

## Just a few: rodents and lagomorphs in the Plio-Pleistocene fossil record of the Upper Valdarno Basin

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### ABSTRACT

The Plio-Pleistocene vertebrate fossil record of the Upper Valdarno Basin (Tuscany, Italy) is well known because of the large mammal collections. Although the small mammals have a documentation that is not even comparable with that of the large mammals; their record from Upper Valdarno Basin is known since early 1800's papers and includes a number of type specimen of species named by early researchers. We present here an overview of the rodents and lagomorphs distribution within the stratigraphic framework of the Upper Valdarno Basin.

**KEY WORDS:** *Upper Valdarno Basin, Villányian, Biharian, Toringian, Pleistocene.*

### INTRODUCTION

The Upper Valdarno Basin record is celebrated for the well-known large mammal collections (CIOPPI & DOMINICI, 2010; DOMINICI & CIOPPI, 2012; ROOK *et alii*, 2013). On the other side, the small mammals have a record that is not even comparable to that of the large mammals: they are just a few. The small mammal record from Upper Valdarno Basin is limited, but it is known since early 1800's papers. CUVIER (1824) first recognized the presence of the fossil porcupine *Hystrix* in Upper Valdarno Basin, later on FALCONER (1865, 1868), FORSYTH MAJOR (1875, 1876, 1884, 1899, 1902) and BOSCO (1898, 1899a,b) reported the occurrence of other rodents and lagomorphs.

A number of new species have been established on Upper Valdarno Basin rodents and lagomorphs by these early palaeontologists. Some are still valid:

1) the name *Castor plicidens*, for the Upper Valdarno Basin beaver, was used by FORSYTH MAJOR (1875, 1876) without a formal description. The species remained a "nomen nudum" until BOSCO (1899a,b) analytically described the Upper Valdarno Basin beaver and formally named the species *Castor plicidens*. In a recent revision (BARISONE *et alii*, 2006) the Upper Valdarno Basin beaver is taxonomically retained at the rank of subspecies (*Castor fiber plicidens*).

2) the vole *Mimomys pliocaenicus*: a fragment of left mandibular branch with M<sub>1</sub> and incisor and a left M<sub>2</sub>, probably belonging to the same individual, from Castel-

franco di Sopra has been described as *Arvicola pliocaenicus* by FORSYTH MAJOR (1889) as collected from "Castel-franco di Sopra". Although the exact site of provenance is unknown, the locality is known by palaeontologists and "fossil-hunters" since 19<sup>th</sup> century (ROOK, 2012). *Arvicola pliocaenicus* was recombined by the same author (FORSYTH MAJOR, 1902) under the name *Mimomys pliocaenicus*, being the type species of genus *Mimomys*.

3) The specific name of the rabbit *Oryctolagus valdarnensis* was defined by WEITHOFER (1889) who ascribed to "*Lepus valdarnensis*" the leporids from Upper Valdarno Basin previously attributed to *Lepus* sp. by FORSYTH MAJOR (1875, 1876, 1884). The Upper Valdarno Basin leporid remains have been then split into different species, and have a very long history of taxonomic controversies. According to a recent revision (ANGELONE & ROOK, 2012) *Oryctolagus valdarnensis* is a valid species characterised by a very large morpho-dimensional variability and until now characteristic of the Late Villányan-Early Biharian (Early Pleistocene) of the Italian peninsula.

As a matter of fact, almost 200 years of palaeontological researches in the Upper Valdarno Basin have been elapsed, but the small mammal record has not increased too much, comprising just a few isolated findings (SALA & MASINI unpublished, in MASINI & TORRE, 1987; GHINASSI *et alii*, 2005; MAZZA *et alii*, 2006).

We provide here a short review of the Upper Valdarno Basin rodents and lagomorphs. In doing so, we will follow SALA & MASINI (2007) and ROOK & MARTÍNEZ-NAVARRO (2010) for biochronological references, whereas for the stratigraphic and chronologic setting of the Upper Valdarno Basin we refer to BONINI *et alii* (2013), BROGI *et alii* (2013), FIDOLINI & ANDRETTA (2013), FIDOLINI *et alii* (2013), GHINASSI *et alii* (2013).

