance of various "Galerian elements" (F. U. of Farneta, Pirro and Colle Curti) occurs. The lower limit could coincide with the first occurrence of "galerian" equids in the Selvella local fauna, whereas the upper limit may possibly coincide with the disappearance of *M. (Allophaiomys)* and the turnover of the Slivia F. U.

3) the choice of a conventional marker for the beginning of the Galerian, such as *Megacerooides verticornis*, which appears in Italy at Colle Curti, in a fauna which is calibrated with the Jaramillo subchron.

Last of all, the number of extinctions and appearances associated in different ways in the single turnovers must be pointed out. Considering in the whole Olivola and Tasso F. U., new arrivals (16) and extinctions (12) are more or less equivalent in number (with a slight prevalence in the appearances), in the Torre in Pietra and Vitinia F. U. There is a prevalence of appearances (9) to extinctions (only two), but a considerable phase of extinction (6) characterized the Fontana Ranuccio F. U./Torre in Pietra F. U. passage. The greatest phase of extinction occurs in the last Glacial Age, during which there was a progressive disappearance of the hippopotami, elephantids, rhinocerotids, large carnivores, large artiodactyls of the plains, not to mention some boreal forms which in the coldest acmes had extended their territory to our peninsula.





## ADDENDA

After the presentation of this paper at the First ATIT Congress, the Italian vertebrates paleontologists of the AIQUA Working Group, during the XIX INQUA Congress in Berlin, August 1995, proposed setting the beginning of Galerian in coincidence with the appearance of *M. verticornis* and instituted the Aurelian for the Italian associations of the late Middle and Late Pleistocene (Gliozzi et alii, 1997).

According to Abbazzi (Abbazzi L. 1995. *Megaceroides obscurus* from the Val di Chiana (Cava Liberatori, Tuscany, Central Italy. Farneta F.U., Early Pleistocene). Remarks on the early evolution and systematic of *Megaceroides*. Boll.Soc. It., 34. 2). *Megaceroides obscurus* is the only large cervid present in the Italian faunal assemblage of Farneta F.U.

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