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REVIEW

Sicily and the process of Neolithisation: a review of the archaeobotanical data

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Abstract

This review paper analyses the first steps of the spread of domestic plants into Sicily. Despite being the biggest island of the Mediterranean and its central position, the process of arrival and diffusion of crops in Sicily is still poorly understood. Starting from the limited but significant record from Grotta dell'Uzzo, the plant macrofossil data are presented and discussed with some comparison with the pollen, zooarchaeological and obsidian data. The closest regions to Sicily, from where these domesticates may have come, are discussed. The arrival of domesticated plants in Sicily fits perfectly with the model of dispersal by sea. The introduction of crops was a slow process that covered the whole of the Neolithic period. The intention is to raise interest in this field and to inspire researchers to analyse more plant macro- and micro-remains from prehistoric archaeological contexts in Sicily.

Keywords Island · Obsidian · Domesticated plants · Grotta dell'Uzzo · Farming · Sicily · Neolithic

Introduction

The origins and spread of agriculture from southwest Asia to Europe have been some of the most significant topics in archaeological research for the last 40 years (Ammerman and Cavalli-Sforza 1979; Pinhasi et al. 2005; Renfrew 2017; Shennan 2018). In the dispersal of the Neolithic from its sources of origin, various routes were followed, including the crossing of shorter or longer stretches of the Mediterranean Sea. Islands, due to being geographically circumscribed, are models for the dispersal of plants, animals and humans by sea (Warren et al. 2015). For example, the latest research in Cyprus and Crete has allowed archaeologists to accurately describe the arrival and spread of Early Neolithic communities, and this has radically changed our knowledge of the start of the Neolithic there (Guilaine 2017; Lucas and Fuller 2020).

Surprisingly, despite being the biggest island and forming a central region where the concept of the northern and southern coasts of the Mediterranean loses its sense, the process of Neolithisation in Sicily is still poorly understood. And in contrast to Sardinia and other Mediterranean islands, Sicily is quite close to the mainland of Italy, being just 3 km away from Calabria across the straits of Messina. So, potentially, the spread of domestic plants and animals, together with other aspects of the Neolithic culture, could be the result of both a very short or a longer distance sea crossing.

The earliest dated Neolithic archaeological complexes in Sicily are characterized by the *Impresse Arcaiche* pottery, which started to appear in the island between the end of the 7th and the beginning of the 6th millennium BCE (Natali and Forgia 2018). Most of the archaeological sites lie in the north-western part of the island and are limited to the coast and in caves, and no open-air settlement is known. The cave sites of Grotta dell'Uzzo, near San Vito Lo Capo, Grotta d'Oriente on the island of Favignana, and Grotta del Kronio, near the town of Sciacca in southwestern Sicily, represent the most significant dated sequences for these early Neolithic phases, together with the finding of *Impresse*

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Arcaiche in other caves in the area of Trapani and Palermo. Grotta del Kronio is the only site on the southwestern coast of the island where a sequence from *Impresse Arcaiche* to *Impresse Evolute* and the Kronio styles of pottery were identified (Tiné and Tusa 2012). Lithic technology, mostly found on flint tools, shows a continuity between the Mesolithic and the Early Neolithic industries, with very few exceptions (Collina 2012). All of these records show the early arrival of the Neolithic on the western part of the island, while eastern Sicily has very few signs of Neolithisation before the 6th millennium BCE (Tiné and Tusa 2012). The introduction of domestic animals like *Bos taurus* (cattle), *Ovis aries* (sheep) and *Capra hircus* (goat) is known from the Early Neolithic phase of Grotta dell'Uzzo and Grotta d'Oriente (Tagliacozzo 2005/2006; Martini et al. 2012).

With the development of Stentinello ware or *Impresse Evolute* (phases I and II) during the 6th millennium BCE, decoration with complex patterns on pottery became more common and the first open air settlements with huts are recorded, even if they are limited to very few "villages with enclosures" that instead characterize the late Early and Middle Neolithic in southern Italy (Tiné and Tusa 2012). Islands like the Isole Eolie (Aeolian or Liparian archipelago) northeast of Sicily (Fig. 1) were occupied at least by the middle of the 6th millennium BCE, when Stentinello pottery was already associated with the painted *Tricromica* ware, mostly in northern and western Sicily (Natali and Forgia 2018). Stentinello phase II is also marked by a significant increase in the spread of obsidian from Lipari, that reached its peak in the mid 5th millennium BCE (Freund et al. 2015), together with a general demographic growth (Giannitrapani 2023), even in the inner areas of the island as indicated at the sites of Rocche di Roccapalumba and Stretto Partanna (Tiné and Tusa 2012). The presence of domesticated livestock during the 6th millennium is shown by remains of ovicaprines (sheep or goats) both at coastal and inland sites (Prillo et al. in press).