### GEOLOGICAL SETTING

The Upper Valdarno Basin, located about 35 km South of Florence (fig. 1), is a NW-SE oriented tectonic depression bounded by the Chianti Mounts to the West and the Pratomagno Ridge to the East (MARTINI & SAGRI, 1993; MARTINI *et alii*, 2001; FIDOLINI *et alii*, 2013). The basin shows an outstanding paleontological record including terrestrial vertebrates (ROOK *et alii*, 2013, and reference therein), palinology (BERTINI, 2013, and reference therein), and non-marine molluscs (ESU & GHINASSI, 2013).

The basin is filled with 550 m thick lacustrine and alluvial deposits (see FIDOLINI & ANDRETTA, 2013; FIDOLINI *et alii*, 2013; GHINASSI *et alii*, 2013, for a more

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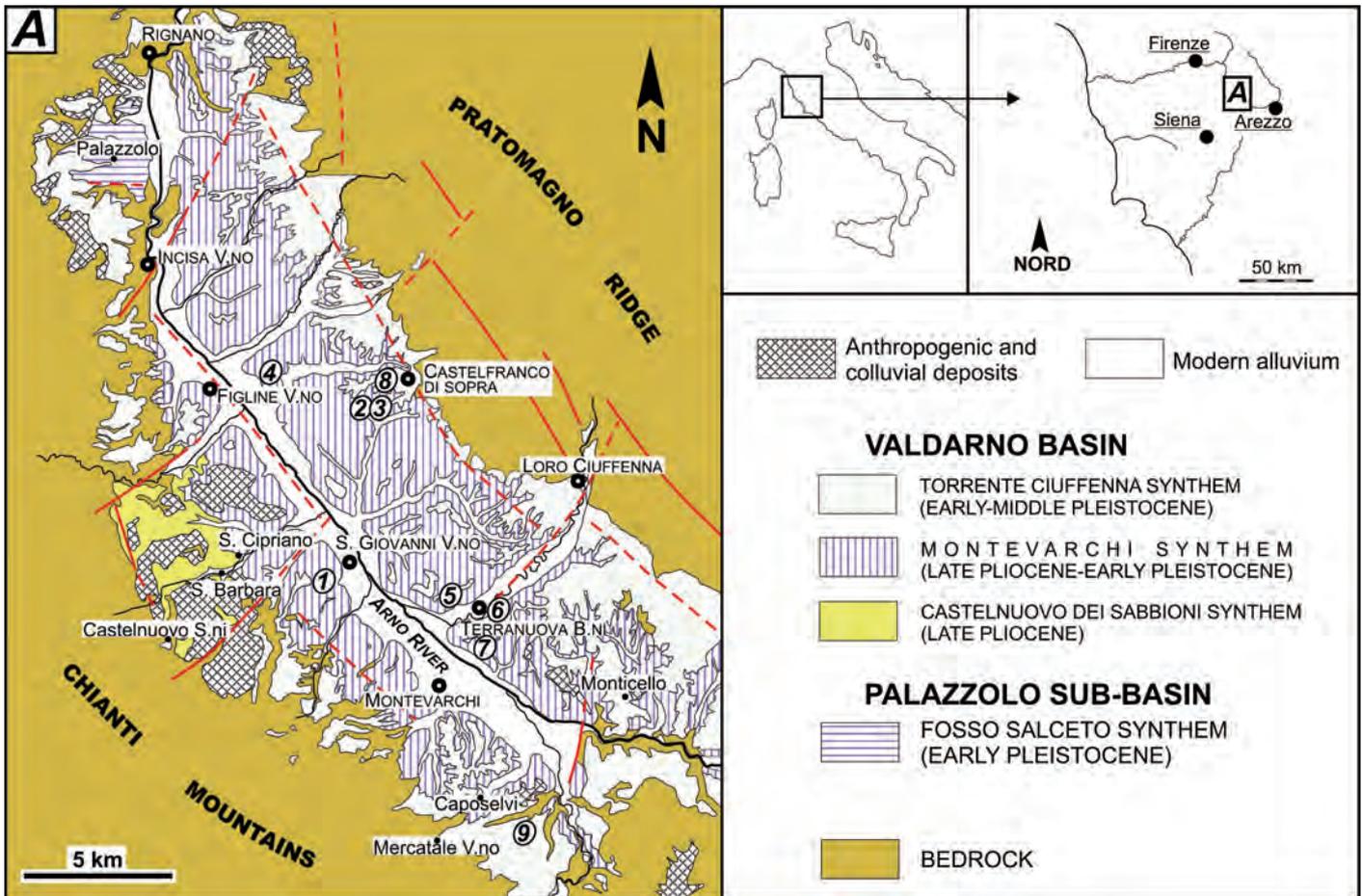


