

“QUI GATTA CI COVA”¹
A SHORT NATURAL HISTORY OF *FELIS SILVESTRIS* SCHREBER, 1777, IN ITALY

“QUI GATTA CI COVA”¹
BREVE STORIA NATURALE DI *FELIS SILVESTRIS* SCHREBER, 1777, IN ITALIA

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Abstract. A most highly successful carnivore, the wildcat, *Felis silvestris* Schreber, 1777, is today dispersed from the south-central Palearctic Biogeographic Region to the Afro-tropical and Oriental Regions, where several subspecies are recognised. Paleontological evidence suggests that this felid maintains almost unchanged its biological model starting from, at least, the Upper Pliocene and/or the Lower Pleistocene. The Italian territory is among the few in Europe inhabited by two different wildcats: the European wildcat, *Felis silvestris silvestris* Schreber, 1777, dispersed in continental Italy and Sicily, and the African wildcat, *Felis silvestris libyca* Forster, 1780, which occurs in Sardinia (and Corsica) where it has been introduced by man, very likely in protohistoric times. Recent observations indicate a widening of the range of the species within the national boundaries. Though the felid was known for a long time in the western ecumene, it seems that in Italy the domestic cat may not have become fully widespread until the establishment of the Islamic culture. Since ancient times, the repeated inbreeding of domestic cats with wild individuals has eventually altered the genetic and phenotypic characteristics of the Italian population of the species.

Riassunto. Uno dei carnivori di maggiore successo, il gatto selvatico, *Felis silvestris* Schreber, 1777, è oggi disperso dalla Regione Biogeografica Paleartica centro-meridionale alle Regioni afro-tropicali e orientali, dove sono riconosciute diverse sottospecie. Evidenze paleontologiche suggeriscono che questo felide mantenga pressoché inalterato il suo modello biologico a partire, almeno, dal Pliocene superiore e/o dal Pleistocene inferiore. Il territorio italiano è tra i pochi in Europa abitato da due diversi gatti selvatici: il gatto selvatico europeo, *Felis silvestris silvestris* Schreber, 1777, disperso nell'Italia continentale e in Sicilia, e il gatto selvatico africano, *Felis silvestris libyca* Forster, 1780, presente in Sardegna (e Corsica) dove è stato introdotto dall'uomo, molto probabilmente in epoca protostorica. Recenti osservazioni indicano un ampliamento dell'areale della specie all'interno dei confini nazionali. Nonostante il felino fosse conosciuto da molto tempo nell'ecumene occidentale, sembra che in Italia il gatto domestico possa non essere diventato pienamente diffuso fino all'affermarsi della cultura islamica. Fin dall'antichità, i ripetuti incroci tra gatti domestici e individui selvatici hanno alla fine alterato le caratteristiche genetiche e fenotipiche della popolazione italiana della specie.

INTRODUCTION

THE WILDCAT, *Felis silvestris* Schreber, 1777, can be regarded as one of the most biologically successful carnivore (CLUTTON-BROCK 1981), when success is measured in terms of geographical and ecological size of the range (cf. RAGNI *et al.* 1993; MASSETI 2012). According to DRISCOLL *et al.* (2007) and OTTONI *et al.* (2017), the species would be divided into at least 5 groups. Genetic and morphometric investigations have confirmed that these groups belong to the same polymorphic species, differentiating only at a sub-specific level (RAGNI & POSSENTI 1991; HEMMER 1999; YAMAGUCHI

et al. 2004; RANDI 2010, and references therein; cf. MATTUCCI 2014; OTTONI *et al.* 2017). These are dispersed from the south-central Palearctic Region to the Afro-tropical and Oriental Regions, occurring in a broad spectrum of habitats, from deciduous woodland to savannah and steppe and sub-desert zones, as well as coniferous forest (cf. KUMERLOEVE 1967; HUS 1974; HARRISON 1968; GASPERETTI *et al.* 1985; HARRISON & BATES 1991). Wild populations interbreed intensively with domestic individuals throughout their vast range (MASSETI 2000, and references therein; YAMAGUCHI *et al.* 2004), and today the domestic cat is, together with the dog, the most widespread carnivore in the world.

¹ This is an Italian proverb that translates literally the sentence “*here (female) cat hatches there*”, with the meaning of “*I don't know, there's something there!*”.



Fig. 1 - If a metric comparison could not be made, the extreme morphological affinity between the mandible of a lion and that of a cat highlights the difficulty in distinguishing the two species (photo by Saulo Bambi; courtesy Zoological Museum "La Specola" of the University of Florence)

The wildcat represents a biological model common to most species of the Felidae family, regardless of their size and destined to last over a very long chronological period. This would make it not so easy to distinguish the skeletal morphology of a cat from that of a lion, *Panthera leo* L., 1758, if a metric comparison could not be made (Fig. 1). Actually, the species of the genus *Panthera*

Oken, 1816, differ from the smaller felids (genus *Felis* L., 1758, *Priolainurus* Severtzov, 1858, etc.) for some morphological characters, such as the partial ossification of the hyoid apparatus and the substitution of the ceratoid with an elastic bundle, that allow them to roar, but to purr only in exhalation (GRZIMEK *et al.* 1972). When eating, the smaller species stand upright on their legs, while the others lie on the ground and do not hold the food tight with the forelimbs (GRZIMEK *et al.* 1972). The most diffused biological model- characterised by long tail, short ears and a slender body - in the Felidae family repeats itself, varying from the wildcat to the tiger, *Panthera tigris* (L., 1758), and passing through the Pallas' cat, *Otocolobus manul* (Pallas, 1776), the fishing cat, *Prionailurus viverrinus* (Bennett, 1833), the margay, *Leopardus wiedii* (Schinz, 1821), the ocelot, *Leopardus pardalis* (L., 1758), and many others. Somewhat different from this biological model is instead that of the caracal, *Caracal caracal* (Schreber, 1776), the serval, *Leptailurus serval* (Schreber, 1776), or the lynxes (genus *Lynx* Kerr, 1792), characterised by long ears and shorter tails.