Although there are recent data on plant remains from late prehistoric phases (Pasta and Speciale 2021), archaeobotanical research in Sicily is still underdeveloped (Pasta et al. 2022). In the latest review of the spread of the first crops in the central and southern Italian peninsula, Sicily stands out for the presence of only one site (Costantini and Stancanelli 1994, Fig. 1). The picture has not significantly changed in the last 30 years, except for some rare cases which are presented here, so other sources of proxy evidence like lake pollen cores are also discussed; in particular, especially when there are no local archaeobotanical data, pollen data can compensate by giving an insight on vegetation changes, such as an increase in Cerealia-type and pollen from ruderal plants and/or those connected with human activities, or a significant decrease in trees and change in biodiversity (Woodbridge et al. 2021).

The objective of this work is to put together all the available information on the Neolithisation of Sicily and the introduction and spread of domestic plants through the central Mediterranean, mostly from seeds and fruits but also from pollen and phytoliths for the pre-Neolithic phase, and obsidian for the Mesolithic and-Neolithic phases. This will hopefully inspire other researchers to study this interesting region and provide more data beyond what we already know (Fig. 1).

The pre-Neolithic phases: archaeology, pollen and other micro-remains

Considering the pace of the Mesolithic to Neolithic transition in the European continent, the period between 8500 and 6500 cal BCE represents a phase of slow inland expansion (0.40 km/year, Bocquet-Appel et al. 2012) and the first voyages by sea. According to the regional palaeoenvironmental data, the Late Mesolithic and the beginning of the Neolithic (6500 – 5500 BCE) were moderately wet phases, with some episodes of dry and cool winters such as the 8.2 ky cal BP cold event (Frisia et al. 2006), which according to some authors were very prolonged (Pasta et al. 2022). This climatic event, characterized by an abrupt climatic change, had a significant impact on the last Mesolithic and the first Neolithic communities. Encounters of local Mesolithic groups with the new farming communities have recently been suggested for Sicily (Lo Vetro and Martini 2012; Martini et al. 2012; van de Loosdrecht et al. 2020). As shown by some archaeological contexts and also differing from southern Italy, the hypothesis that pre-Neolithic populations in Sicily played a role in the transitional phase between the Mesolithic and the Neolithic is a possibility, as shown by the genomic and isotopic data from Grotta dell'Uzzo (Yu et al. 2022). This interpretation is well placed in a wider picture of several possible variations of the Neolithic according to their local features and depending on how foragers accepted the new systems (Robb 2013).

One of the earliest studies of botanical remains from prehistoric contexts in Sicily is that of Grotta dell'Uzzo, which is still considered a key site for understanding the spread of the Neolithic in the central Mediterranean. The site was excavated in the 1980s and the archaeobotanical results published in several papers (Fig. 2; Piperno et al. 1980; Costantini 1981, 2014). The most significant aspect of this site, together with Grotta d'Oriente on Favignana (Isole Egadi, Aegadian islands) (Table 1) may be the evidence of continuity between Mesolithic and Early Neolithic occupation (Mannino and Thomas 2007), which is different to that from most of the Italian Peninsula, but maybe more similar to the demographic continuity of North Africa (Broodbank and Lucarini 2020). Nevertheless, the date of the arrival of the Neolithic into Sicily remains partially unclear, probably