Fig. 1 - Location and geological sketch map of the Upper Valdarno Basin. Geographic location of the main fossiliferous sites with small mammals is shown: 1) Montecarlo; 2-3) Castelfranco di Sopra, and Le Mignai; 4) Poggiorosso, and SoLaVa brick factory; 5) Case Inferno; 6) Terranova Bracciolini; 7) Le Strette al Tasso; 8) Poggitazzi; 9) Campitello quarry.

detailed reconstruction), which have been temporally constrained by detailed palaeomagnetic analysis closely integrated with mammal chronology (NAPOLEONE *et alii*, 2003; ROOK *et alii*, 2013) and radiometric dating (GHINASSI *et alii*, 2004).

The Upper Valdarno Basin fill succession is made of three synthems, which are, in stratigraphic order: Castelnuovo dei Sabbioni, Montevarchi, and Torrente Ciuffenna synthems (fig. 1). In the Palazzolo area, northwestern sector, a fourth synthem is recognised, Fosso Salceto Synthem, which is limited to this sector of the basin and is coeval with the Montevarchi Synthem (fig. 1). The Castelnuovo dei Sabbioni Synthem (Late Pliocene) consists of fluvio-deltaic gravel and sand, grading upward into lignitiferous lacustrine clay, in turn overlain by fluvio-deltaic sand (FIDOLINI *et alii*, 2013). Deposition of the Castelnuovo dei Sabbioni Synthem began during the Mammoth subchron (at about 3.3 Ma) and continued through the latest Gauss extending to the Late Pliocene. The Montevarchi Synthem (Late Pliocene-Early Pleistocene) consists of two portions separated by a minor unconformity passing basinward into a depositional surface (GHINASSI & MAGI, 2004). The lower portion (Late Pliocene-Early Pleistocene) is made of alluvial-fan gravels grading upward into eolian-reworked alluvial sands. The upper portion (Early Pleistocene) is made of axial fluvial sand

and mud interfingering with gravely alluvial-fans sourced from the margins (FIDOLINI *et alii*, 2013). The Montevarchi Synthem started to accumulate shortly before the Gauss-Matuyama boundary (2.58 Ma) and finished few meters above the Olduvai subchron (1.78 Ma). The Torrente Ciuffenna Synthem (Middle Pleistocene) includes fluvial gravel and sand in the central portion of the basin and alluvial-fan gravels and sand developed at the margins (FIDOLINI *et alii*, 2013). The magnetostratigraphic record in the Torrente Ciuffenna Synthem is fragmentary, mainly because of the prevalence of coarse-grained sediments, anyway the Matuyama-Brunhes boundary has been documented in the lower part of the synthem, indicating an age of the synthem spanning from the late Early Pleistocene to the Middle Pleistocene (fig. 2).

#### UPPER VALDARNO SMALL MAMMALS

##### *Castelnuovo dei Sabbioni Synthem*

No small mammal remains have been found associated to the early Villafranchian large mammal assemblages known from the Castelnuovo dei Sabbioni synthem (Gaville, Santa Barbara, etc.) (fig. 2; cfr. fig. 26 in ROOK *et alii*, 2013).