EARLY WILDCATS OF THE EUROPEAN SUBCONTINENT

The appearance of wildcats in the fossiliferous horizons of the Western Palearctic is very ancient, perhaps dating back to the final part of the Upper Pliocene or the beginning of the Pleistocene (KURTÉN 1968), almost two million years ago. The remains of the oldest wildcat, *Felis lunensis* Martelli, 1906, from the Villafranchian (Upper Pliocene) fossiliferous horizons of the site of Olivola in Val di Magra (north-western Tuscany) (MARTELLI 1906; STEHLIN 1933), show a great morphological affinity with the extant European wildcat, *Felis silvestris*

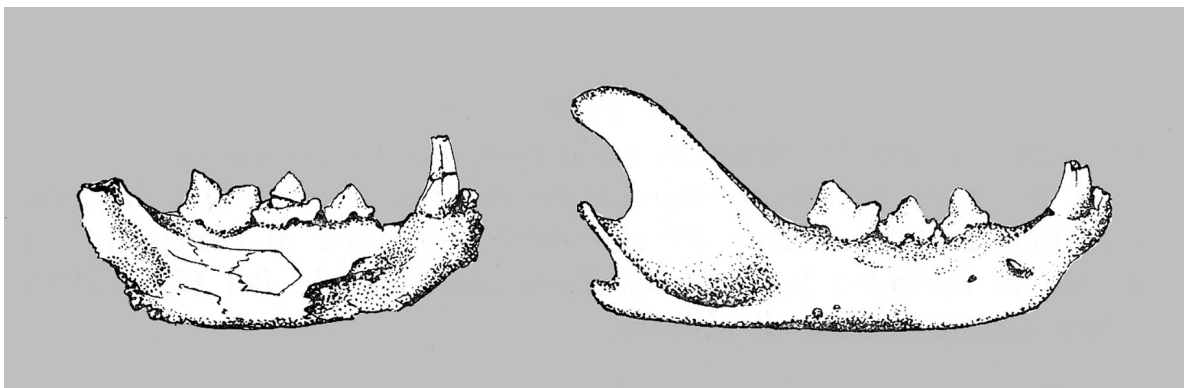


Fig. 2 - Partial mandible of the Upper Pliocene *Felis lunensis* Martelli, 1906, from the Villafranchian site of Olivola (Val di Magra, north-western Tuscany), on the left, compared to the mandible of a present day wildcat, *F. silvestris* Schreber, 1777. The original of this last drawing was made on the basis of specimens from the surroundings of Spoleto, kindly made available to the work of Ficarelli & Torre (1974) by Bernardino Ragni (from Ficarelli & Torre, 1974, redesigned)

silvestris Schreber, 1777 (FICCARELLI & TORRE 1974) (Fig. 2). The holotype specimen is now preserved in the palaeontological collection of the University of Florence, in Italy. Another cat osteological fragment was described by Depéret from the Lower Pliocene of Perpignan in France, but it was so much like the extant African wild cat, *F. s. lybica* Forster, 1780, that the author did not propose a special name for it. According to Zeuner (1963), it cannot be, therefore, excluded that the ancestral line of our cat begins with Depéret's felid and passes through Martelli's species to the wildcats of the Pleistocene of Eurasia and Africa. The morphotype could have already settled down in the ancient Pleistocene and, since then, all European wildcat osteological findings would be related to the same single species. In fact, according to Ficcarelli & Torre (1974), *F. lunensis* does not differ from the European wildcat and at the most can be considered a subspecies of it. Even the remains found at Lunel Viel (France) by Bonifay (1971), who described them as belonging to the new species *F. monspessulana*, have to be ascribed to the former taxon (FICCARELLI & TORRE 1974). The conservation of the biological model "*Felis silvestris*", which has lasted from the Lower Pleistocene to the present day, would therefore confirm its evolutionary validity, revealing not only its great morphological strength, but also its ethological and genetic stability (RAGNI *et al.* 1995). The biological success of the wildcat can be evaluated also in consideration of the great extension of its geographical diffusion - equivalent

if not superior, within the Felidae family, only to that of the leopard, *Panthera pardus* L., 1758 (WOZENCRAFT 2005; JDEIDI *et al.* 2010) - and of the consequent ecological variations of the area.

Three main subspecies are recognised within its Western Palaearctic range. The European subcontinent, the Caucasus, and Asia Minor are interested by the diffusion of the European wildcat, whereas the African wildcat, is found in northern and Saharan Africa, several Mediterranean islands, and in the Near East, including the Arabian peninsula (MASSETI 2000, 2009b and 2010; YAMAGUCHI *et al.* 2004; DRISCOLL *et al.* 2007). The easternmost area of distribution of the species, which includes Transcaucasia, Central Asia and part of the Indian subcontinent, is instead occupied by the Asiatic wildcat, *F. s. ornata* Gray, 1832 (YAMAGUCHI *et al.* 2004; OTTONI *et al.* 2017), which is characterised by a very peculiar spotted coat. In the ancient Western World, animals of the latter subspecies are perhaps evoked in the artistic representation of an *opus vermiculatum* of the late Roman Republican era (first quarter of the 1st century BC; Rome, National Roman Museum - Palazzo Massimo), or in a mosaic detail from the "House of the Faun" (1st century AD) in the dead city of Pompeii (Naples, Museo Archeologico Nazionale) (Fig. 3). The ancient diffusion of the Asian subspecies beyond its homeland may be also documented in several medieval artistic productions, such as a miniature of the mid-15th century *Master of Game* by Edward duke

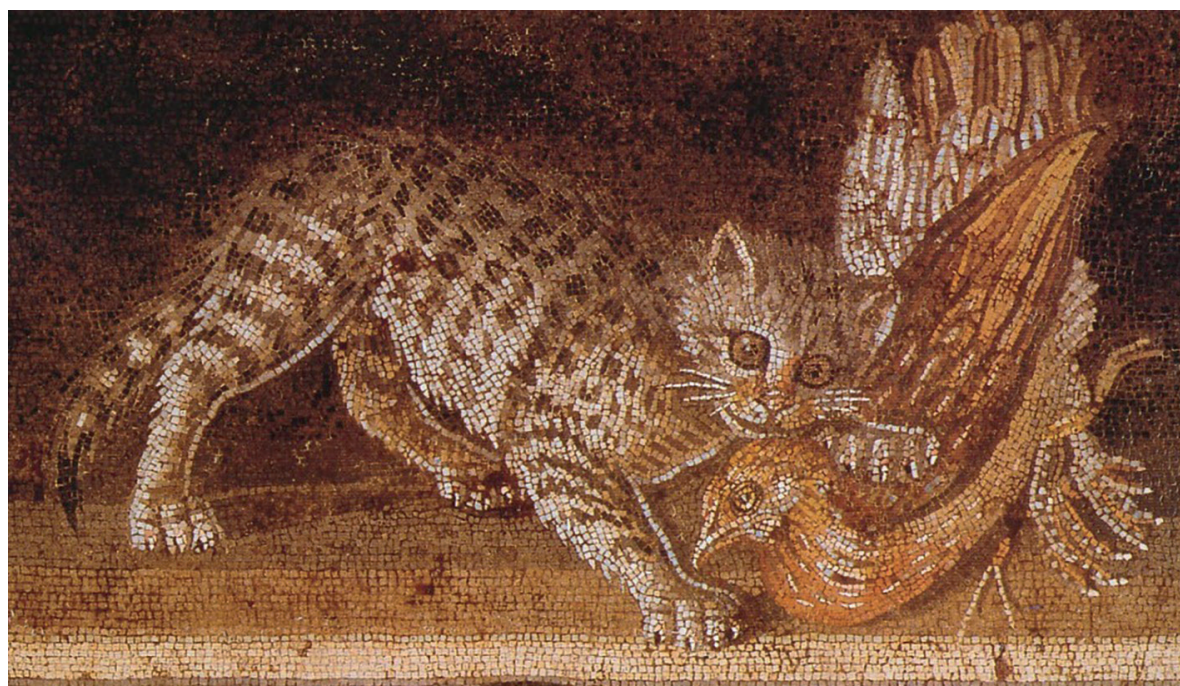


Fig. 3 - Detail of a floor mosaic from the House of the Faun (Pompeii), showing a probable Asiatic wildcat, *Felis silvestris ornata* Gray, 1832 (1st century AD; Naples, National Archaeological Museum)