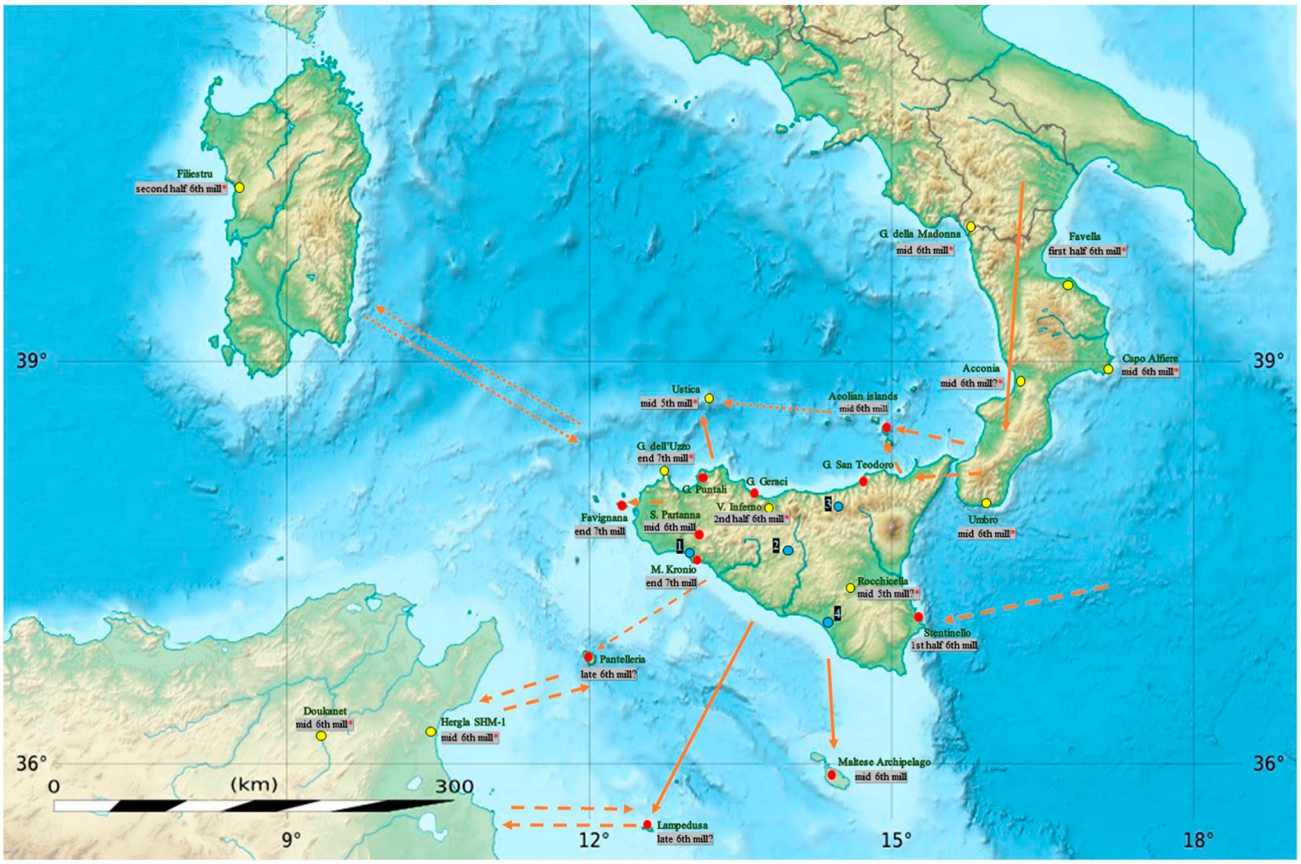

Fig. 1 Sites mentioned in the text; arrows showing potential routes for the spread of domesticates during the Neolithic, dashed lines mean uncertain routes; 1, Gorgo Basso and Lago Preola; 2, Lago di Pergusa; 3, Urio Quattrocchi; 4, Biviere di Gela; red dots, sites with no archaeobotanical analyses; blue dots, lake/ponds with pollen analyses; yellow dots, some of the sites with the most ancient Neolithic occupation; red * indicates archaeobotanical analyses

due to the continuity in the Mesolithic-Neolithic Castelnovian lithic industry (Mannino et al. 2015; Leppard 2022). Finally, the plant remains are mostly not directly dated, but attributed stratigraphically to archaeological phases; only a direct dating of the botanical specimens can then confirm the exact chronology of the steps in the introduction of plant taxa. The archaeobotanical data show the presence only of wild plants such as *Quercus* cf. *ilex* (acorns), *Arbutus unedo* (strawberry tree) and *Vitis vinifera* var. *sylvestris* (wild grapes) in the Mesolithic phase. The isotopic data show that the Early Mesolithic hunter-gatherers at Grotta dell'Uzzo relied mainly on hunting land animals together with significant contributions of plant foods, but limited consumption of sea food. In contrast, the diet of the Late Mesolithic inhabitants was characterized by more marine-based proteins, maybe enhanced by the stranding of big cetaceans (Mannino et al. 2015). After that, at the beginning of the Early Neolithic, a mixed economy of fishing and farming may have become established there a few centuries after the introduction of farming and grazing (agropastoralism) (Yu et al. 2022).

