Review

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The wild goat, *Capra aegagrus* Erxleben, 1777, of the island of Montecristo (Northern Tyrrhenian Sea, Italy): does it still exist?

Abstract: On the small island of Montecristo, in the Tuscan archipelago (Northern Tyrrhenian Sea, Italy), a wild goat population, *Capra aegagrus* Erxleben, 1777, of very ancient origin continues to display the phenotypic patterns of its wild ancestors, despite the fact that, in recent decades, questionable management by the authorities in charge of its protection may have favoured its radical impoverishment through randomized selective shootings and the illegal introduction of domestic individuals. In the period between 2010 and 2014, this population has been drastically reduced, if not almost entirely eliminated, following the implementation of the EEC LIFE Project+ Montecristo 2010, aimed at redefining the ecological equilibrium of the small Tyrrhenian island, mainly focused on the eradication of the local population of black rats, *Rattus rattus* (L., 1758) using poison pellets, with the primary purpose of protecting a single species of marine bird.

Keywords: *Capra aegagrus*; eradication of alien species; Mediterranean islands; Montecristo; *Rattus rattus*; wild goat.

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Introduction

Since time immemorial, several islands of the Mediterranean basin have been populated by herds of wild goats whose principal function was to provide a store of fresh meat that would be readily available to seafarers at any time (Masseti 1998, 2002a, 2003a, 2009a). Many of these goat populations have been described by ancient scholars, such as Homer (*The Odyssey*, IX, 116–124, see Shewring 1980) and Varro (37 B.C. *Rerum rusticarum*, II: III), while others were mentioned by more recent authors, including the Sardinian naturalist Francesco Cetti (1774). From a morphological point of view, several of these populations, which inhabit the Mediterranean islands – or did up to very recent times – are referred to *Capra aegagrus* Erxleben 1777, in other words displaying the phenotypic patterns of the true wild goat, the Asiatic pasang or Bezoar goat (Weinberg et al. 2008). Several authors, including Schwarz (1935), Harris (1963), Spagnesi and Toso (2003), Grubb (2005) and others, identify the wild goat with the scientific definition of *Capra hircus* provided by Linnaeus in the tenth edition of the *Systema naturae* in 1758 (see De Beer, 1956), preferring it to *C. aegagrus*, which was instead created a few years later, in 1777, by the German biologist Johann Christian Polycarp Erxleben in his *Anfangsgründe der Naturlehre* und *Systema regni animalis*. Thus, the scientific definition made by Linnaeus is certainly older than that of Erxleben. The term *hircus* derives from Latin and means "goat", whereas the expression *aegagrus* derives from the conjunction of two ancient Greek words (*aix*/*aig*="goat" and *agrios*="wild"), and translates "wild goat". The definition of *Capra aegagrus* is still adopted by various authors, including Harrison (1968), Harrison and Bates (1991), Weinberg et al. (2008), Masseti (2009a), Geskos (2013), Seguí Campaner et al. (2014) and others, and is also followed in the present work. In my opinion, Exleben (1777) was the first to describe the wild goat, basing his observation on the examination of wild specimens from the Dagestan district of the Caucasus (southeastern Russia), whereas Linnaeus (1758) established the species on the basis of examination of domestic goats, all collected in Sweden (cf. Ellerman and Morrison-Scott 1951, De Beaux 1955, Corbet 1978, Gentry et al. 1996, Masseti 2002b). Moreover, taking into account that the wild goat is certainly the principal – possibly the only – ancestor of all domestic breeds (Corbet 1978, Clutton-Brock 1981, Davis 1987, Masseti 1997), it

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is somewhat difficult to accept the IUCN position (see Giannatos et al. 2007), which considers the wild goats of the Mediterranean islands as belonging to a different species – *Capra hircus* – from that of their real ancestor, that is *C. aegagrus*. In light of this, it is also difficult to understand how it is possible to consider the wild goat separated at a specific level from its domestic derivations, as also suggested by Groves and Grubb (2011) and the already mentioned Giannatos et al. (2007).

In addition to the goats of Montecristo, other populations with the phenotypic characters of *Capra aegagrus* are those of the islands of Crete, Antimilos, Youra, Mallorca and the extinct goats of Samothrace, Rhodes, Skopelos (Aegean Sea, Greece), Lampedusa (in the Strait of Sicily, Italy), La Galite and possibly San Pietro (off south-western Sardinia) (Masseti 2008, 2009a, 2012, 2014b). The maintenance up to the present of the relatively unchanged phenotypical patterns of *C. aegagrus* in all these goats led to the assumption that these populations were introduced onto the islands not later than the Neolithic times (Masseti 1998, 2009a, 2012). More specifically, the presence of a population of ungulates with similar characters on the islet of Montecristo, in the Tuscan archipelago (Italy) (Figure 1), has been documented in literature since at least the famous novel by Alexandre Dumas (*père*), "The Count of Montecristo" (1844–1845): "*... At every step that Edmond took he disturbed the lizards glittering with the hues of the emerald; afar off he saw the wild goats bounding from crag to crag ...* ", but there are also other descriptions, slightly earlier or later, such as those of Thièbaut de Berneaud (1808), d'Albertis (1877–1878), and Angelelli (1903), followed by Fucini (1918) and others. Unfortunately, no certain data are available on the initial occurrence of these animals on Montecristo due to the composition of the island soil, which does not allow the formation of fossils (cf. Spagnesi et al. 2003). Thus, it is presumed that these ungulates, too, were introduced onto the Tyrrhenian island in very early times (Masseti 1993, 1998, and 2009a, cf. Masseti and Vianello 1991). Imported onto Montecristo through individuals deriving from an initial phase of domestication of *C. aegagrus*, the local wild goat currently represents the most ancient Bezoar goat population existing in the wild in Italy (Masseti 2003, Raganella Pelliccioni et al. 2013, Gotti et al. 2014) and perhaps in the entire western Mediterranean area (cf. Masseti 2014b).