of York (Oxford, Bodleian Library: MS Bodley 546, fol 40 verso) (Fig. 4), English translation of the 14th century *Livre de Chasse* by Gaston Phébus (MASSETI 2011; cf. WALKER-MEIKLE 2011). Once regarded as separate taxonomic entities, all these subspecies are now considered to belong to a single polytypical species (HARRISON 1981; HARRISON & BATES 1991; CORBET & HILL 1992; WOZENCRAFT, 2005). Despite their wide diffusion, they are morphologically very similar and there are no constant craniological differences between them (POCOCK 1951; HEPTNER & SLUDSKII 1992).

DIFFUSION OF THE EUROPEAN WILDCAT IN CONTINENTAL ITALY

In Italy, the European wildcat is dispersed over a large part of the mainland, where it is characterised by four genetically differentiated groups (MATTUCCI *et al.* 2013). Up to about twenty-fifteen years ago, its distribution was reputed to interest the majority of the peninsula from Aspromonte (southern Calabria) to the central Apennines, south of an ideal borderline that roughly joined the town of Piombino on the Tyrrhenian coast, to Ancona on the Adriatic Gulf (RAGNI *et al.* 1994; cf. CAGNOLARO *et al.* 1976). Studies carried out by CRUDELE *et al.* (2001), AGOSTINI *et al.* (2010), RAGNI & PETRUZZI (2010), SANTOLINI *et al.* (2010); RAGNI *et al.* (2014), MATTUCCI *et al.* (2013), VELLI *et al.* (2015), and VELLI *et al.* (2018) in the area of the Riserve Naturali Biogenetiche Casentinesi have revealed the presence of a population of the

carnivore in the territories of the Foreste Casentinesi, Monte Falterona and Campigna National Park (northern Tuscany), ascertaining a process of recent expansion of the European wildcat in the Italian peninsula. More recent reports would give the presence of wild individuals in even more northern and western areas of Tuscany, including the territory of Mugello (Andrea Sforzi, 2020 *in verbis*, and in the present volume). There is a second population in the Eastern Alps, which appears to belong to the large Dinaric-Balkan core that extends to the countries of former Yugoslavia, Romania, Bulgaria, Greece, Slovakia, Hungary, Ukraine and southern Poland (CAGNOLARO *et al.* 1976; HEMMER 1999; BASHTA & POTISH, 2005; HELTAI *et al.* 2006; RAGNI & PETRUZZI 2010; LOZANO & MALO 2012). A further population is still found in the Gargano promontory (northern Apulia) (CAGNOLARO *et al.* 1976), where it appears to be ecologically isolated (RAGNI & PETRUZZI 2010). Records from western Liguria and Piedmont seem also favorable to the return of the species from the adjacent French territories (CAGNOLARO *et al.* 1976; RAGNI 1981; GAVAGNIN *et al.* 2010; GAVAGNIN *et al.* 2018; Patrizia Gavagnin, 2020 *in verbis*) (Fig. 5).

The absence of the European wildcat from a large portion of the north-central Italian peninsula is not easy to explain. It may be a consequence of the great anthropisation that affected these territories, in relatively recent historical times. This fact, together with the habitat alteration, may have favoured the abnormal spread of inbreeding with the domestic form, seriously diluting the wild phenotypic and



Fig. 4 - Detail of an illuminated page of the 15th century *Master of Game* by Edward, Duke of York, English translation of the *Livre de Chasse* by Gaston Phébus (Oxford, Bodleian Library: MS Bodley 546, fol 40 verso) (cf. Masseti, 2011)

genetic traits until they disappear. Other carnivores have revealed large gaps in their Italian range for long periods of the last century. We must not forget that the former human impact on these same territories has led to the disappearance of the wolf, *Canis lupus* L., 1758. This species reached the minimum of its historical occurrence in Italy in 1970s (SIMONETTA 1968; TASSI 1971; ZIMEN & BOITANI 1975), being already disappeared from the entire central-northern Apennines between 39°N and 43°N of latitude (CIUCCI & BOITANI, 2003, and references therein). Even the fox, *Vulpes vulpes* (L., 1758), was for a long time absent from a large portion of Italy, roughly coinciding with the Po plain (Pianura Padana), from the surroundings of Turin to the Adriatic Gulf, where the species progressively reappeared only during the 1980s (BOITANI, 1981; BOITANI & CIUCCI 2003). This disappearance could be attributed to the combined action of the excessive anthropisation and urbanisation, assiduous control of fox populations on the part of the farmers, and intensive exploitation of all lowland farming environments (cf. BOITANI 1981). At present, the diffusion of the fox appears almost continuous throughout continental Italy, except for a few areas that have yet to be recolonised in the central Po valley (BOITANI & CIUCCI 2003).

The diffusion of *F. s. silvestris* in the Italian mainland interests a wide variety of habitats, which vary both in altitude and latitude. The species is primarily associated with forest and is found in highest numbers in broad-leaved or mixed forests with low densities of humans (cf. NOWELL *et al.* 2010). Oak and beech forests are, as a general rule, the forest biocenoses where European wildcat populations reach optimal densities and are more stable (RAGNI 1981). Its altitudinal dispersion can reach 2,250 m above sea level (GARCÍA-PEREA, 2002). The carnivore is also found in Mediterranean scrubland, riparian forest, marsh boundaries and along sea coasts, but areas of intensive cultivation are avoided. In north-eastern Italy, the extant expansion of the European wildcat seems to be clearly related to the return of the forest, which in the last 40 years has come back to cover the orographic reliefs due to the abandonment of numerous traditional agricultural, zootechnical and silvicultural practices (LAPINI 2006). This would have created favourable conditions for the growth of many forest mammalian populations, which at the end of the 1970s reached high densities even in the areas bordering the plains, thus being able to serve as a reservoir for the colonisation of the latter. The most evident case studied in north-eastern Italy is certainly that of the roe deer, *Capreolus capreolus* (L., 1758) (see Perco, 1987), but during the 1980s and 1990s also the Eurasian badger, *Meles meles* (L., 1758), and the red squirrel, *Sciurus vulgaris* L.,



Fig. 5 - Present distribution of wildcats in Italy and adjacent regions (data from Ragni, 1981; Ragni *et al.*, 1993; Hemmer, 1999; Masseti, 2010; Ragni & Petruzzi, 2010; Gavagnin *et al.*, 2010; Lozano & Malo, 2012; Velli *et al.*, 2015; Gavagnin *et al.*, 2018, and Velli *et al.*, 2018)

1758, have invaded the plains, reaching the sea also along the high Adriatic coasts in the last 30 years. According to Lapini (2006), the model followed for these colonisation seems to be always the same, with the autonomous movement of animals along the main river floodplains, whose function as ecological corridors seems even more remarkable than previously assumed. Very recently, the wild cat has also reached some insular environments, as in the case of the river island *Isola della Cona* at the mouth of the river Isonzo, in the northern Adriatic Gulf (VITIELLO 2020) (Fig. 6).