Several pollen records from lakes show small peaks of Cerealia-type pollen in the Mesolithic, as in the rest of southern Europe (Githumbi et al. 2022; see for example Masi et al. 2018). Cerealia-t. pollen can be attributed to some wild taxa within the Poaceae (unless we assume a very early introduction of crops to some areas), which were nevertheless part of the diet of human communities in the early Holocene (Mannino et al. 2015) and which indicate an opening up of the landscape around the sites. Lago Preola (Calò et al. 2012) has a small peak of Cerealia-t. at ~ 8000 BCE and the adjacent lake of Gorgo Basso (Tinner et al. 2009), about 7500 BCE. Also, in Urio Quattrocchi, starting from ~ 8000 BCE, the curves show a low incidence of Cerealia-t. (Bisculm et al. 2012). Mesolithic sites are almost unknown in these parts of southwest Sicily and the Nebrodi mountains; nevertheless, an insight into Upper Palaeolithic subsistence as evidenced by the analyses of the starch granules recovered from the dental calculus of remains from Grotta San Teodoro (Acquedolci, Messina) and Grotta d'Oriente C, indicates, as expected, the early consumption of grasses of

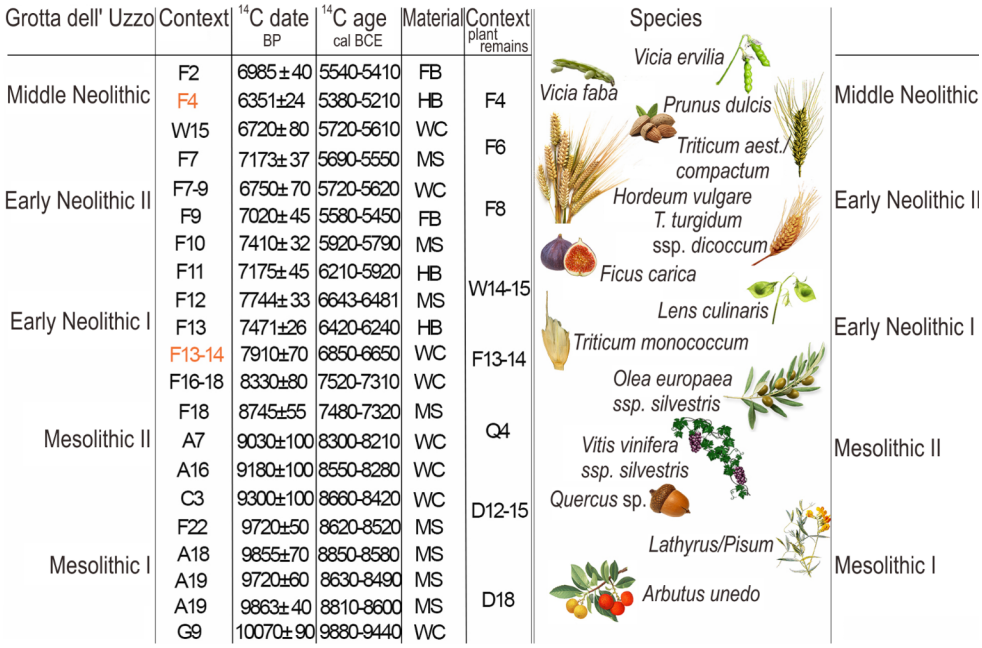

Fig. 2 Schematic representation of the sequence of Grotta dell'Uzzo. In the "Species" column, the first appearance of plants at the site. Dates of seeds/fruits are estimated from the archaeological stratigraphy. In the "Context" column, red lettering, the layer where archaeobotanical remains were directly dated. In the "Material" column, WC, wood charcoal; FB, fish bone; HB, human bone; MS, marine shell. Archaeobotanical data from Costantini (1981); Costantini and Costantini Biasini (1997); selected radiocarbon dates from Mannino and Thomas (2007), Mannino et al. (2015) and Yu et al. (2022)

the Poaceae family, and more likely grasses of the Paniceae and Triticeae tribes (Carra et al. 2023).