Figure 1: The island of Montecristo is a granite cone that rises to 645 m above sea level, with an area of 10.39 km^2 (photo by Marco Masseti).

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The island of Montecristo, in the Northern Tyrrhenian Sea

Montecristo is a small island of the Tuscan archipelago (Italy), located in the Northern Tyrrhenian sea (N42°20′, W10°9′) about halfway between Corsica (23 marine miles) and the coast of central Italy (24 marine miles) (Figure 2). It rises to 645 m above sea level and has an area of 10.39 km^2. Its perennial supply of fresh water is provided by a number of springs in various parts of the island. The vegetation of Montecristo is a remnant of the primeval Mediterranean phytocoenosis (Paoli and Romagnoli 1976; Filippello and Sartori 1980–1981, Pavan 1989). The island is characterised by the occurrence of a peculiar vertebrate fauna comprising relics of the Tertiary geological era. Examples include the Tyrrhenian painted frog, *Discoglossus sardus* Tschudi, 1837 (Bruno 1968, see Lanza et al. 1984, Capula 2006, 2007), while the local viper displays unmistakable features of the subspecies *Vipera aspis hugyi* Schinz, 1833, characteristic of southern continental Italy and Sicily (Masseti and Zuffi 2011, Masseti and Böhme 2014). Breeding, wintering and migrant birds are also well represented (Moltoni 1954, Baccetti et al. 1981, Baccetti 1994, Baccetti et al. 2009).

After a period between the first half of the 1950s and the end of the 1960s in which Montecristo was managed by the private company Oglasa, which wished to exploit it for tourism, in 1971, the entire island was declared a Nature Reserve (biogenetic reserve of the European Council) by the Italian government, through an agreement between the National Research Council (*Consiglio Nazionale delle Ricerche*, CNR) and the Navy, Finance and Agriculture ministries (Pavan 1971, 1989). Its management was entrusted to the State Forestry Corps (*Corpo Forestale dello Stato*) (Spagnesi et al. 1986). Since that time, therefore, Montecristo ought to have been integrally managed as a strict nature reserve, where in theory there should have been no significant anthropic activity. But that is not exactly how things went. To recall only the most invasive actions, we can mention those carried out already in 1973 and 1978, aimed at the eradication of the alien tree-of-heaven, *Ailanthus altissima* (Mill.), albeit without achieving particularly encouraging results (Pavan 1989, Banfi and Galasso 2010). In the meantime, intense activity to control the number of goats by hunting was begun by the authorities designated to their protection and conservation (the *Laboratorio di Zoologia Applicata alla Caccia* of the University of Bologna together with the *Corpo Forestale dello Stato*). Later, between 2010 and 2014, the EEC project (LIFE Project+ Montecristo 2010) was launched on the island to eradicate alien plants and animals and protect the native species and habitats of the Tuscan archipelago (Sposimo et al. 2010, Vagniluca and Quilghini 2014, Vagniluca et al. 2014). The project was aimed primarily at the protection and conservation of the Yelkouan shearwater, *Puffinus yelkuan* (Acerbi 1827), a species endemic to the Mediterranean, through the eradication of the local population of black rats, *Rattus rattus* (L., 1758) (Sposimo et al. 2010, Sposimo 2014, Vagniluca et al. 2014, Zanichelli 2014, cf. Capizzi et al. 2014). Although the latter marine bird is included in Annex I of the Birds Directive and listed as "vulnerable" by the IUCN Red List, it is, nevertheless, a species still dispersed on many of the Mediterranean islands and islets, its breeding range extending from the Marseille islands (France) to the eastern Aegean Sea and, possibly, to several Bulgarian islands in the Black Sea (Handrinos and Akriotis 1997, Bourgeois and Vidal 2008). The estimate of numbers of its global population is, at least, no <15,337–30,519 pairs (Derhé 2012a,b, cf. Gotti et al. 2014). On the contrary, the entire unique Montecristo goat population has been estimated at 300 individuals by Spagnesi et al. (1986), but much more probably fluctuates between 210 (Ciani and Masseti 1998) and 200 animals (Raganella Pelliccioni et al. 2013).