The distribution of the felid on the circum-Italian islands, including Corsica, deserves however a separate discussion.

INSULAR WILDCATS

Apart from continental islands such as Sicily and Corfu (Greece) where fossil bones of wildcats have been discovered in Upper Pleistocene contexts (MARINOS, 1971; MARINOS & SYMEONODIS 1977; DERMITZAKIS & SONDAAR 1978; MASSETI 2010 and 2012), felids do not figure in the late Quaternary faunal assemblages of the Mediterranean archipelagos (cf. MASSETI & MAZZA 1996; MASSETI 2012). These carnivores seem to have never undergone endemic modifications on islands



Fig. 6 - The recent occurrence of the European wildcat has been documented through a photo trap on the river island *Isola della Cona* at the mouth of the river Isonzo, in the northern Adriatic Gulf (from Vitiello, 2020)

(MAZZA *et al.* 2013). In fact, the differences between insular felids and their mainland ancestors never range beyond the subspecific level (cf. MASUDA & YOSHIDA 1995). Neontological data can show that more resource-demanding hypercarnivores (i.e., those with more than 70% of their diet consisting of meat) are more vulnerable on islands than are meso- (meat between 50% and 70% of their diet) and hypocarnivores (meat less than 50% of their diet) and that they rapidly disappear (O'REGAN *et al.* 2002). It seems therefore that, despite the undoubted swimming abilities of many felids, such as tigers, *Panthera tigris* (L., 1758), jaguars, *Panthera onca* (L., 1758), fishing cats, *Prionailurus viverrinus* (Bennett 1833), or leopard cats, *P. bengalensis* (Kerr 1792), the representatives of this taxonomic group show no endemic adaptations to insular life.

In the light of this, the extant wildcat of Sicily does not seem to differ substantially from its counterpart of continental Italy, if not for some minor phenotypic characters that allowed it to be regarded as a distinct geographic variety (MORABITO, 1987; RAGNI & SEMINARA 1987; RAGNI *et al.* 1995; DI VITTORIO & FALCONE 2008; SIRACUSA 2010; ANILE *et al.* 2014), perhaps an ecotype. Nevertheless, the scientific community has not yet felt the need to describe it at a sub-specific level (cf. RAGNI & SEMINARA 1987).

Together with the British population and, possibly, that of few other continental islands, the Sicilian one is the only European insular population of *F. s. silvestris*. There are no biogeographical elements such as to rule out the possibility of the penetration of this species onto the large Mediterranean island during an unspecified moment of the last glacial episode (see BURGIO 1997), in concomitance with the entry of the remaining mainland fauna of the so-called "Stadio di Castello". The wildcat, however, has never been described among the typical species of the latter faunistic stage (KOTSAKIS 1978; TAGLIACOZZO 1993; VILLARI, 1995). According to Villari (1995), although considering the exiguity and fragmentary of the available archaeological findings, no difference in the osteological morphology of the Sicilian specimens would have been found compared to the continental ones. Only the phenotypic characters of the coat (pattern and colours) of the Sicilian population show some differentiation from the more recurrent continental patterns: increase in eumelanin, detectable in the design and background colour and increase in the white gular, inguinal and digital areas (RAGNI & SEMINARA 1987) (Fig. 7). As far as is presently known, the most ancient remains of *F. silvestris* found in Sicily date between the late Upper Pleistocene and the beginning of the

Holocene, and are documented by findings made in the transition levels between the Mesolithic and Neolithic fauna horizons of the Cave of Uzzo (Trapani) (TAGLIACOZZO 1993). Osteological fragments of the species have also been reported from the Cave of Corruggi (Corruggi, Syracuse), the Neolithic Cave of Stentinello (Syracuse) (VILLARI 1995), and the site of Rocca Palumba. The bones of wildcats are, however, rather rare in Sicilian pre-Neolithic deposits (KOTSAKIS, 1978; TAGLIACOZZO, 1993; VILLARI, 1995; BURGIO, 1997).

Sicily is the only Mediterranean island inhabited by European wildcats while all the other islands are characterised by the occurrence of populations with the phenotypes of the African wildcat (TOSCHI, 1965; CAGNOLARO *et al.* 1976; AZZAROLI, 1977; MASSETI, 1993, 2012). The latter appears to have been exported beyond its natural distribution after it had already experienced some sort of human cultural control since ancient times (MASSETI, 2010, 2012, and references therein). Taxonomists described the felid present in Sardinia as the subspecies *F. silvestris cf. sarda* Lataste, 1885, while the Corsican population



Fig. 7 - Adult male Sicilian wildcat, captured with a photographic trap on the slopes of Mount Etna (photo by Stefano Anile). The black-brilliant pattern of the dorsal colour contrasts with the light-silver background and is a phenotypical trait of the Sicilian population

was assigned to *F. silvestris cf. rey* Lavauden, 1929 (RAGNI, 1981; ARRIGI & SALOTTI 1988; SALOTTI 1992; STAHL & LEGER 1992). The evidence suggests that African wildcats were imported voluntarily by man onto Sardinia and Corsica, that have not been characterised by the Quaternary occurrence of any felid (VIGNE 1988 and 1992; MASSETI 1993; ANGELICI & MASSETI 2003). In fact, these carnivores would not have been able to pass unobserved on board the small boats employed by humans to reach Sardinia and Corsica (cf. VIGNE & ALCOVER 1985; MASSETI 1995). The appearance of the wildcat in the former island seems to have occurred prior to the Roman occupation, but probably not before the end of the Iron Age (MASSETI & VIANELLO 1991; MASSETI 1993; cf. WILKENS 2003). In Corsica, this introduction may have happened perhaps earlier (VIGNE 1992). In the eastern Mediterranean, the introduction of *F. silvestris* is associated with the cultural horizons of the Pre-Ceramic Neolithic, between the end of the 9th and the 8th millennium BC (VIGNE *et al.* 2004).

Also the extant occurrence of felids which fall within the phenotypic characters of the African wild cat on Mallorca, Crete, and a few other Aegean islands, such as Amorgos and Rhodes (Fig. 8), can be essentially attributed to a more or less ancient human mediation (MASSETI 2012; CHEKE & ASHCROFT 2017) (Fig. 9). Concerning the importation of medium-sized allochthonous carnivores in the insular and continental Western World, we must not forget the diffusion of the domestic cat, the more consistent spread of which appears to coincide with human cultures destined to affirm themselves many millennia later (MASSETI 2009a, 2010 and 2016).

