

On the origin of the asp viper *Vipera aspis hugyi* Schinz, 1833, on the island of Montecristo, Northern Tyrrhenian Sea (Tuscan archipelago, Italy)

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ABSTRACT - For some time there has been debate regarding whether the asp viper, *Vipera aspis* (Linnaeus, 1758), belonged to the original fauna of the small island of Montecristo, Northern Tyrrhenian Sea (Tuscan archipelago, Italy). It has long been believed that the asp viper population of this island is made up of the subspecies *Vipera aspis hugyi* Schinz, 1833, also found in southern continental Italy and Sicily. A recent genetic study confirmed that this colonisation was exclusively mediated by humans, but also revealed that the extant vipers of Montecristo displayed closest relationships with those found in the Palermo region of Sicily, and southern Italy. It might be assumed that the animals that were introduced onto Montecristo originated from western Sicily. In light of recent contributions the aim of this paper is to make an original contribution regarding the times and mode of such an importation that was performed possibly around the 5th Century.

MONTECRISTO has traditionally been regarded as a remote sea-bound world, cloaked since time immemorial in the mists of its own legend. It is a small island of the Tuscan archipelago (Fig. 1), located in the Northern Tyrrhenian sea (N42°20', W10°9') about half-way between Corsica (23 marine miles) and the coast of central Italy (24 marine miles). It rises to 645 m above sea level and has an area of 10.39 km². Its perennial supply of fresh water is provided by a number of springs in various parts of the island. Declared as a Natural Reserve in 1971 by the Italian government, Montecristo is a remnant of the primeval Mediterranean phytocenosis (Filippello & 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 (see Lanza et al., 1984; Capula, 2006; 2007) and wild goat *Capra aegagrus pictus* Erhard, 1858, that were introduced possibly from the Near East in prehistoric times (Masseti, 2008a,

2009a). Wintering and migrant birds are also well represented on the island (Baccetti et al., 1981; Baccetti, 1994).

For some time there has been debate within the international scientific community regarding whether the asp viper *Vipera aspis* (Linnaeus, 1758) belonged to the original fauna of Montecristo. The main reason surrounding this query is that there are practically no palaeontological records of the taxon. Osteological fragments referred to the species complex as characterised by a morphology similar to that of *V. aspis* and *Vipera ammodytes* (Linnaeus, 1758) (Delfino & Bressi, 2000; Delfino, 2006). This evidence is not considered unusual among the Quaternary deposits of continental Italy. Apart from Montecristo and Elba, the majority of the remaining Tyrrhenian islands, such as Corsica, Sardinia, Gorgona, Capraia, Giglio, Pianosa, Giannutri, the Pontino and Flegrean archipelagos, Capri, and others, have not been colonised by vipers. According to Barbanera et al. (2009), Elba was likely colonised by asp vipers moving through land bridges with peninsular Italy during marine



Figure 1. Habitats of *Vipera aspis hugyi* on Montecristo.

regressions. However, it should not be excluded that today's population of *Vipera aspis francisciredi* (Laurenti, 1768) on Elba is the result of a human mediated introduction that occurred in former or recent times. The external features of the extant Elban vipers show an almost complete overlap with the phenotypes of the species dispersed in opposite areas on the Italian peninsula, but the vipers of Montecristo display unmistakable features of the subspecies *Vipera aspis hugyi* Schinz, 1833, (Fig. 2) which is more characteristic of vipers in southern continental Italy and Sicily (Zuffi & Bonnet, 1999; Zuffi, 2002). This is likely the reason why several scientists assumed that the snake was introduced onto Montecristo by humans. Among the first authors who cast doubts on the non-indigenous nature of the local viper were Mertens (1956), La Greca & Sacchi (1957), Müller (1967), and Bruno (1968). Bruno & Sauli (1976), Pozio (1980), Bruno (1984, 1985, 1988), and Bruno & Maugeri (1990) noted the affinities between the external characters of the Montecristo viper and

V. a. hugyi. The hypothesis was later agreed by Corti et al. (1991), Zuffi & Bonnet (1999), Zuffi (2001; 2002), Carpaneto (2002) and Masseti (2005; in press).

In light of recent new specimen acquisitions, the aim of this paper is to make an original contribution regarding the possible times and modes of the importation of the viper onto the island of Montecristo.