This drastic ecological redefinition of Montecristo was enacted by scattering rat poison pellets via helicopter, which took place in January 2012, while manual distribution continued until March of that year (Sposimo 2014, Vagniluca et al. 2014, Zanichelli 2014). Apart from

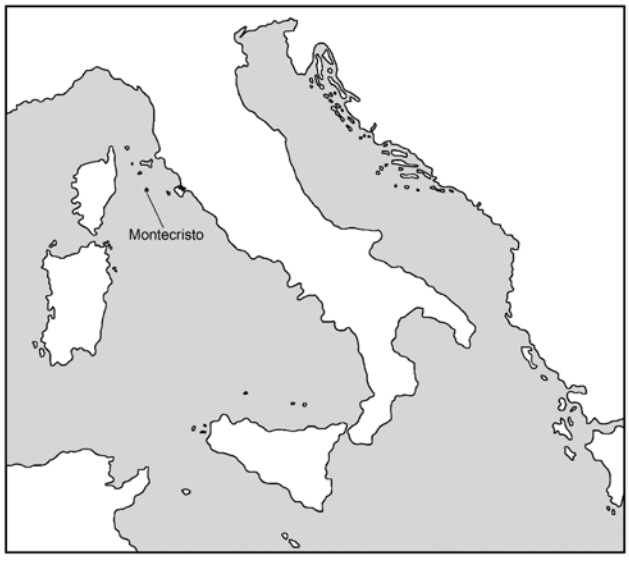

Figure 2: Montecristo is a small island in the Tuscan archipelago, located in the Northern Tyrrhenian sea (N42°20′, W10°9′) about halfway between Corsica (23 marine miles) and the coast of central Italy (24 marine miles).

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the synthetic report of Gotti et al. (2014), detailed evaluation of the damage to other biological organisms of Montecristo produced by the implementation of the project in question is not yet available. Clearly, this eradication produced devastating effects on the consistency of the goat population too.

The wild goat of Montecristo

This ungulate was first scientifically described by Toschi (1953), who stated that its population displayed phenotypical characters identical to those of the Anatolian wild goat or Asiatic pasang, *Capra aeagrus aegagrus* Erxleben, 1777, and the Cretan wild goat or *agrimi*, *C. aegagrus cretica* Schinz, 1838. This statement was later confirmed by Toschi (1965), and followed by other authors including De Beaux (1955), Baccetti (1973), Bruno and Sauli (1976), Ciani and Masseti (1991), Ciani et al. (1999), Masseti (2008, 2009a), and partially also by Spagnesi et al. (1986) and Spagnesi and Toso (2003) (Figure 3). The phenotype in question is characterised by scimitar-shaped horns in both sexes, but longer in the males, emerging close together on the forehead and displaying a parallel development more or less divergent at the tips (Erhard 1858, Reichenow 1888, Lorenz-Liburnau 1898, Zimmermann 1952, De Beaux 1955, Wettstein 1955, Couturier 1959, Schultze-Westrum 1963, Harrison 1968, Clutton-Brock 1981, Masseti 1981, 1997, Davis 1984, Groves 1989). The males are long-bearded and usually have a prominent body pattern, consisting of a dark median spinal stripe, transverse shoulder stripe and a flank stripe from the axilla to the groin (cf. Harrison 1968). Both sexes have a dark stripe on the front of the distal segments of the limbs, extending down to the dark grey hooves and strongly contrasted with cream colour on the sides of the metapodials. The belly is generally whitish, and the colour of the rest of the coat varies from tawny to greyish and isabella. Mature males have blackish brown marks on the face, beard, and throat, with a neck collar spreading into a breast plate. Out of the rutting season, the body markings of the males are fainter, as are those of the females throughout the year. There is apparently a clearly marked seasonal variation in the colour and development of the pelage, which also varies with age (Nievergelt 1986). Old males, for example, display a tendency towards pale and whitish tones of coat colour (Masseti 2009a). The iris of the eye is pale yellow, and the pupil is transverse and slit-shaped. Wild goats are not characterised by the occurrence of tassels, the cartilaginous outgrowth emerging at the base of the throat in many domestic goats (Masseti 2008, 2009a).

The occurrence on Montecristo of animals with similar characteristics is testified by several photographic documents dating to very recent historic times, such as a daguerreotype showing a subadult male dating to the end

Figure 3: Adult male of the Cretan wild goat, or *agrimi*, *Capra aegagrus cretica* Schinz, 1838. Island of Dhia (Crete), September 1979 (photo by Marco Masseti).

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of the 19th century, still conserved in the archives of the Florentine family of the late Count Carlo Ginori Lisci (see Masseti 2002, 2003, 2009a) or the photograph of a beautiful adult male shot in the 1920s, a few years after the end of the First World War (courtesy of Orlando Franchi) (Figure 4). Many other photographs documenting the occurrence of these phenotypes on the small Tyrrhenian island have since been published by Toschi (1953), Pratesi and Tassi (1976), Petretti (1980), Spagnesi et al. (1982), Masseti and Gavazzi (1984), Spagnesi et al. (1986), Spagnesi, 1993, Masseti (2002b, 2003b) and others.