THE DOMESTICATION OF THE CAT

“... an animal that always keeps something wild in itself, nor can it be completely domesticated”

(G. Soderini, 1526-1597, *Il trattato degli animali domestici*: 199)

While it would seem that both the Near Eastern and Egyptian populations of *Felis silvestris* contributed to the original gene pool of all the extant domestic breeds (OTTONI *et al.* 2017; cf. LINSELEE *et al.* 2009), in prehistoric China the ancestors of the domestic cat appear to have derived from another species, the already mentioned leopard cat, tamed between 5,500 and 4,900 years BP (VIGNE *et al.* 2016). This is a medium-sized felid dispersed in a wide variety of habitats in Asia, from tropical rainforest to temperate broadleaf and, marginally, coniferous forest, as well as shrub forest and successional grasslands (CORBET & HILL 1992; FRANCIS 2008;

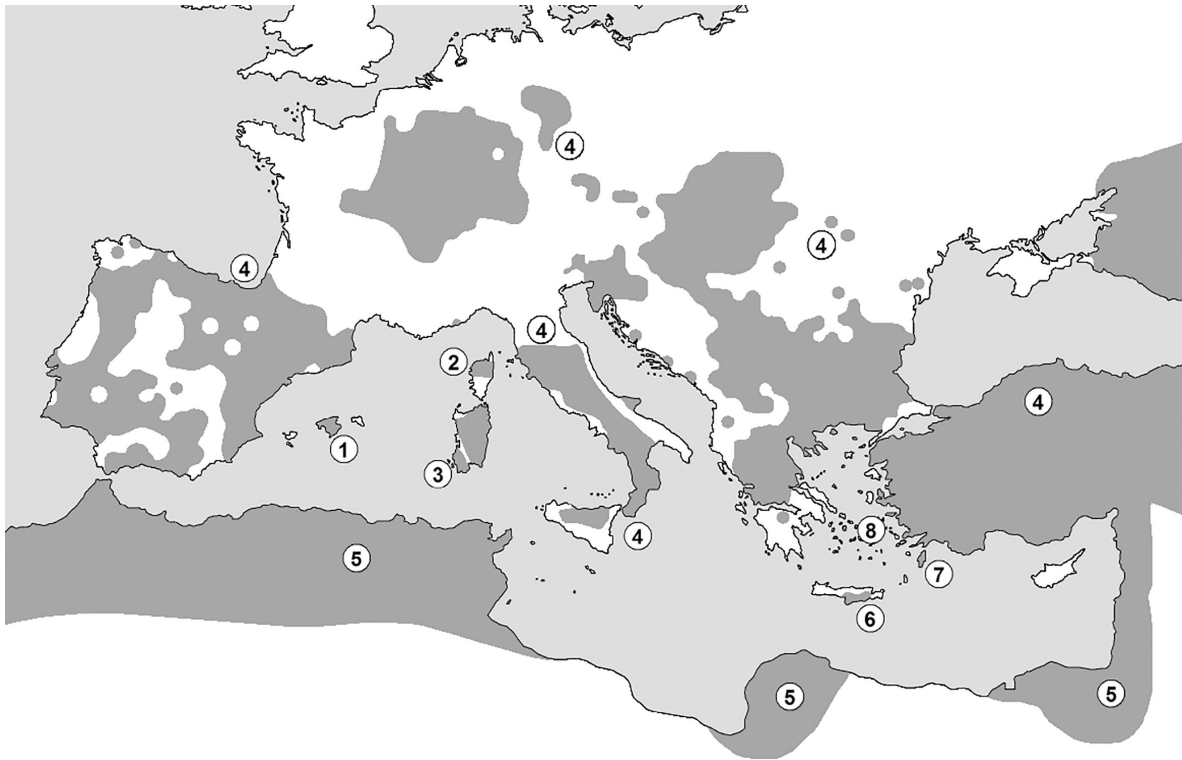


Fig. 8 - Present distribution of the wildcat in the Mediterranean region. 1) *Felis silvestris jordansi* Schwarz, 1930 (Mallorca); 2) *F. s. rey* Lavauden, 1929 (Corsica); *F. s. sarda* Lataste, 1885 (Sardinia); *F. s. silvestris* (Schreber, 1777); 5) *F. s. libyca* (Forster, 1780); 6) *F. s. cretensis* Haltenorth, 1953 (Crete); 7) the wildcat of Rhodes? ; 8) the wildcat of Amorgos (from Masseti, 2020, modified)

Ross *et al.* 2015). It is found through parts of the Indian subcontinent (Habibi, 2004), the Himalayan foothills, most of China, north to the Korean peninsula and into the Russian Far East (NOWELL & JACKSON 1996; IUCN Cat Specialist Group, 2002). Leopard cats are excellent swimmers, and have successfully colonised offshore islands throughout their range which includes Sumatra, Java, Borneo, Bali, Lombok, Taiwan, and the Philippines, as well as many small offshore islands of mainland Asia (KITCHENER *et al.* 1990; NOWELL & JACKSON 1996, SUNQUIST & SUNQUIST 2002). The type specimen of the species was caught swimming in the Bay of Bengal (POCOCK 1917). The former occurrence of a carnivore with the phenotypic characters of the leopard cat has also been reported by Wallace (1869) and Tate (1944) from the Indonesian island of Timor, but needs further confirmation.

The early domestication of this felid in China should come as no surprise since the leopard cat can easily be bred in captivity and it has been hybridised with an American shorthair domestic cat in 1963 to produce the famous domestic Bengal breed (HELGREN, 2013; VIGNE *et al.* 2016) (Fig. 10). However, *P. bengalensis* does not appear to have contributed genetically to any lineages of domestic

cats living in China today (DRISCOLL *et al.* 2007; DRISCOLL *et al.* 2009; MONTAGUE *et al.* 2014; see also OTTONI *et al.* 2017). In fact, according to VIGNE *et al.* (2016), domestic cats descendants of *F. silvestris* appears to have completely replaced the leopard cat from its purported commensal role in China, at some point after the Late Neolithic. These data provide wholly new evidence for another possible history of cat domestication, not only by revealing a possible independent process in the Far East, but also by adding a new species to the pantheon of commensal and/or domestic animals who began their relationships with humans at the onset and spread of agriculture during the Holocene (VIGNE *et al.* 2016).