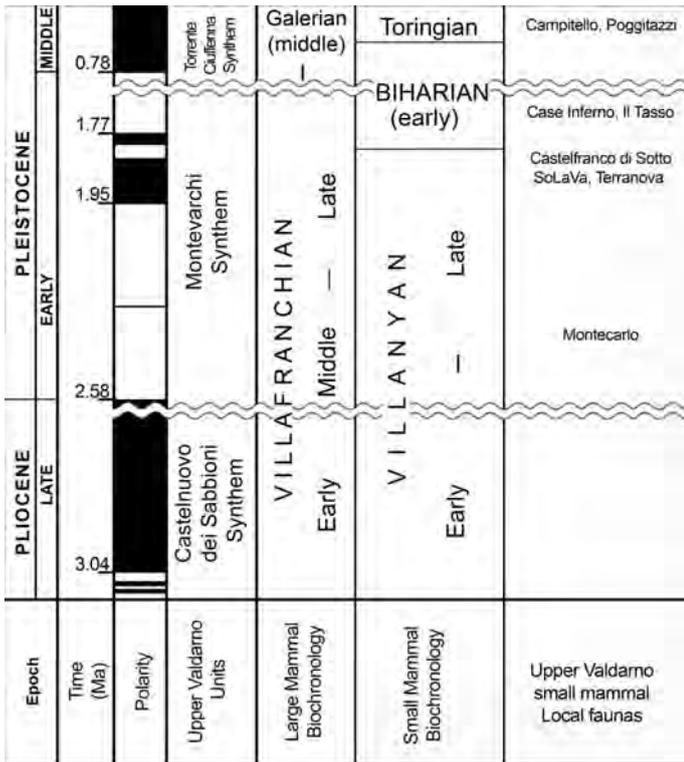


Fig. 2 - Upper Valdarno Basin stratigraphic units (from FIDOLINI *et alii*, 2013; NAPOLEONE *et alii*, 2003), combined with Large Mammal Biochronology, Small Mammal Biochronology and stratigraphic position of Upper Valdarno Basin local faunas mentioned in the text.

The early Villafranchian Large Mammal Age, corresponds to the Early Villányian (Late Pliocene) in small mammal chronology. In Italy the most representative Early Villányian assemblage is from Cascina Arondelli (Asti, Piedmont), a site that has yielded a rich fauna (KOTSAKIS *et alii*, 2003). Albeit the Upper Valdarno Basin has no record of this small mammal biochron, other sites in Tuscany have a better documentation: *i*) Arcille (in southern Tuscany, Grosseto district; HÜRZELER & ENGESSER, 1976) contained a small fauna that includes *Mimomys hassiacus* (MASINI & TORRE, 1987); *ii*) the locality of San Giusto (in Lower Valdarno, Firenze district) yielded the type specimen of *Mimomys stehlini* (KORMOS, 1931). These assemblages are coeval with the large mammal assemblages of the Triversa Faunal Unit (F.U.; cfr. fig. 26 in ROOK *et alii*, 2013) and are correlated to the Gauss Chron both in the Triversa area near Villafranca d'Asti (Piedmont) and within the Castelnuovo dei Sabbioni Synthem in the Upper Valdarno (NAPOLEONE *et alii*, 2003).

#### Montevarchi Synthem

The lower portion of the second sedimentary phase of Upper Valdarno Basin infilling (the Montevarchi Synthem) recently yielded a few vole remains allowing to identify the Late Villányian (base of the Early Pleistocene) *Mimomys polonicus* zone, in sediments characterised by reversed magnetization referred to the pre-Reunion interval of the Matuyama Chron (GHINASSI *et alii*, 2004, 2005). These findings are important because the Middle Villafranchian within the Upper Valdarno Basin tends to be

really elusive (MASINI *et alii*, 1994). Before the discovery of the voles from Montecarlo (GHINASSI *et alii*, 2005), the occurrence of this biochronologic unit was inferred only because of the "biochronological" affinities of a few isolated remains with unknown provenance from old collections (MASINI *et alii*, 1994).