In the course of an estimate of the number of the Montecristo wild goats carried out on behalf of the *Corpo Forestale dello Stato* (CFS) – *Ufficio territoriale per la Biodiversità di Follonica* – in the summer of 1998 (Ciani and Masseti 1998), the *Capra aegagrus* or *agrimi* phenotypes still represented 30% of the entire population (Masseti 2002, 2003). Moreover, and not incidentally, when in the first half of the 1980s the *Museo Civico di Storia Naturale* of Milan decided to create a diorama representing the terrestrial natural environment of Montecristo, two adult goat specimens were selected, one male and one female, which fully displayed the aforementioned phenotypes (Figure 5). Furthermore, a beautiful stuffed *agrimi*-like adult male, killed in Montecristo on the October 5, 1987, still figures in the ISPRA museum (technical sheet 6509, inventory 7418) at Ozzano dell'Emilia (Bologna), while another similar one, killed in the island before 1981, represented a fine specimen of the Montecristo goat population up to a few years ago in the small *in situ* museum of the island. At the time of the establishment of the nature reserve, animals with these phenotypic characters were anything but rare on the island, as also documented by Leporati (1971). Today, however, as observed by Spagnesi et al. (1982, 1986), we can note that the majority of the Montecristo goats display different coat types. In a large part of the population, the characteristics of the coat colour of the Asiatic wild goat appear to be progressively diluted, leading to the expression by the insular population of a peculiar phenotype of coat colour, which can be indicated as typical, also known as *Montecristo chiaro* ("Montecristo light") and *Montecristo scuro* ("Montecristo dark"), which is at present displayed by the majority of the local ungulates (Spagnesi and Toso 2003). It consists of a brown coat, noticeably varying from darker to lighter tones, sometimes shading to buff, where black markings are lacking, being replaced by a more brownish tinge that also more or less characterizes the dorsal line, the muzzle, the legs, the tail and the beard (Spagnesi et al. 1986, Masseti 2008) (Figure 6). According to Spagnesi et al. (1986), Ciani and Masseti (1998), and Spagnesi and Toso (2003), this is the phenotype, relatively and absolutely more widespread, respectively, in both the male and female classes, "*... which the Montecristo population naturally tends to*" (Spagnesi et al. 1986). Spagnesi et al. (1982) and Spagnesi et al. (1986) described the occurrence on the island of 12 main different coat colour phenotypes. These, however, may be broken down into only two main types of goat:

Figure 4: An adult Montecristo male photographed in the 1920s, a few years after the end of the First World War (courtesy of Orlando Franchi).

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Figure 5: Diorama showing one of the natural aspects of the island of Montecristo, with two stuffed specimens of the local wild goat characterised by the *Capra aegagrus* phenotype, in the Museo Civico di Storia Naturale of Milan (1980s) (photo courtesy of the Museo Civico di Storia Naturale of Milan).

Figure 6: The so-called "Montecristo phenotype" (see Spagnesi et al. 1986) consists of a brown coat, noticeably varying from darker to lighter tones, sometimes shading to buff, where black markings are lacking, being replaced by a more brownish tinge that also more or less characterizes the dorsal line, the muzzle, the legs, the tail and the beard. Montecristo, August 1998 (photo by Marco Masseti).

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the *C. aegarus* phenotype and the so-called "Montecristo" one, both characterised by straight scimitar-shaped horns (Figure 7).

But, why have the Asian pasang and/or the *agrimi* phenotypes so drastically decreased over the last decades? What has happened to the original goat population of Montecristo?

A matter of contamination

Like many other *capraje* (=goat sites) scattered throughout the Mediterranean literature since antiquity (i.e., Varro, *Rerum rusticarum*, Cetti 1774), the goat population of Montecristo, too, has been subject over time to even drastic numeric fluctuations, essentially attributable to excessive hunting. As a result of this, unlike Thièbaut de Berneaud (1808), d'Albertis (1877–1878), Angelelli (1903) and others, several explorers of the past, such as Lord Lilford who visited the island on April 22, 1882 (Trevor-Battye 1903), did not report the sighting of even a single animal. Even Toschi (1953), during his visit to the island, noted that: "*Needless to say poaching was extremely common, despite the reduced human population. The goats were continuously killed by the labourers assigned to the building restoration, hunters from Marciana Marina (on the island of Elba) landed expressly for the purpose, as well as fishermen. Almost all the fishing boats that stopped over at Montecristo had shotguns on board and many fishermen boasted of having killed dozens of goats. According to them, the wild goats on the island amounted at the time to one hundred individuals. I have reason to believe that their number was smaller and continually decreasing in view of the fact that in the sole week of our permanence* [end of May 1953] *at least a dozen goats were killed, despite the Ministerial Decree no. 6139 of 30 November 1951 that expressly prohibits hunting this game...*". The result of this indiscriminate and totally uncontrolled hunting practice became particularly evident a few years later, when the zoologist Kahmann (1959) visited the island: "*On the island of Montecristo the goat is clearly on the verge of extinction; in 1958, in the course of 10 days of exploration, we were able to sight only four individuals, and if these represented the totality of all those in existence, a very significant reduction of the animals must have taken place in the wake of*

Figure 7: Adult males of the Montecristo goat. The individual portrayed on the right side of the photograph falls within the character of the so-called Montecristo phenotype, while the other on the left is characterised by the Asian pasang one. More specifically, the latter goat falls within the phenotypic range of *C. aegagrus pictus* Erhard, 1858. This is the typical subspecies of the Greek islands, where it became extinct on Samothrace before the end of the 1980s (Sfougaris, 1990, 1995), but is still surviving on the islet of Antimilos (Erimomilos), five marine miles off the north-western coast of Milos (Western Cyclades, Aegean Sea) (Schultze-Westrum 1963, Sfougaris 1995, Sfougaris and Lymberakis 2009, Masseti 2009, 2012). Compared to the coat colour of the true Asiatic wild goat, that of *C. aegagrus pictus* can appear sometimes dominated by a recessive character, with a dark belly extending to the dark area of the flanks (Masseti 2008, 2009; see also Spagnesi et al. 1986). Montecristo, April 2009 (photo by Massimo Piacentino).