We have already observed that, as far as is known, the only ancestor of all the extant domestic breeds is the African wildcat (ZEUNER 1950; CLUTTON-BROCK 1981; HEMMER 1990; MALEK 1993; MASSETI 2002; RAGNI & RAGNI 2019), all descended from the latter due to artificial selection. In fact, the already noted morphological affinity of the various subspecies of *F. silvestris* does not correspond to similar ethological analogy with respect to susceptibility to domestication (RAGNI & RAGNI, 2019). Any attempt of taming or domesticating the



Fig. 9 - Adult cat characterised by the phenotype of the *F. s. lybica* group, shot on the island of Amorgos, eastern Cyclades (Greece) (photo by Anthony S. Cheke)

European wildcat has never succeeded (TOMKIES 1977, and 1991; LEYHAUSEN 1979; RAGNI 1981), while the taming and/or “relative domestication” of the African-Near Eastern wildcat has been perpetuated for millennia up to the present day (LEYHAUSEN 1979; RAGNI 1981; MENDELSSON 1989; MASSETI 2002). The earliest certain evidence of a sort of cultural control of *F. silvestris* on the part of early human groups comes from the 9th millennium BC site of Shillourokambos on the island of Cyprus, in the eastern Mediterranean basin (VIGNE *et al.* 2004), where the species resulted completely absent among the Holocene fossil endemics (cf. BOEKSCHOTEN & SONDAAR 1972). The introduction of the carnivore from somewhere in continental south-western Anatolia or the Levant may have been a deliberate act on the part of the Pre-Pottery Neolithic settlers to deal with commensal rodents (VIGNE *et al.* 2016, and references therein). Still on Cyprus, another cat remain has been found in the archaeological site of Khirokitia, dated between the end of the 7th and 6th millennium BC (DAVIS 1984 and 1987) (Fig. 11). The measurements of this specimen have confirmed that it belonged to *F. silvestris* and not to the other two species of medium-sized felids that still occur in the Near East. These are the jungle cat, *Felis chaus* Schreber, 1777, and the caracal,

Caracal caracal (Schreber, 1776) (Fig. 12). The Cypriot archaeological findings suggest a much older chronology of the domestication of the cat than the commonly accepted one according to which the felid was first domesticated in ancient Egypt (CLUTTON-BROCK, 1981 and 1988; DAVIS, 1987), at the latest by the 20th to 19th century B.C. (Middle Kingdom, 12th dynasty) (MALEK 1993).

THE DOMESTIC CAT IN ITALY

As far as is presently known, it is still rather difficult to establish the chronology of the first appearance of the domestic cat in the Western World. It has been supposed that the earliest remains of domestic cats in Italy were found in an 8th BC hut at Fidene, an Iron Age site in the surroundings of Rome (central Italy), where the complete skeleton of an adult animal, possibly trapped inside the building during its destruction, was identified (DE GROSSI MAZZORIN 1997). However, this identification is not universally accepted (Masseti 2002, and 2010). The specimen - which showed its osteological remains heavily calcined due to the probable fire of the hut - might even have been a wild animal, brought to the place of discovery from outside, such as a hunting trophy (MASSETI 2002). The possibility of



Fig. 10 - The leopard cat, *Prionailurus bengalensis* (Kerr, 1792), can easily be bred in captivity and it has been hybridised with an American shorthair domestic cat in 1963 to produce the famous domestic Bengal breed (photo by Camilla Saccardi)

dealing with a real wildcat - and not a domestic specimen - would also be favoured by the fact that the archaeological area of Fidene - as well as those of Ficana and Cures, where De Grossi Mazzorin (1989) and Ruffo (1988) respectively recognise the presence of “*other domestic felines*” - is included in the area of diffusion still occupied by the wildcat in



Fig. 11 - Cat mandible from the Pre-Ceramic Neolithic site of Khirokitia, on the island of Cyprus (photo by Odile Le Brun, courtesy of Simon J.M. Davis)

Italy (Masetti, 2010, and present work).

Undoubtedly known in classical antiquity (cf. Herodotus, *The Stories*, II: 66-67, 5th century BC), the domestic cat made its first sporadic appearances in eastern Europe from at least the start of the 6th century B.C. or, possibly, even earlier (cf. TOYNEBEE 1973; MALEK 1993; MASSETI 2002). It is suggested that the felid came to Greece from Egypt, where it was an object of worship even before the 5th century B.C. (HUGHES 2003; VOULTSIADOU & TATOLAS 2005). A recent analysis of the Etruscan artistic production conducted by Ragni & Ragni (2019), only on iconographical basis, would suggest the appearance in Italy of the domestic cat between the 7th and 3rd centuries BC. Despite this, however, it seems that the animal was still uncommon in the early Roman Imperial period (KING, 2002; MASSETI, 2009a, 2010 and 2019), becoming slightly more diffused in later times (KING 1994; MACKINNON 2004). At the end of the Roman Empire it is documented more or less everywhere by scattered osteological remains. Bobis (2000) believes that its diffusion was favoured by the trade routes, in particular the tin road that linked the British Isles to the Mediterranean. The Roman army too must have represented a crucial carrier for