The upper part of the Montevarchi Synthem yielded the majority of the small mammals remains from the Upper Valdarno Basin, representing two different biochrons in the small mammal biochronologic scheme, the latest Villányian and the early Biharian, whose transition corresponds – within the Late Villafranchian large mammal Faunal Units – to the transition between Olivola and Tasso F.U. (fig. 2; see also fig. 26 in ROOK *et alii*, 2013).

Castelfranco di Sopra site is the type locality of *Mimomys pliocaenicus* (FORSYTH MAJOR, 1889, 1902; TORRE, 1985), the vole who defines the homonymous zone of the latest Villányian (MASINI & TORRE, 1987). Several local faunas bearing large mammals, grouped in the Olivola Faunal Unit, are indirectly referred to the *M. pliocaenicus* zone (TORRE *et alii*, 2001). The sediments outcropping in these localities are directly correlated with the post-Reunion Matuyama and the early part of Olduvai Subchron (NAPOLEONE *et alii*, 2003).

In addition to the *Mimomys pliocaenicus* type locality, further latest Villányian sites yielded other rodents and lagomorphs: the porcupine *Hystrix refossa* from Terranova (AZZAROLI, 1998); the beaver *Castor fiber* spp. from Poggiorosso and SoLaVa brick factory near Matassino (BARISONE *et alii*, 2006); the pika *Prolagus* aff. *sorbinii* from SoLaVa brick factory (ROOK & MASINI, 1990; ANGELONE & ROOK, 2012); the rabbit *Oryctolagus valdarnensis* from Le Mignaie (FORTELEONI, 1971; ANGELONE & ROOK, 2012).

Among sites celebrated for the large mammals belonging to the Tasso Faunal Unit, a few localities also yielded rodents and lagomorphs. Case Inferno (in literature also referred to as "Inferno", or "L'Inferno"), one of the most celebrated sites of the Tasso F.U., yielded remains of a vole described as *Mimomys intermedius* by KORMOS (1931) and later on revised as *Mimomys savini* by TORRE (1985). In addition to Case Inferno, an isolated M<sub>1</sub> of *Mimomys savini* comes from "Le Strette presso il Tasso" (TORRE, 1985). The sediments cropping out at Case Inferno and Le Strette yielded faunal assemblages representing the Tasso F.U., and the occurrence of *Mimomys savini* suggests that these sites can be correlated with the early Biharian (MASINI & TORRE, 1987).

*Hystrix refossa* is documented by two exquisitely preserved skulls (kept at the Museum of the Accademia Valdarnese del Poggio, Montevarchi) and by a number of fragmentary mandibles or isolated teeth (AZZAROLI, 1998; ROOK & KOTSAKIS, 1994; VAN WEERS, 1994). BARISONE *et alii* (2005) recognised the occurrence of *Castor fiber plioidens* from San Giovanni Valdarno (correlated by the authors to Tasso F.U. sites). ROOK & MASINI (1990) reported the occurrence of a fragmentary mandible of the ochotonid *Prolagus* at Case Inferno (the specimen originally mentioned by TOBIEN, 1935). The latter has been revised by ANGELONE & ROOK (2012) favouring an attribution to *Prolagus* aff. *sorbinii*. The same authors also revised the record of the rabbit *Oryctolagus valdarnensis* from Tasso F.U. sites in the collections of the Florence Museum and the Basel Naturhistorisches Museum.

The sediments cropping out in this complex of localities have been magnetostratigraphically correlated to the upper part of Olduvai and the very base of the following reverse interval of the Matuyama Chron (NAPOLEONE *et alii*, 2003).

#### *Torrente Ciuffenna Synthem*

The Middle Pleistocene Torrente Ciuffenna Synthem yielded a few rodents documenting the Early Toringian.

At Poggitazzi, a site in the area East of Figline Valdarno, where a scanty number of Galerian elements are known from old collections (AZZAROLI, 1984; MASINI *et alii*, 1994), *Arvicola cantianus* is recorded (TORRE, 1985), as well as an incisor of the porcupine *Hystrix refossa* (AZZAROLI, 1998).