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Dr. Toschi visit". It is thus very likely that, when, in the first half of the 1950s, the Oglasa company was given a State concession to the island to convert it into an exclusive association devoted to hunting big game and deep sea fishing, the "Montecristo Sporting Club" (Mattoli 1970, Pardossi 1971, Bruno and Sauli 1976, Baccetti 1977) (Figure 8), the number of the goats had been drastically reduced, effectively jeopardizing the future of the enterprise itself. In fact, according to Guidi (2007), this was also a time of indiscriminate hunting, especially around the mid-1960s, which could perhaps explain the need to reintroduce new goats for the big game restocking of the island.

Therefore, in the population of Montecristo, all of a sudden, there appear goats that no longer respond the description offered by Toschi (1953, 1965), who compared them to the Asiatic wild goat. In actual fact, when the Montecristo Sporting Club was being set up, the regulations stated "*in relation to the killing of* hircus *goats … hunters are kindly requested, as far as possible, to preferably shoot those individuals that display clear patterns of hybridism* [sic!] *(white spots on ribs and legs)*" (Mattoli 1970). How is it possible that a meticulous and informed zoologist such as Toschi, who a few years earlier had confirmed the absence of any residual pattern of shape and colour in the Montecristo goats that recalled "*hypothetical domestic origins or less recent hybridsations or contaminations*" (Toschi 1953, 1965), failed to notice the "*white spots on ribs and legs*" described by Mattoli (1970)? As soon as the Oglasa company acquired the island on concession from the Italian government, it also began to perform an action of effective control on the local goats (Baccetti 1977), putting an end to the illegal hunting and also taking other practical measures aimed at increasing the big game of the island. Mattoli (1970), in fact, clearly states that since 1954, the company Oglasa: "*has exerted an assiduous vigilance over the goats, monitoring them also from a veterinary aspects*". The non-pure blooded patterns now occurring in the goat population of Montecristo would, therefore, suggest the introduction onto the island of a group of other animals, possibly domestic goats. This would not, however, have been the alleged importation to Montecristo of a few fictitious "goats from Montenegro" performed by the Italian king Vittorio Emanuele III at the end of the 19th century, as reported by Mattoli (1970), Bruno and Sauli (1976), or Raffaele Sandolo (2014, pers. com.), nor the consequence of another improbable importation carried out by the same Italian king, this time, however, from an unidentified Greek island, as suggested by Guidi (2007), but rather the appropriate restocking of the island big game.

Figure 8: Company logo of the Montecristo Sporting Club, which opened in 1970.

The current phenotypic similarity of the majority of the Montecristo goats to the so-called "ancient Corsican breed" would at least suggest that this was the race used for the restocking of its ungulate population. According to Porter (1996), the original Corsican domestic breed displays a range of colours often chestnut, or grey, as well as red, chamois-coloured, dark brown or black with tan, plain black, light brown roan, often with pale belly, and with or without areas of white and assorted patterns on their long coats (Figure 9). Moreover, Lauvergne (1986, 1988) observes that the vast majority have erect ears of medium size and straight scimitar horns; about half of them had tassels. It cannot, however, be ruled out *a priori* that the population of Montecristo may also have undergone some contribution from other domestic races with primitive characteristics, such as the so-called "chamois coloured" goat, a short-haired domestic race still bred in the Alps, with the typical dark areas particularly pronounced, as also assumed by Silvestri (1985). Both these domestic breeds are characterised by scimitar-shaped horns. Nevertheless, despite the crossing with these domestic animals, the Montecristo goats never display the occurrence of tassels. Individuals characterised by phenotypic patterns quite distinct from the morphology of the Asiatic wild goat appear to have already been established in Montecristo at the end of the 1960s, as testified, for example, by Pejrone (1970), who described the capture of almost blackish-dark brown goats (Figure 10). A few of these introductions of domestic animals continued up to recent times; indeed, Raganella Pelliccioni et al. (2005) surprisingly report on the last having taken place

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Figure 9: Adult male and female of domestic goats of the ancient Corsican race.

Figure 10: A blackish-dark brown specimen killed at the end of the 1960s, on the background of Cala Maestra (from Pejrone 1970).

in the year 1998. Therefore, if on the island there was a massive contamination of the local wild goat population by domestic individuals, this must necessarily have happened in very recent times, and possibly to a significant degree following the visit of Toschi to the island, that is to say after the year 1953 (Masseti 2002, 2003). Silvestri (1985), too, is of the opinion that this importation was probably not carried out before Toschi's survey. Today, the phenotypic appearance of the goats of Montecristo can be regarded as the direct consequence of the management measures adopted in relation to this insular population largely in recent decades, approximately between the first half of the 1950s and the end of the 1960s (Masseti 2014a).