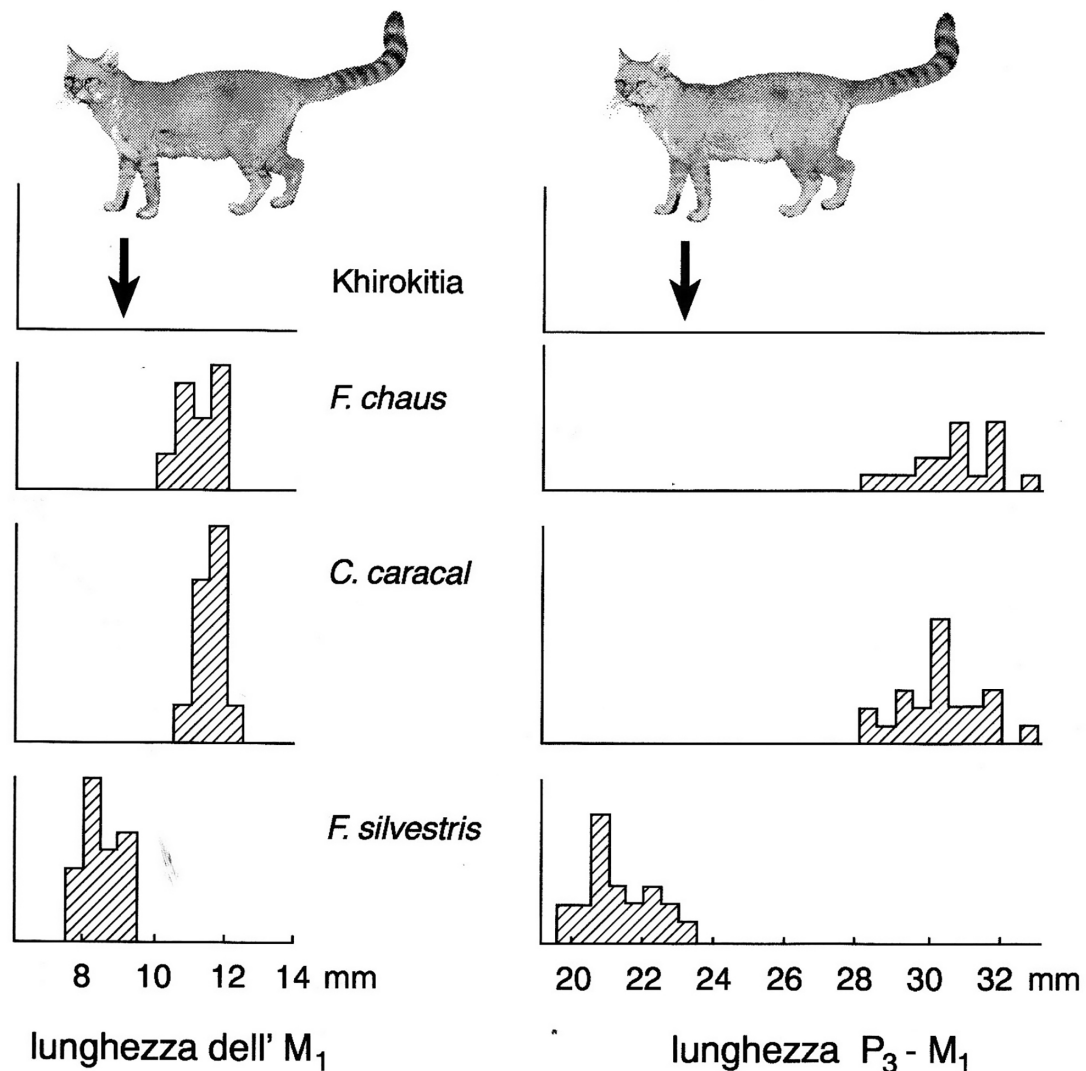


Fig. 12 - The measurements of the Khirokitia specimen (M₁ length, left; P₃-M₁ length, right) have confirmed that it belonged to *F. silvestris* and not to other species of medium-sized felids that occur in the Near East, such as the jungle cat, *Felis chaus* Schreber, 1777, or the caracal, *Caracal caracal* (Schreber, 1776) (from Davis, 1987, redesigned)

the penetration of the animal in northern Europe, since several fortresses guarding the Rhine-Danube *limes* were home to cats (Fig. 13). Nevertheless, according to the results of a research carried out by MacKinnon (2004), cat bones were infrequent in most Roman sites of the Italian peninsula between the Republican period and the Late Antiquity (end of the 6th century B.C. - 6th century A.D.), having been found in only 16 of the 146 rural and urban sites considered in the study (approximately 20%). Furthermore, it should be ascertained whether they were all domestic cats or whether they could include even a number of wild specimens.

In Classical Antiquity, another small-sized carnivore was preferred to the cat to be employed for the control of unwanted rodent populations,

namely the weasel, *Mustela nivalis* (L., 1766), as also documented by Bon & Masseti (1995) (Fig. 14). This animal was referred in ancient Greek as *gale* (Masseti 2002). For example, in the encomiastic poem from the 5th century B.C. *Batracomiomachia*, the mouse says to the frog: “There are two beings I fear most on earth: the hawk and the weasel”. In his comedy *The Wasps*, Aristophanes (about 445 - after 388 BC) indicates in the *gale* the domestic hunter of mice *par excellence*, not considering the cat. Still in Roman times, literary documents do not seem to assign to the cat the specialised role of domestic mice hunter. In the comedy *Stichus* (499-501) by the Latin author Plautus (259/251-184 BC approx.) is a weasel and not a cat to catch a mouse at the foot of an actor. Pliny the Elder (1st century A.D.), in his



Fig. 13 - Cat's footprints on brick from the 2nd- 3rd century archaeological context of the Roman site of Silberberg (Pförring, Eichstätt), in Germany (photo by Marco Masseti)

Naturalis historia (XXIX, 60-61), handed down to us that the weasel was allowed to walk inside the houses, where: "... according to Cicero, every day it transports its puppies and changes location..." (cf. CAPITANI & GAROFANO 1986). In antiquity, other carnivores of larger size, such as the stone marten, *Martes foina* (Erxleben, 1777, the pine marten, *Martes martes* (L., 1758), and the polecat, *Mustela putorius* L., 1758 - generically indicated by the ancient Greek term of *ictis* - were also used to defend the domestic larders from the damages produced by rodents (MASSETI 2002). In this regard there is the later witness of Pecci (1760), who explains, still in the 18th century, that on the island of Giglio, in the Tuscan archipelago (Italy), the hunt for martens was: "[...] forbidden at any time due to the fact that they have been properly introduced in ancient times because, together with the many non-poisonous snakes, they diminish the large number of mice that will otherwise devastate all the country".

Although the presence of the domestic cat in Europe is testified by a range of documents dating to the early Middle Ages prior to any

Islamic influence (cf. BOBIS 2000), it may not have become widespread until the establishment of the Arab culture (from the 8th century onwards), in concomitance with which the felid finally became more extensively diffused at least in the countries of the northern Mediterranean, its islands, and western Europe (MASSETI 2010 and 2019). A noticeable diffusion in Sicily of the felid can be traced to shortly after the year 1000 (MASSETI 2009a and 2016), vestiges having been found in the excavations at the "Antonino Salinas" Regional Archaeological Museum of Palermo, in chronological contexts referred to the second half of the 10th - early 11th century (SARÀ 1997). Prior to this discovery, the oldest Sicilian finds of domestic cats dated to the 12th century came from a pit of the castle of Fiumedinisi (VILLARI 1995) and Brucato (BOSSARD-BECK 1984). Both sites yielded remains bearing butchering cut marks and traces of burns (VILLARI 1995), as has also been documented from other Italian sites of 14th-18th century (cf. VILLARI 1995; CORBINO 2009). In Sicily, the domestic cat is also present in 13th century layers in Calathamet (SARÀ 2005), and in the 14th and 15th century contexts of Palazzo Steri, in Palermo (DI PATTI & LUPO, 2009). In the Iberian Peninsula too, the more consistent spread of the domestic cat appears to coincide with the full affirmation of Islamic culture (MASSETI 2009a and 2019). Finds referred to the carnivore have been yielded by the exploration of the Spanish sites of Granada (Califal period, 10th-11th century) (RIQUELME 1992), Calatrava La Vieja (Almohad period) (MORALES MUÑIZ *et al.* 1988), Saltés (Huelva) (12th-13th century) (LENTACKER & ERVYNCK 1999), Motril (Granada) (16th-18th century) (Riquelme Cantal, 1993), and the Portuguese site of Alcáçova de Mértola (second half of the 12th century-first third of the 13th century) (TELLES ANTUNES 1996). In the towns of medieval Britain too there is some evidence that the frequency of domestic cats increased in the years following the Norman conquest (O'CONNOR 1982 and 1992), that is, from the second half of the 11th century (cf. ROWLEY 1999; CROUCH 2002).