BACKGROUND

To estimate the time of colonisation we took into account the authors' data (above) and hypotheses. A genetic study carried out by Barbanera et al. (2009) confirmed the hypothesis that the colonisation of Montecristo by the asp viper was exclusively mediated by humans, as the island was never connected with the mainland, or with other islands (see Krijgsman et al., 1999). To judge this factor effectively we considered information on the translocation of different zoological taxa by humans between northern and southern Italy, a



Figure 2. *Vipera aspis hugyi*.

process that has taken place for many years (see Masseti, 2005).

Barbanera et al. (2009) demonstrated that the *V. a. hugyi* clade included all Montecristo vipers with the closest relationships existing with the Sicilian populations, especially specimens from the Palermo region (Table 1). The results of the genetic analyses showed closest apotypic affinities between the specimens of Montecristo (AM944786, AM944787, AM944788) and western Sicily (AM944789, AM944791, AM944792), rather than with those of eastern Sicily (AM944793, AM944794, AM944797, AM944795). Barbanera et al. (2009) quote that; “This is the first genetic evidence that *V. a. montecristi* Mertens 1956 should be placed in synonymy with *V. a. hugyi*, as suggested by Pozio (1980), Corti et al. (1991) and Zuffi & Bonnet (1999)”.

Thus, it appears that the animals introduced onto the small Tyrrhenian island originated from western Sicily. Since southern Italy and Sicily correspond to the boundary of ancient Magna

Graecia, a geographical area inhabited since the 8th Century B.C. by Greeks (see Masseti, 2008b), Barbanera et al. (2009) assumed that vipers might have been exported from there to Montecristo. In support of this hypothesis, the same authors cite the reports of the classical scholar Strabon (58 BC-25 AD, in: Lassère, 1967). The geographer Strabon reported that vipers were thrown as weapons during attacks on vessels coming from Africa and Sardinia intending to pirate rich Etruscan towns. They were protected as commercial partners by Greeks, who, for the purpose, established a military base on Montecristo Island (Barbanera et al., 2009). As a consequence, Barbanera et al. (2009) suggested that the colonisation of Montecristo by asp vipers very probably originated from *V. a. hugyi* specimens that were imported by the ancient militia from Magna Graecia between the 8th and the 3rd Centuries B.C.

However, there is no reference to the island of Montecristo in any passage of Strabon’s work. In Book V (7) of his "Geographia", the Greek author simply records that certain indigenous Sardinian

Phenotype	Ref.	Specimen	Field/Collection	Collection Site	mtDNA Haplotype	Accession Code
<i>V. aspis hugyi</i>	34	9	Field	Montecristo (LI)	H49, H50 (7), H51	AM944786 AM944787 AM944788
<i>V. aspis hugyi</i>	73	1	Zoological Museum	Firenze, Madonie (PA)	H52	AM944789
<i>V. aspis hugyi</i>	70	1	Zoological Museum	Firenze, Bosco Ficuzza (PA)	H54	AM944791
<i>V. aspis hugyi</i>	71	1	Field	Mazara del Vallo (TP)	H55	AM944792
<i>V. aspis hugyi</i>	69	3	Field	Etna (ME)	H56, H57, H60	AM944793 AM944794 AM944797
<i>V. aspis hugyi</i>	74	2	Field	Anapo (SR)	H58	AM944795

Table 1. Genetic results of the investigation on specimens of *Vipera aspis hugyi* Schinz, 1833, from the islands of Montecristo (Northern Tyrrhenian Sea, Italy) and Sicily performed by Barbanera et al. (2009).

peoples neglected cultivation "...preferring rather to plunder what they find cultivated by others, whether on the island or on the continent, where they make descents, especially upon the Pisatae." Lopes Pegna (1953) is perhaps the only author to confirm that the Greeks called the island "Ocrasia", while Angelelli (1903) and Pardossi (1971) are of the opinion that there is no explicit reference to the island of Montecristo in the whole ancient Greek literature. Both these latter authors, together with Repetti (1835), instead consider that, apart from Pliny the Elder who makes a fleeting mention, referring to the island as Oglasa (Naturalis historia, III: 80), there are no references to Montecristo in Latin literature either. The presence of the Etruscans and of the Romans on the island was, however, suggested respectively by Giuli (1833) and by Degli Albizzi (1854), on the basis of finds of elements of material culture.