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Problems of management (1971–2014)

Among the main aims of the institution, in 1971, of the Montecristo Nature Reserve was precisely that of guaranteeing the protection and conservation of the local wild goat, at that time already declared "*selvaggina stanziale protetta*" (="protected resident wild game") by the Royal Decree no. 1016 of June 5, 1939, while the Ministerial Decree no. 6139 of November 30, 1951 expressly prohibited its hunting. The goat of Montecristo is still regarded as "of cultural and scientific importance" (Raganella Pelliccioni et al. 2005, Giannini and De Pietro 2014, Vagniluca et al. 2014), and as observed by Raganella Pelliccioni et al. (2013), its value as a faunistic entity is linked not only to aspects related to the antiquity and peculiarity of the population but also to the very important role of *flagship* species that it played during the 1970s, when its conservation was, to a degree, instrumental in the establishing of the Nature Reserve and endorsing the protection of the entire island, otherwise destined to be left to touristic exploitation. These reasons, of a historic and cultural nature, indissolubly link this goat population to the island, at the same time justifying its conservation.

In addition to periodical and more or less extended periods of abandon to poaching, the goats of Montecristo have over the years been subject to different systems of hunting management and numerical control (Raganella Pelliccioni et al. 2013). The first killings for study purposes officially date to the year 1960, under the scientific control of the then *Laboratorio di Zoologia applicata alla Caccia* of Bologna. Between 1975 and 1977, 19 individuals were killed, which, together with the 36 carcasses found on the island in the same period (Raganella Pelliccioni et al. 2013), supplied the material for the first monograph on the Montecristo wild goat by Spagnesi et al. (1986). At least, according to Vagniluca and Quilghini (2009), between the years 1975 and 2006, 801 individuals were killed, 423 males, 375 females, and three of non-determined sex. Again according to Vagniluca and Quilghini (2009) and Raganella Pelliccioni et al. (2005 and 2013), up to 1997 an almost regular slaughter was carried out for the purpose of population control, in order to favour the persistence and renovation of the vegetation, with particular reference to holm oaks, *Quercus ilex* L., 1753. Since 1997, no further slaughter of the goats took place up to 2003, when a systematic monitoring of the population was resumed with annual frequency (Raganella Pelliccioni et al. 2005 and 2013). More specifically, in 2006 alone, 37 individuals were killed and purely for study purposes (Vagniluca and Quilghini 2009). Often, however, these killings turned out to be in the nature more of randomized shootings than selective actions. Indeed, even some of the animals characterised by the *C. aegagrus* phenotypes were killed, too. For example, evidence of this is to be found in the photograph published on page 10 of Spagnesi (1993) (Figure 11), showing a just-killed adult male, which displays the characteristic phenotype of *C. aegagrus*. The latter is, therefore, one of the cases in which a hunting selection aimed at the preservation of the phenotype described by Toschi (1953, 1965) was not performed.

As we have seen, therefore, the management measures adopted in relation to the goat population of Montecristo in recent decades, at least since the mid-1950s/1960s, may have mainly consisted in debatable restocking utilizing domestic breeds (see also Randi et al. 1990, Kolska Horwitz and Bar-Gal 2006). Added to this is the significant impact of the randomized hunting performed in the course of the last 40 years by the authorities in charge of the protection of the goats: the *Laboratorio di Zoologia della Selvaggina*, which later became the *Istituto Nazionale per la Fauna Selvatica* (INFS) and finally merged with the *Istituto Superiore per la Protezione e la Ricerca Ambientale* (ISPRA).

The EU Life Project Montecristo 2010–2014 or the end of a pure-blooded population

The inexplicable but reiterated attempts made since the 1960s, first by the private concessionaires and owners of the island, and later by the authorities in charge of the protection and conservation of the wild goat population of Montecristo, to alter the phenotypic purity through randomized shootings and the illegal introduction of domestic animals, culminated between 2010 and 2014, in the drastic reduction of this population resulting from the implementation of the aforementioned EEC Life project aimed at the redefinition of the ecological equilibrium of Montecristo. But this extermination did take place despite the assurances of the managers of the LIFE project that: "*The conservation status of species potentially threatened by the application of rat poison was also assessed, and no significant changes or population losses were recorded*" (Vagniluca et al. 2014). Apart, that is, from the drastic reduction, if not almost complete eradication of the wild goats. This was despite the "precautionary measures" taken to prevent the disappearance of the ungulates: up to the end of the programme, 45 individuals were confined