Moreover, a relatively abundant small mammal sample has been recently recovered (MAZZA *et alii*, 2006) at Campitello quarry, in the Bucine area. The Campitello quarry small mammal assemblage includes *Clethrionomys* cf. *glareolus*, *Arvicola cantianus*, *Microtus (Terricola)* gr. *multiplex-subterraneus*, *Microtus arvalis*, and *Apodemus sylvaticus*.

Several characters of the Campitello faunal assemblage point towards an Early Toringian, late Middle Pleistocene age. *Arvicola cantianus*, showing a poorly differentiated tooth enamel, indicates a late, but not final, Middle Pleistocene; the occurrences of *Microtus arvalis* and of *Microtus (Terricola)* gr. *multiplex-subterraneus* are characteristics of Middle Pleistocene. Furthermore, a few teeth of an advanced form of *Arvicola cantianus* have then been recovered for higher stratigraphic position still in the Campitello succession, magnetostratigraphically correlated to the Brunhes Chron (MAZZA *et alii*, 2006; NAPOLEONE *et alii*, 2003).

### DISCUSSION

Six families within Rodentia and Lagomorpha are known from the Upper Valdarno Basin record. Here follows a discussion of their current taxonomical status.

#### *Hystriidae*

VAN WEERS (1994) provided a revision of the European Plio-Pleistocene record of *Hystrix refossa* and clarified the taxonomic and nomenclatural status of this species. The species has been described from the fossil record under different names (including *Hystrix etrusca*). The Plio-Pleistocene species *Hystrix refossa* is characterised by a strongly built postcranial skeleton and hypsodont cheek teeth (VAN WEERS, 1994; ROOK & SARDELLA, 2005). The species is documented in Upper Valdarno as occurring from in the upper part of the Montevarchi Synthem, both in the Late Villányian (Olivola F.U.) and in latest Villányian (Tasso F.U.). A single incisor attests to its occurrence also in the late Middle Pleistocene of the Torrente Ciuffenna Synthem (AZZAROLI, 1998). The latter single specimens, on the basis of its dimensions, allows to exclude the occurrence in Upper Valdarno of a second Middle Pleistocene species known in the fossil record of Europe: *Hystrix (Acanthion) brachyura* (a junior synonym of *Hystrix vinogradovi*; VAN WEERS, 2005; SALARI & SARDELLA, 2009).

#### *Castoridae*

The name *Castor plicidens* was published by FORSYTH MAJOR (1875) for an Upper Valdarno Basin beaver remain from San Giovanni Valdarno, without a formal description of the new species. A first preliminary description of *C. plicidens* was made by BOSCO (1899a,b) who noticed that the most important characters distinguishing *C. plicidens* from other forms of living and fossil beavers are the pronounced secondary enamel folds on the premolar and molar occlusal surfaces. The species has been then debated in the literature; among others VIRET (1954) considered *C. plicidens* to be a valid species whereas LEHMANN (1957) believed the fossil record of the Middle and Late Villafranchian beavers better representing a subspecific differentiation of the extant species, thus *C. fiber plicidens*. BARISONE *et alii* (2006), studied the beaver from Pietrafitta (Late Villafranchian; Umbria, central Italy) and concluded that a specific distinction between Pietrafitta and *Castor fiber* (both fossil and living) populations is not statistically significant. However, the latter authors suggest a subspecific separation between Late Villafranchian beavers from Pietrafitta and *C. fiber* and conclude that the name *C. fiber plicidens* can be used for Pietrafitta and other Italian samples, including the San Giovanni Valdarno specimen.

A lower molar of a large rodent collected near Terranova Bracciolini was misidentified by BOSCO (1899a) and described as the beaver *Trogontherium cuvieri*. The specimen (an isolated lower molar) actually belongs to the porcupine *Hystrix refossa* (ROOK & KOTSAKIS, 1994). To date no fossil evidence support the occurrence of the large beaver *Trogontherium* south of the Alps.