The arrival of domesticated plants and animals by crossing the sea

Most of the graphic representations or descriptions of the spread of the Neolithic into the central Mediterranean show Sicily as a marginal or transit area of Neolithic expansion from the Greek peninsula (Cunliffe 2008), Crete (Paschou et al. 2014; Malone 2015, Fig. 9.1) or far beyond (Pereira et al. 2017). In Bocquet-Appel et al. (2012, Fig. 4), the authors even avoid showing Sicily and Sardinia at all.

It is today commonly accepted that many areas of the Mediterranean were "domesticated" through "long-distance colonization that targeted certain types of niche" (Leppard 2022, p. 235) or in other words by a "leapfrog" expansion from one place to another, bypassing some places altogether (Forenbaher and Miracle 2005). Towards the end of the 7th millennium BCE, the opening of the vegetation in southern Italy and Sicily might have favoured the dispersal of "embryonal agricultural activities, as well as the spreading of unspecialized breeding along the coastal ecotones and, in general, within the lowlands" (Natali and Forgia 2018, p 266). Moreover, the rate of dispersal by sea was significantly faster than by land (Fort 2022), and it is at the end of this period of acceleration of the inland expansion (0.67 km/year) at ~6000 – 5950 cal BCE, that the dispersal rate by sea accelerated too (1.70 km/yr, Bocquet-Appel et al. 2012).

According to the archaeological excavations and surveys carried out, early farming and herding activities in Sicily first developed on coastal sites and lowlands, such as at Grotta dell'Uzzo and the area of Palermo/Trapani with Grotte Geraci and Puntali, Favignana and Grotta del Kronio, San Calogero (Table 1; Ayala et al. 2012; Tinè and Tusa 2012), where the Neolithic communities of the *Impresse Arcaiche* culture preferred to occupy partially open landscapes (for a detailed chronology, see Natali and Forgia 2018). Unfortunately, no economic data are available for most of the sites because of the lack of archaeobotanical investigations. But this spread of occupation supports the finding of a major change in genetic ancestry during the Mesolithic-Neolithic transition in Sicily, as shown by the data from Grotta dell'Uzzo. Excluding the dates from the latter, all the other dates available from the sites with *Impresse Arcaiche* are within 6000 – 5900 BCE, in line with the southern Italian chronology. It is worth saying that, without any records of domesticated plants from the sites, the presence of pottery does not imply directly that the "full" Neolithic package was integrated with the local economy, including farming (Dolbunova et al. 2023). That said, the assemblage from Grotta dell'Uzzo shows a transitional phase corresponding to the Early Neolithic where *Triticum monococcum* and *T. turgidum* ssp. *dicoccum* (the first hulled wheats), *Lathyrus/Pisum* sp. and *Lens culinaris* (domesticated legumes) appeared, together with the use of wild grapes which were already present in the Mesolithic phase, *Olea europaea* var. *sylvestris* (wild olive) and *Ficus carica* (fig). The isotopic values for diets agree with the archaeobotanical data, confirming that these Early Neolithic communities had a land-based farming diet (Yu et al. 2022).

Ficus carica pollen together with that of crops such as cereals appears at ~5500 BCE in the Lago Preola sequence.

Table 1 Names of the sites cited in the text and their data; in the column "^{14} C dates" only one uncal date is cited, the full list is in the reference. LME-EN, Late Mesolithic to Early Neolithic; EN, Early Neolithic; MN, Middle Neolithic