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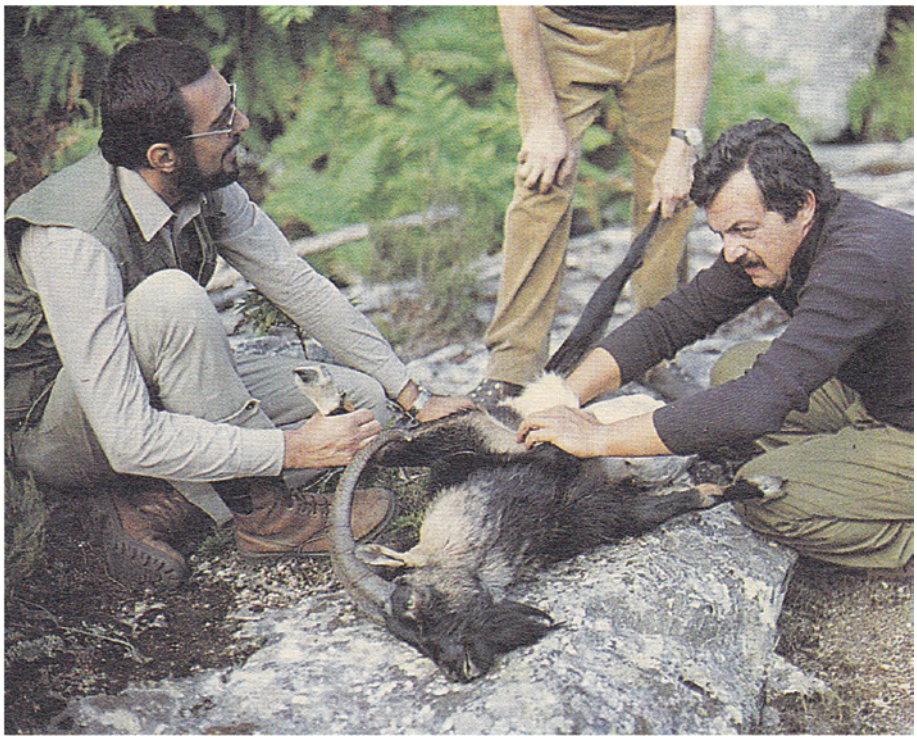

Figure 11: Montecristo adult male killed during selective hunting carried out by the representatives of INFS, *Istituto Nazionale per la Fauna Selvatica* (today ISPRA, Istituto Superiore per la Protezione e la Ricerca Ambientale). The specimen shows the phenotypic pattern of a pure *C. aegagrus* goat (from Spagnesi 1993).

to a large enclosed area where the rat poison was placed in special dispenser (Vagniluca et al. 2014, Zanichelli 2014). As explained by Vagniluca et al. (2014): a "*...large enclosure was built in October 2011 encompassing about 25 hectares, comprising the entire Belvedere promontory from Cala Maestra to Cala Santa Maria. This area was used to temporarily host the goat herd meant to serve as a buffer against drastic population declines* [...] *In December 2013 all the goats were released from the enclosure...*". The problem was, however, that a great number of the ungulates that were outside this enclosure fell victim to the rat poison.

Additionally, five other goats were transferred to the Bioparco Zoo in Rome (Fraticelli 2014, Gotti et al. 2014). However, the selection of the animals to allocate to this continental enclosure failed to take into consideration the original phenotypic characters of the population, so that all the goats selected were characterised by the brown colour phenotype without black areas on the limbs (see Spagnesi et al. 1986, Spagnesi and Toso 2003), better defined as proper to the "ancient Corsican race", and not to the original *Capra aegagrus* phenotypes of the Montecristo wild goats (Figure 12). They were officially presented to the Italian authorities and the public during a lavish ceremony marking the opening of the enclosure of the Montecristo wild goats at the zoological garden of Rome on December 5, 2012. As a consequence, it would seem logical to assume that, in the allocation to both the insular enclosure and that in the Rome zoological garden, there was no intention of making a phenotypic selection aimed at ensuring the conservation of the true Montecristo wild goat, that is to say, the *C. aegagrus* and/or the *agrimi* phenotypes.

Concluding remarks

As observed by Raganella Pelliccioni et al. (2013), the lack of information regarding both the ecologic and demographic aspects of the Montecristo wild goat population and the effects of the browsing and consumption of the fruits of the holm oak and other botanic species appears to be significant. Certainly, the goats contributed to the alteration of the insular ecosystem, determining the trivialisation of the local phytocoenosis, in synergy with other factors, such as the invasion of the tree of heaven and the diffusion of the pathology, which caused the reduction

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Figure 12: None of the five individuals of Montecristo goats transferred on November 8, 2012 to the Bioparco of Rome displayed the phenotypic patterns described by Toschi (1953, 1965) in relation to the original population of the island (inauguration of the enclosure of the Montecristo wild goats in the zoological garden – Bioparco – of Rome: photo from *Roma Today*, 05/12/2012).

of *Erica arborea* L., 1753. Nevertheless, how will it now be possible to understand the mechanisms of interaction between the goat population and the rest of the insular ecosystem, and assess its range and possible evolution with a view to adopting the most opportune conservation measures, when the original insular ungulates have already vanished? How will it be possible to recover the phenotypical characters and the original ecological role of the Asiatic wild goat in the Montecristo ecosystem when the selection made by the EU Life project was more concerned with conserving the individuals derived from a domestic breed imported onto the island in very recent historical times than with that of the ancient *Capra aegagrus* of Neolithic introduction? In the light of all this, could it still make sense to investigate the destiny of the wild goats of the *C. aegagrus* phenotypes that, up to 1998, represented 30% of the Montecristo population?