However, the fact is it was not the Greeks but the Carthaginians who were in the habit of launching terracotta jars filled with snakes against enemy ships to frighten the crews. This practice had already been referred to by Bruno (1985) in the attempt to explain the origin of the population of Montecristo vipers: "We know from the historians that the snakes used for this purpose were captured regularly in Sicily and in Dalmatia". Bruno (1985) does not, however, provide the historic sources for such claims, and we have no alternative but to return to the page of the De Viris Illustribus (chapter X) of Cornelius Nepos where the Roman biographer reported that the Carthaginian Hannibal Barca: "Imperavit quam plurimas venenatas serpentes vivas colligi easque in vasa fictilia conici. Harum

cum effecisset magnam multitudinem, die ipso, quo facturus erat navale proelium, classarios convocat hisque praecipit, omnes ut in unam Eumenis regis concurrant navem, a ceteris tantum satis habeant se defendere. Id illos facile serpentium multitudine consecuturos" (= "He ordered as many venomous serpents as possible to be brought together alive, and to be put into earthen vessels, of which when he had collected a large number, he called the officers of his ships together, on the day on which he was going to fight at sea, and directed them all to make an attack upon the single ship of King Eumenes, and to be content with simply defending themselves against others, as they might easily do with the aid of the vast number of serpents").

Nepos described the naval battle of 184 BC between King Eumenes II of Pergamon (r. 197-159 B.C.) and King Prusias I of Bithynia (c.228-182 B.C.). Hannibal served as commander of the Bithynian fleet. He used catapults to hurl pots filled with venomous snakes into the enemy ships; the Pergamese panicked and fled, allowing the Bithynians to win (Sabin et al, 2007). Pergamon and Bithynia were regions of Asia Minor, respectively located in western and in north-western Anatolia (McEvedy, 1967). The setting of these events is, thus, a considerable distance from the coasts of Sicily and Dalmatia where, according to Bruno (1985) the serpents employed by the Carthaginians in the sea battles were habitually captured.

In effect, however, there is no historical evidence support an even hypothetical origin of the present vipers of Montecristo that could be placed between the 8th and the 3rd centuries BC. Even if we accept

that the animals may have been transported from Sicily to the islands of the northern Tyrrhenian Sea for the purpose of warfare, there remain other problems to be addressed.

VIPERS, SAINTS AND DRAGONS

Calibration of the molecular clock based on mtDNA markers was not possible in *V. aspis* due to a lack of fossils (Barbanera et al., 2009). However, calibration for Cyt-b based on geological evidence (the emergence of the Isthmus of Panama, 3.5 Mya) is available for the Viperidae, with a suggested divergence rate of 1.4% My⁻¹ (95% confidence interval = 1.09–1.77%: as in Wüster et al. [2002]; cf. Ursenbacher et al. [2006]). If this supposed divergence rate is correct, we could hypothesise a 0.0014% rate 1000 y⁻¹ (ranging 0.0011–0.0018%, that is 1100–1800 years), that could be around 1400 years ago. We realise that our data set is fairly small. Genetic characterisation of only ten samples from Sicily and Montecristo prevented us from performing additional robust phylogeographical analysis and, as a consequence, our final results may remain controversial. However, these results suggest that the introduction of the viper onto Montecristo might be many centuries after the chronological span indicated by Barbanera et al. (2009). Thus placing the introduction no longer at the height of the consolidation of Greek civilisation in the central Mediterranean, but rather around the middle of the first millennium AD, at the time of the fall of the Western Roman Empire. Consequently, it could also be ruled out that the importation of the viper onto Montecristo from Sicily was possibly performed not earlier than around the 5th Century of the current era. As explained by Fo (1992), the historical context is that of the major Barbaric invasions perpetrated throughout the peninsula, comprising the sacking of Rome by the Visigoths in 410. At this time, that is from the beginning of the 5th century AD, the islands of the Tuscan archipelago began to be populated by anchorites fleeing the devastation of civil society to take refuge in prayer in isolated and remote places. These were people who, as their contemporary Rutilius Claudius Namatianus, praefectus urbi of Rome in 414, explained in his work *De reditu suo*: "... call themselves 'monks'

using the Grecian name, because they wish to live alone, observed by no-one. They fear the blows of fortune and dread her gifts". The monks arrived in the Tuscan archipelago from all parts of Italy, now utterly defenceless and exposed to the destructive fury of the Barbarians, and even from Rome (Fo, 1992). An ancient popular tradition holds that the anchorites that took refuge on Montecristo were from Sicily. The legend in fact records that the bishop of Palermo, Saint Mamilian, landed on Montecristo with a handful of followers to escape the persecution of Genseric, king of the Vandals (Angelelli, 1903; Pardossi, 1971; Brizzi, 1986). The saint settled on the little Tyrrhenian islet, vanquished the dragon that lived on the highest peak, and changed its name from Mons Iovis to Monte Christo.