Site	Province	Height (m a.s.l.)	^{14} C dates (BP)	Material	Chronology	Archaeobotany	Domesticated taxa	References
Grotta San Teodoro	Messina	140	12,531 ± 80	Human bone	-	Yes	-	Carra et al. 2023
Perriere Sottano	Siracusa	50	8,460 ± 70	Wood charcoal	LME	No	-	Aranguren and Revedin 1989
Grotta dell'Uzzo	Trapani	93	See Fig. 2	Wood charcoal, human bones, fish bones, marine shells	LME-MN	Yes	*Triticum monococcum, T. dicoccum, T. aestivum, Hordeum vulgare, Lens culinaris*	Mannino and Thomas 2007; Costantini 1981
Isolidda, San Vito Lo Capo	Trapani	30	8,620 ± 45	Marine shell	LME-EN	No	-	Lo Vetro et al. 2016
Grotta d'Oriente	Trapani	40	8,699 ± 60	Wood charcoal	LME-EN	No	-	Martini et al. 2012
SHM-1	Hergla (Tunisia)	7	8,220 ± 40	Marine shell	LME-EN	Yes	Absent	Broodbank and Lucarini 2021
Grotta Geraci	Palermo	200	No	–	EN	No	-	Tiné and Tusa 2012
Grotta Puntali	Palermo	12	No	-	EN	No	-	Tiné and Tusa 2012
Monte Kronio	Agrigento	300	6,991 ± 60	Wood charcoal	EN	No	-	Tiné and Tusa 2012
Stentinello	Siracusa	11	No	–	EN	Yes	?	Basile et al. 2006
Grotta Filiestru	Sassari	410	6,710 ± 75	Wood charcoal	EN	Yes	*T. monococcum, T. dicoccum, Pisum* cf. *sativum*	Lugliè 2018
Pantelleria – Cuddia Bruciata	Trapani	120	No	–	EN?	No	-	Cattani and Tusa 2012
Lampedusa – Cala Pisana	Agrigento	20	No	–	EN?	No	-	Radi 1972
Fiaccati, Roccapalumba	Palermo	340	5,820 ± 45	Mammal bone	MN	No		Iannì et al. 2022
Vallone Inferno	Palermo	770	6,340 ± 30	Wood charcoal	MN	Yes	Uncertain	Forgia et al. in prep.
Rocchicella, Mineo	Catania	116	6,210 ± 40	Mammal bone	MN	Yes	*Pisum* cf. *sativum*, Cerealia	Castiglioni 2008; Giannitrapani 2023
Ustica – P. Cardoni	Palermo	100	5,860 ± 30	Mammal bone	MN	Yes	*H. vulgare*	Speciale et al. 2023
Santa Verna – Maltese archipelago	Xagħra (Malta)	130	6,412 ± 44	Seed	MN	No	*T. dicoccum, T. compactum, L. culinaris, Hordeum* sp.	Malone et al. 2020

The increase of *Ficus carica* and Cerealia-t. and the decline of *Olea* and *Pistacia* at ~5350 BCE could indicate agricultural activity in this part of southwestern Sicily. Signs of farming are, according to the authors, clear around Gorgo Basso after this time and persisted for around 500 years. The results are different for the central part of Sicily, where Lago di Pergusa and Biviere di Gela show anthropogenic pollen indicators (APi) (Mercuri et al. 2019) of pastoralism more

than farming. This could show an uneven spread of agriculture throughout the island at the transition between the Early and Middle Neolithic; the significant presence of domesticated animals at sites like Roccapalumba (Iannì et al. 2022), Vallone Inferno and Stretto Partanna (Martínez Sánchez et al. 2016) shows, on the other hand, the wide introduction of livestock to the inner part of the island already between the end of the 6th and the beginning of the 5th millennium BCE.

Considering the regions around Sicily, one possible source of the domesticated plants which arrived in Sicily would be Calabria, on the closest lying mainland of southern Italy. The latest work on the spread of farming in Calabria has now defined the steps of this introduction through the analysis of some key cave sites (Natali et al. 2021; Pessina and Tiné 2022). In this region, the arrival of the first cultivated crop, *Hordeum vulgare* (barley) and the growing of hulled wheats and pulses began at least in the Early Neolithic at the beginning of the 6th millennium BCE (Natali and Forgia 2018, Table 2). The first appearance of domesticated plants and animals at Grotta dell'Uzzo, though, in the most western part of Sicily, and the spread of *Ceramiche Impresse* more or less contemporary to that in Calabria, indicates their dispersal after crossing the sea approximately at the same time; the lack of archaeobotanical analyses and the limited amount of zooarchaeological analyses at the Sicilian sites does not allow confirmation whether the spread of pottery types happened together with that of the first farming and herding activities. But it is important to say that *Hordeum vulgare* appears in Grotta dell'Uzzo only by a more advanced phase of the Early Neolithic (Costantini and Costantini Biasini 1997), when new taxa are thought to have been introduced.