Nevertheless, it cannot be ruled out that for the Iberian Peninsula - together with continental Italy and Sicily - the absence of finds for slightly earlier historic periods may very plausibly be attributable to the lack of excavations or the absence of specific archaeozoological studies. Unfortunately, it is not always possible to document the past presence of a certain zoological species in a specific territory and/or a particular cultural context, solely on the basis of the data offered by archaeozoological research (MASSETI 2009a). Consequently, it would be advisable to adopt a different approach to this

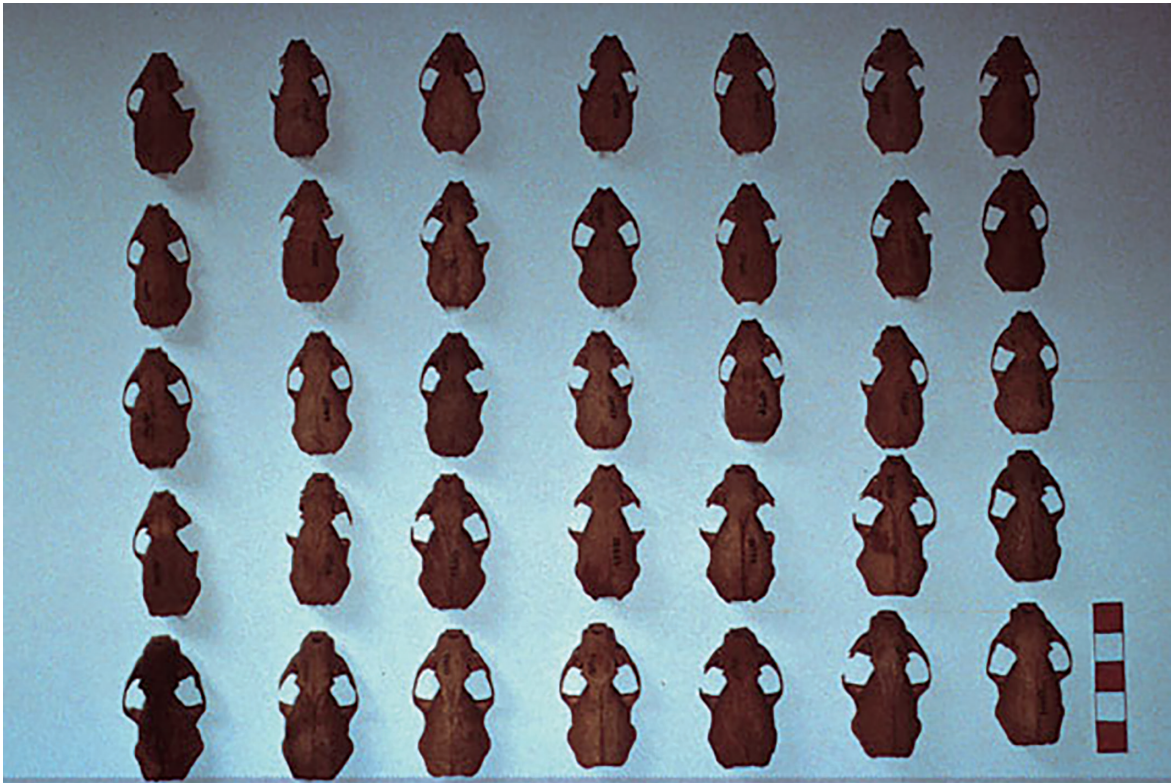


Fig. 14 - Skulls of *Mustela nivalis* L., 1766, from the pit IV of the Roman site of Oderzo (Treviso), dated between the end of the 1st century and the 2nd century AD (photo Civic Museum of Natural History of Venice)

subject, taking into account a multidisciplinary view which includes also literature and iconography.

A MATTER OF TAXONOMY. CONCLUDING REMARKS

Since ancient times, the continued and repeated crossbreeding of domestic cats and wild individuals has eventually altered the genetic and phenotypic characteristics of the specific Italian population, both in the mainland and on the islands (RANDI *et al.* 2001; OTTONI *et al.* 2017). The latest techniques for investigating population genetics have shown that the Italian samples are considered to be European wild cats, African cats and domestic cats belonged to the same polymorphic species (RANDI 2010; MATTUCCI *et al.* 2013), although some alleles are peculiar to domestic cats (RAGNI & RANDI 1986; RAGNI & POSSENTI 1991; RANDI & RAGNI, 1991). The presence of domestic mitochondrial haplotypes shared with some wild individuals led Mattucci (2014) and Mattucci *et al.* (2016) to hypothesise the possibility that ancient introgressive events might have occurred, further revealing that the genetic variability of microsatellites would show that European wildcat populations currently distributed in Italy originated from two distinct glacial refuges during the Last Glacial Maximum.

Unfortunately, this last assumption cannot yet be confirmed by the discovery of any fossil remain. Moreover, the wildcats of Mount Etna in Sicily (RAPAZZO *et al.* 2010) and the already mentioned population of the Gargano promontory (RAGNI & PETRUZZI 2010) appear to be respectively genetically and ecologically isolated.

From a taxonomic point of view, there has been almost universal use of *Felis catus* L., 1758, for the domestic cat, and *F. silvestris* for wildcats. This is, however, not only wrong but also misleading. First of all, because Linnaeus described in 1758 *Felis catus* on the basis of the examination of domestic specimens, while the true definition of *Felis silvestris* for the true wildcat was made only several years later by Schreber, in 1777. Personally, I believe that the name given to the description of the wild form should be preferred to denominate the species and not what is ordinarily given to the product of a reiterated artificial selection (see MASSETI 2002 and 2016). But, I understand that this subject can be considered from a different point of view. In any case, the result of thousands of years of artificial selection cannot be defined as a different species compared to its wild ancestor, as Wozencraft (2005) would instead indicate. Many other authors have treated the domestic cat as separate from the wildcats



Fig. 15 - Adult female of domestic cat struggling with a western whip snake, *Hierophis viridiflavus* (Lacépède, 1789) (photo by Stefano Porcinai)

(POCOCK 1951; CORBET & HILL 1992; KITCHENER 1991; DANIELS *et al.* 1998; NOWAK 1999; MATTERN & McLENNAN 2000; WISEMAN *et al.* 2000; and others). RAGNI & RANDI (1986), ESSOP *et al.* (1997), JOHNSON & O'BRIEN (1997), RAGNI & PETRUZZI (2010), RANDI (2010), MATTUCCI *et al.* (2013) presented instead morphological and genetic evidence to support *catus*, *lybica* and *silvestris* as conspecific. In my opinion, however, it is not possible to say that the product between the domestic and the wild form should be indicated as a hybrid (see e.g. BALLESTEROS-DUPERON *et al.* 2014), that normally occurs between two different species. We must instead regard it as a crossbreeding, the result of the mating between two representatives of the same species (Fig. 15). Also for this reason, I think it would be appropriate to indicate all domestic breeds using the definition of *Felis silvestris* Schreber, 1777, since these races are exclusively the result of a profound, artificial genetic manipulation conducted on the highly elastic capacity of the same species unique genome.

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