At times legends can conceal events that really took place. Thus the anchorites of Saint Mamilian, who had settled on the island in the 5th Century AD, later founding an important monastery, could have transferred the vipers to Montecristo from western Sicily. It is not immediately apparent why humans would have wished to introduce these animals. The snakes might have reached the island hidden in containers of victuals or agricultural provisions. However, it cannot be ruled out that the pharmacopoeia of the monks envisaged the extraction and study of the poison of venomous snakes to obtain theriac, a medical concoction, originally formulated by the Greeks in the first century AD, which was an alexipharmic, or antidote that was considered a universal panacea. Ethnozoological enquiries document that venomous snakes were utilised as medicine from very ancient times (Masseti, in press). The zoologist Augusto Toschi (1953) set the presence of the viper on Montecristo in direct relation with that of the monks, observing that: "The quantity of ophidians in Montecristo and the danger that they can represent would appear to find confirmation in tradition and legend, and in particular in the story of the life of Saint Mamilian".

Among the biological affinities between the biocenoses of Montecristo and the circum-Sicilian archipelago, we should also mention the occurrence on the Tyrrhenian islet of microgastropod, *Deroceras cf. golcheri* Van Regteren Altena, 1962,

(Giusti, 1976). Up until 1976, the taxon *D. golcheri* had been regarded as a Maltese endemic. It cannot be excluded that this mollusc too could have been imported involuntarily by man. However, in view of the marked polymorphism that characterises the bodies and genitals of snails, Giusti (1976) himself has not, at least to date, been able to diagnose with certainty the specific taxonomic classification of the gastropod, limiting himself to recording it with the name of *D. cf. golcheri*. Thus, at present, only further studies will be able to make an illuminating contribution to a better understanding of this taxon and the definition of its zoogeography. Should it prove to be a snail endemic to Malta. In which case an involuntary introduction together with the seeds of lettuce and other vegetables cannot be ruled out. These are in fact animals typical of turned soil, such as that of kitchen gardens (F. Giusti, pers. comm.).

The importation into the Tuscan archipelago of another invertebrate, the freshwater planarian, *Dugesia sicula* Lepori, 1948, has also been attributed to involuntary introduction. The taxon was described on the basis of sexual specimens from a population comprising both sexual and fissiparous individuals from the Sicilian locality of Cardillo near Catania (Lepori, 1948). It was then also recorded on the island of Elba by Benazzi (1950), who suggested passive transfer of the taxon on this island. Recent studies revealed, however, that the species occurs in the whole Mediterranean region (Pala et al., 1995).

The effect of human activity has not always ensured a decrease in overall species richness but more generally a change in community composition, often with the settlement of species adapted to environments originally extraneous to their natural distribution, but which they have inhabited since ancient times (see Masseti, 2009b). In any case, human activity must be considered one of the main factors to explain some present day composition of animal communities, as well as a key factor that explains most of the recent island extinctions (Williamson, 1989; Corti et al., 1999). For taxonomic groups such as the reptiles, biogeographical data suggests that humans have introduced several taxa on the Mediterranean islands (Corti et al., 1999; Masseti, 2009c). This may be the case among other herpetofauna such

as the *Bufo viridis* Laurenti, 1768 complex, on the Gymnesic and Pityusic islands (Hemmer et al., 1981), *Testudo marginata* Schoepff, 1795, on Sardinia (Arnold & Burton, 1978), *Macroprotodon cucullatus* (Geoffroy Saint-Hilaire, 1827), on Menorca and Mallorca (Pleguezuelos et al., 1994), *Chamaeleo chamaeleon* (L., 1758), in southern Spain (Talavera & Sanchiz 1985; Pleguezuelos & Feriche, 2003) and on Malta (Baldacchino, 1995), and perhaps even *Lacerta laevis* Gray, 1838, on Cyprus (Böhme, 1996). These ecological and cultural transplantations may not have been the result of casual maritime prospecting, but of the outcome of expeditions planned and prepared with a specific objective - the colonisation of the islands (see Masseti, 2009b).

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