Sicily could then have been a staging point for the Neolithisation of the surrounding small islands and then North Africa. For the central part of North Africa (modern eastern Algeria, Tunisia and western Libya), the most recent investigations do not indicate an early spread of domestic plants, but a preference for gathering wild plants until the end of the 6th millennium BCE (Mulazzani et al. 2016; Lucarini and Radini 2021; Portillo et al. 2021); this contrasts with the record from the eastern and western Maghreb in North Africa, where both cereals and pulses arrived earlier (Morales et al. 2016, 2018); the southern Mediterranean picture can be described as one where "the uptake of domesticates was selective, spread over time" (Broodbank and Lucarini 2020, p 224).

Although some authors do not think that there was trade between Sicily and Tunisia before 5000 BCE (Zilhão 2014), obsidian from the island of Pantelleria which lies in between them is present in Hergla SHM-1 in northeastern Tunisia at the end of the 7th millennium BCE (Broodbank and Lucarini 2020). The first phases of occupation of Pantelleria, though, are still extremely unclear and there are even claims of underwater pre-Neolithic sites (Abelli et al. 2016). Sources of obsidian in Pantelleria and also in Lipari in the Isole Eolie (Aeolian Islands) north-east of Sicily, could be one of the reasons for their early occupation. The use of this volcanic glass for making blades, irreplaceable in terms of sharpness but with very limited sources, can be linked to a change in technological choices (Mazzucco et al. 2020), perhaps also because wild grasses were increasingly being gathered. One of the possibly oldest records of obsidian artefacts in Sicily would be the Mesolithic layer of Perriere Sottano (Aranguren and Revedin 1989–1990); the next earliest ones were found in contexts dated between the end of the Mesolithic and the early Sicilian Neolithic (6020 – 5790 BCE) at Grotta d'Oriente (Martini et al. 2012) and at Isolidda (Lo Vetro et al. 2016). Obsidian from Pantelleria has even been found at an Early Neolithic site on the nearby island of Lampedusa (Radi 1972). Finally, the site of Cuddia Bruciata, in the northern part of Pantelleria, could belong to a Neolithic phase (Cattani and Tusa 2012) with Capsian pottery (Giannitrapani personal communication) and according to the chronology of Mulazzani (2013). All of this seems clearly to point to an early occupation of Pantelleria with contacts both with Tunisia and Sicily, possibly to extract the obsidian there before Lipari, in the mid 6th millennium BCE (Martinelli et al. 2020). The role of Pantelleria as a potential bridge for domesticated taxa will be clarified only by new investigations and scientific analyses.

In Sardinia, Lugliè (2018) records a broad distribution of sites with evidence for Neolithic domesticates and *Ceramiche Impresse*; the earliest evidence of cultivated plants is from the second half of the 6th millennium BCE, becoming more widespread after the mid 5th millennium BCE (Ucchesu et al. 2017). The presence of *Ceramiche Impresse* sites in the Arcipelago Toscano of islands west of Tuscany may, together with the evidence from Corsica, Sardinia and northwestern Sicily including the island of Ustica, suggested by Mannino (1998) and confirmed by new unpublished surveys by the author of this paper, indicate a migration route of people navigating along the western shores of Sardinia and Corsica and colonising the coasts (Leppard 2022), but nothing is recorded so far in terms of the spread of domesticated taxa.

The Middle Neolithic phase: new waves of colonisation?

The demographic contraction of the Early Neolithic (Guilaine 2015) was counterbalanced by a demographic increase in the Middle Neolithic, dated to the end of the 6th millennium BCE by AMS radiocarbon dating (Giannitrapani 2023). In Sicily, a dramatic change in settlement patterns is

observed in this period. The first demographic "boom" (following the theories on "boom-and-bust" trends, Shennan et al. 2013) goes together with the use of different ecological areas, a process that started in the mid 6th millennium BCE. In most of the Mediterranean, the speed of culture spread by sea increased significantly to reach its maximum average value (1.7 km/yr) on the 5200 cal BCE isochrone, but towards 4200 cal BCE, it slowed down again (Bocquet-Appel et al. 2012).