#### *Arvicolidae*

The Upper Valdarno Basin records a succession of three Early Pleistocene arvicolid species within the Montevarchi Synthem: at Montecarlo the occurrence of the Late Villányian *Mimomys polonicus* (GHINASSI *et alii*, 2005) is recorded; the presence of the latest Villányian *Mimomys pliocaenicus* (TORRE, 1985) is only attested by the type specimen from Castelfranco di Sopra; the Early Biharian *Mimomys savini* (TORRE, 1985) is present in two sites belonging to the Tasso F.U.

The Torrente Ciuffenna Synthem documents the occurrence of *Arvicola cantianus* at two sites, Poggitazzi (TORRE, 1985) and at Campitello (MAZZA *et alii*, 2006). The latter site yielded a sample documenting the occurrence of other voles such as *Clethrionomys* cf. *glareolus*, *Microtus (Terricola)* gr. *multiplex-subterraneus*, and *Microtus arvalis*.

#### *Muridae*

The only murid documented within the Upper Valdarno Basin fossil record is *Apodemus sylvaticus*. *Apodemus* is one of the elements characterising the small mammal assemblage found at Campitello, a late Middle Pleistocene site within the Torrente Ciuffenna Synthem (MAZZA *et alii*, 2006).

#### *Ochotonidae*

FALCONER (1868) first reported the occurrence of *Lagomys* (= *Prolagus*) among the vertebrates of Upper Val-

darno Basin. The presence of this taxon was then confirmed by FORSYTH MAJOR (FORSYTH MAJOR in STOPPANI, 1872; data also reported in a synopsis, FORSYTH MAJOR, 1884; ROOK & ALBA, 2012). Neither FALCONER nor FORSYTH MAJOR figure the specimens, nor mention repository and inventory numbers thus we do not know if such specimens were lost or if their taxonomic assignment was reconsidered. Indeed in later lists *Lagomys* is substituted by *Lepus* (FORSYTH MAJOR, 1875, 1876, 1884). BOSCO (1899a,b) reports and describes two lower right molariforms of *Lagomys* from Upper Valdarno Basin acquired by the Florence Museum in 1887. TOBIEN (1935) reports a *Prolagus* mandible from Upper Valdarno Basin kept within the Basel Naturhistorisches Museum collections, identified by ROOK & MASINI (1990) with specimen NMBVA2246 from Case Inferno. The latter Authors also described a *Prolagus* fragmentary mandible from the SoLaVa brick factory, near Figline Valdarno. ANGELONE & ROOK (2012) provided a review of the Upper Valdarno Basin ocothonid record. They assigned *Prolagus* from Upper Valdarno Basin to *Prolagus* aff. *sorbinii* (a new species left for the moment in open nomenclature due to nomenclatorial problems still to be solved) distributed in the Late Pliocene-late Early Pleistocene of Tuscany, with possible extension to the Pliocene of NW Italy and central Western Europe (ANGELONE & ROOK, 2012).

### Leporidae

The first reports of leporids from Upper Valdarno Basin (attributed to *Lepus* sp.; FORSYTH MAJOR, 1875, 1876, 1884) were followed by their ascription to a new species, *L. valdarnensis* (WEITHOFER, 1889), and were eventually split in two species (*L. valdarnensis* and *L. etruscus*, plus postcranial remains referred to *Lepus* sp.; BOSCO, 1899a,b). FORSYTH MAJOR (1899) attributed all the Upper Valdarno Basin leporid remains to the genus *Caprolagus* whereas, fifty years later, VIRET (1954) recognized them as pertaining to *Oryctolagus*, putting them in synonymy with the Western European species *O. lacosti*. Such decision was followed in the literature from then on.

ANGELONE & ROOK (2012) revising the Upper Valdarno Basin lagomorph record followed VIRET's (1954) attribution of the Upper Valdarno Basin leporids to the genus *Oryctolagus*, and considered *O. valdarnensis* a valid species, up to now known only in the Early Pleistocene (Late Villányan-Early Biharian) record of the Italian peninsula.

### CONCLUSIONS

The small mammals record from Upper Valdarno Basin, although exceedingly limited when compared to the large mammals one (cfr. ROOK *et alii*, 2013), includes a number of type specimens on which have been erected species whose names are still valid, and that are reference species in our understanding of continental stratigraphy and biochronology.

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