Fortunately, notwithstanding the intentions of the Life + Montecristo 2010 project and thanks to the efforts of the ConSDABI, Italian National Focal Point FAO, several stocks of the original phenotypes of the Montecristo goat were previously saved in a number of enclosures in continental Italy, between Tuscany and Liguria, by a few enthusiastic private breeders (Figure 13). They may prove the salvation of the ancient Montecristo wild goat. In fact, from these enclosures alone – and not from the Bioparco of Rome – could the goats be taken, if necessary, for the correct restocking of Montecristo – and other Mediterranean islands – in the near future. Then, regarding the significance of the results of the genetic analyses of the Montecristo goats recently recounted by Gotti et al. (2014), the objection could be raised that the sample chosen from the material available on Montecristo was not the most appropriate, in view of the fact that practically no account was taken of any specimen characterised by the original *aegagrus* phenotypes. According, in fact, to Gotti et al. (2014), these genetic analyses revealed that specimens from several *ex situ* herds do not have the distinctive genetic characteristics of the ungulates at present occurring on the island, as they possessed 27 alleles that are not found in the genotypes of the island population. Therefore, the differences with the *ex situ* specimens are incongruous, in effect, confirming the fact that the wild goats of *Capra aegagrus* phenotypes have been eradicated. However, this character does not appear to conflict with the results of another study carried out, some years ago, through the non-invasive extraction of DNA from the hair of wild goats from Montecristo, Crete (Dhia), Samothrace, and the Termessos National Park (Antalya) (Ciani et al. 1999). These samples showed marked differences in the allele patterns, but albeit, limited to microsatellite analysis, the Montecristo samples characterised by the *agrimi* phenotypes displayed a low variability compared with the greater polymorphism of the samples from Crete (Masseti 2009a).

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Figure 13: One of the stock of Montecristo goat, characterised by the *agrimi* phenotype, preserved *ex situ* at the "La Cerreta" estate in the province of Grosseto (southern Tuscany) (photo courtesy of "La Cerreta" estate).

There can be only two plausible explanations for what has been outlined above. The first is that the removal from Montecristo of almost all the individuals characterised by the phenotypes of the Asiatic wild goat was the result of a specific plan, the motivation for which is unfathomable. It is, indeed, very hard to understand what purpose could have been served by a strategy apparently aimed at the eradication of the goats characterised by the *Capra aegagrus* phenotypes. In this regard, it should be noted that even the stuffed wild goat, which, as mentioned above, up to a few years ago was exhibited in the small *in situ* museum of Montecristo, was recently replaced by two new specimens, an adult male and an adult female displaying phenotypic patterns very similar to the ancient Corsican domestic breed. One is almost led to think that the distribution of the poison pellets for the eradication of the rats, which were launched from helicopters (Sposimo 2014, Zanichelli 2014), was conceived to eliminate not only the rodents from the island. It may perhaps have been a preconceived plan to suppress the entire original population of the wild goats of Montecristo. But to what end? To recreate an island ecosystem that was destroyed and irretrievably lost thousands and thousands of years ago? It is important not to overlook the fact that an excessively philological and "purist" approach to the conservation of the Mediterranean islands may even prove to be detrimental, if not completely futile. We should also consider the real effectiveness of current worldwide management policies and conservation funding for schemes involving the eradication of historical populations of free-ranging island mammals (see Masseti 2009b,c), especially "wild" goats (e.g., Campbell and Donlan 2005, Keitt et al. 2011, Chynoweth et al. 2013). Past and present management and conservation policies regarding these populations have even been dictated (largely or partly) by whether the "authorities" perceived them as wild, feral or domestic animals. This, in turn, may have been influenced by current trends in the eradication of island invasives, as epitomized by the above-cited paper of Campbell and Donlan (2005) on goats on islands. Along the same line, it is also interesting to note that the wild goat – the population of Montecristo being the sole occurring anywhere in Italy – has been very recently included in Appendix II, "*Specie NA* (for which the risk of extinction in Italy is not assessed)" of the *Lista Rossa dei Vertebrati Italiani* drawn up by IUCN Comitato Italiano, in cooperation with the Ministero dell'Ambiente e della Tutela del Territorio e del Mare of the Italian government and Federparchi (Federazione Italiana Parchi e Riserve Naturali) (Rondinini et al. 2013).

The second explanation can be regarded – and I am very sorry to have to say – as a form of negligence resulting from the lack of scientific knowledge of the authorities and specialists in charge of the protection of the local ungulates (*Laboratorio di Zoologia Applicata alla Caccia*, then INFS, then ISPRA) and of the ecologic redefinition of Montecristo, who were apparently ignorant of the morphology and biology of *Capra aegagrus*, and of the history of its population on Montecristo. Evidently, this attitude on the part of the scientific authorities in charge of the indigenous goat management can only be interpreted as a lack of specific zoological knowledge. In both these

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cases, and in the latter in particular, we have to ask ourselves whether it is worth pursuing initiatives of this type, endorsed and financed by the international scientific community, when the final result of such procedures is to eradicate even the memory of certain biologic organisms. Is this the best way of using the funds provided by the European Union to intervene for the recovery – and/or redefinition? – of the ecological equilibrium of the Mediterranean islands?

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