During the Middle Neolithic in Sicily (~5500–4500 BCE), an increasing complexity in the subsistence systems led to the use of the hinterland, with the opening up of wooded uplands and the slow introduction of crop plants into these areas. Inland and hilly areas were occupied more or less permanently, also including more extreme environments like the Madonie mountains and some distant small islands such as Ustica (Fig. 1; Dawson 2014; Forgia 2019; Speciale et al. 2021).

The island of Lampedusa was settled, but maybe not permanently, during the Stentinello phase in the second half of the 6th millennium BCE (Radi 1972; Tiné and Tusa 2012). On Malta and Gozo, initial Neolithisation is traditionally placed at ~5200 BCE with the start of the Għar Dalam phase, although recent palaeoenvironmental research suggests possible human impacts from ~6000 BCE onwards, and new archaeobotanical analyses so far confirm the presence of barley, wheats and domesticated pulses, starting from the second half of the 6th millennium BCE (Malone et al. 2020).

Once again, Grotta dell'Uzzo provides the best evidence for the spread of domesticated plants through the millennia: in the second half of the 6th millennium BCE*Triticum aestivum* and *T. compactum* (naked wheats) were introduced, together with a continuous record of *Vicia faba* (broad bean) and, since the Mesolithic/Early Neolithic phases, foraging for wild plants such as *Olea* (olive), *Vitis* (grape), *Ficus* (fig) and now also *Prunus dulcis* (almond). Some information comes from the eastern part of Sicily, where from Rocchicella (Mineo, Catania) probably domestic pulses like *Pisum* cf. *sativum* (pea) and cereals have been found, confirming that farming had started in the inland areas at least from the second half of the 5th millennium BCE (Castiglioni 2008). Cultivated plants were possibly present from the archaeobotanical analyses of Neolithic phases at Vallone Inferno (Scillato) in the Madonie mountains, but cereals could also belong to the Bronze Age occupation (Forgia et al. in preparation). Some data from Stentinello (Siracusa) in eastern Sicily were announced but never published (Basile et al. 2006). Focusing on the islands, Ustica, a small island off the northern coast of Sicily (Fig. 1), was permanently settled between the end of the 6th millennium BCE and the first half of the 5th millennium BCE. The finding of a megalithic funerary structure that belongs to this phase provided the first appearance of barley on the island; the presence of a large number of wild animal remains, though, together with several domesticated animals, indicates a diet in which hunting and fishing were important (Prillo et al. in press; Speciale et al. 2023).

Finally, considering the pollen sequences, Biviere di Gela (Noti et al. 2009) became wooded at ~5250 BCE, reaching a maximum at ~5050–3050 BCE, but the appearance of Cerealia-t. and *Plantago lanceolata* at ~4650 BCE may suggest modest agricultural activity at the end of the Middle Neolithic, while unambiguous signs of farming are found in the surrounding area only at ~4350–4250 BCE. In Pergusa, the first small peak of human indicators (APi) was found at ~5050 BCE.

Conclusions

The arrival of domesticated plants and animals in Sicily fits perfectly with the model of their dispersal by sea, considering also their possible arrival in Sicily and Calabria, the closest region of mainland Italy, at the same time. The dispersion of domesticated plants was then quite varied and uneven, as the pollen evidence also seems to show. The fast dispersion of *Ceramiche Impresse* pottery in the coastal areas and the small islands around Sicily still has no supporting archaeobotanical evidence. But the role of the island of Pantelleria in the south-north trade in obsidian might suggest such a movement of domesticates too. Understanding what are the socio-economic reasons for the movements of rather small groups of farmers by short or long sea voyages could help in understanding if and how domestic plants spread into the central Mediterranean. The introduction of crops was not a single episode, as the evidence from Grotta dell'Uzzo shows, but rather a long process with many stages over thousands of years, from hulled wheats to barley to naked wheats, and from lentils to broad beans. These introductions could also have involved local choices and/or selection of animals and plants, as happened among the hunter-gatherers of North Africa. Finally, the spread of all the plants which were originally domesticated in the Near East (the "Neolithic package") was accomplished in Sicily by the first half of the 5th millennium BCE. Nevertheless, the establishment of a significant and widespread farming economy was probably only achieved by the end of the Copper Age (end of the 3rd millennium BCE).

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