"To 'seafood' or not to 'seafood'?" An isotopic perspective on dietary preferences at the Mesolithic-Neolithic transition in the Western Mediterranean

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ABSTRACT

Stable isotope investigations of the Prehistory of the Western Mediterranean have increased exponentially during the last decade. This region has a high number of Mesolithic and Neolithic carbon and nitrogen isotope ratio data available compared with other world areas, resulting from the interest in the "transition" between hunter-gathering and farming. This type of analysis is important as one of the few tools that give direct information on the poorly understood dietary transition from hunter-gatherer to agro-pastoralist subsistence in the Mediterranean Basin. Carbon and nitrogen stable isotope analysis on bulk collagen are especially useful for exploring marine vs. terrestrial protein input and therefore assess marine resource exploitation by these two different lifestyles. Gathering together all isotopic data for these chronologies we show that the Western Mediterranean underwent a unique/distinct Neolithisation process. These data show a gradual dietary shift in aquatic resource consumption during the transition to farming that contrasts to elsewhere in Europe.

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1. Introduction

During the last 5 years, a plethora of isotopic studies have been undertaken in the Western Mediterranean region. Before then, most of dietary isotopic studies on the Mesolithic and Neolithic periods were focused on the European Atlantic, Baltic and Central Balkan regions. While these first studies portrayed a brusque shift in subsistence patterns between hunter-gatherers and agro-pastoralists in the Atlantic façade (e.g. Fisher et al., 2007; Lubell et al., 1994; Richards et al., 2003a) and a continuity in the Baltic (e.g. Lidén et al., 2004) and Central Balkan regions (e.g. Bonsall et al., 2004; Borić et al., 2004) regarding the exploitation of marine and aquatic resources, a vast gap existed in the Mediterranean region. The first carbon and nitrogen isotope studies published in the Mediterranean were from the sites of Araguina Sennola and Monte Leone in Corsica (Costa et al., 2003), Arene Candide in Liguria (Francalacci and Borgognini Tarli, 1988; Pettitt et al., 2003), Samari, Ripatetta, Latronico, Catignano and Trasano in Central and South Italy (Giorgi et al., 2005), and the Mesolithic site of El Collado in Eastern Iberia (García-Guixé et al., 2006). Since then the development of research on this area saw several studies in southern France, Corsica, Liguria and Eastern Iberia being published, undoubtedly boosted by the development of research programs dedicated to the Neolithisation in the Mediterranean as well as the completion of PhD thesis on French, Italian (Goude, 2007) and Spanish areas (Salazar-García, 2012; Fontanals-Coll, 2015).

In this review we explore isotope data acquired from bone collagen during the last decade in human Mesolithic and Neolithic human remains from the Western Mediterranean (Mediterranean Iberia, Liguria, southern France, and Corsica), just after briefly summarizing what the archaeological and zooarchaeological evidence tell us about the subsistence patterns of last the hunter-gatherers (Epipalaeolithic and Mesolithic peoples) and first farming communities (Early, Middle and Late Neolithic peoples) from the region. However, before this, we highlight the potential and limitations of stable isotope ratio analysis as a dietary proxy or past populations.

1.1. Isotope analysis and past dietary reconstructions

Carbon and nitrogen stable isotope analysis of collagen from skeletal tissues such as bone and dentine has long been established as a reliable tool for inferring information about the diets of historic and prehistoric humans and animals (e.g. Lee-Thorp, 2008; Makarewicz and Sealy, 2015). This technique is based on the underlying rationale that the isotopic composition of food is recorded in the body tissues of a consumer (De Niro, 1985; De Niro and Epstein, 1978, 1981) after a predictable isotope fractionation (Schoeller, 1999). Well-preserved archaeological remains can retain the stable isotope ratios present during life, and although many types of human tissues are suitable for stable isotope analysis, archaeological studies typically focus on bones, dentine, and enamel. Bone and dentine are composed of both inorganic (ca. 75–80% of dry weight, mostly hydroxyapatite) and organic (ca. 20–25% of dry weight, mostly collagen) matter, while enamel is typically composed of more than 98% inorganic hydroxyapatite (Hillson, 1996; Nanci, 2013). Each of these components have specific stable isotope ratios that reflect their chemical origin and formation: the inorganic mineral derives from the end products of metabolism and reflects the carbon isotopic ratios of the whole diet, while the organic matter derives mainly from dietary amino acids (with possible modification, such as transamination) and reflects carbon and nitrogen isotope ratios mainly linked to protein consumption (e.g. Ambrose and Norr, 1993; Fernandes et al., 2012; Tieszen and Fagre, 1993). Recently, it has been proposed that dental calculus might also serve as a suitable substrate for isotopic investigations, including carbon and nitrogen stable isotope-based paleodietary inference (e.g. Scott and Poulson, 2012). However, subsequent studies have found that interpretation of isotopic values obtained from dental calculus is far from straightforward (Salazar-García et al., 2014a).

Therefore, bulk collagen from bone or dentine is still usually the preferred substrate for carbon and nitrogen stable isotope-based dietary reconstructions for three reasons: 1) its biochemistry is well known, 2) it is the major nitrogen source in skeletal remains, and 3) the atomic ratio of C to N obtained from a sample provides a robust quality indicator that can reliably assess the isotopic integrity of material even more than 100,000 years old (De Niro, 1985; Van Klinken, 1999; Britton et al., 2011; Bocherens et al., 2005; Fontugne et al., 2014). However, there are a few considerations to bear in mind when interpreting collagen isotope ratios. Due to a slow but constant collagen turnover, results obtained from adult human bone collagen represent an averaged protein diet over many years prior to death, depending on the collagen turnover rate of the bone sampled, health conditions and genetic origins (Schwarcz and Schoeninger, 1991; Han et al., 1997; Hill, 1998; Valentin, 2003; Hedges et al., 2007). By contrast, dentine collagen exhibits almost no turnover, and thus the isotopic values measured from dentine primarily reflect the protein sources consumed during the short interval in which the dentine of each tooth was formed, mainly during childhood (AlQahtani et al., 2010; Beaumont et al., 2013),

with the added uncertainty that the values could have been influenced by breastfeeding and weaning (Fuller et al., 2006; Eerkens et al., 2011; Beaumont et al., 2013; Herrscher et al., 2017).

Carbon stable isotope values of collagen are used to distinguish between the consumption of marine (^{13}C enriched) or terrestrial (^{13}C depleted) foods in the diet (Chisholm et al., 1982; Peterson and Fry, 1987; Schoeninger and De Niro, 1984). However, the interpretation of δ^{13}C values becomes more complicated if fish obtained from brackish water are included in the diet (Fuller et al., 2012; Grupe et el., 2009), as has been previously reported for Western Mediterranean prehistoric times (Salazar-García et al., 2014b). δ^{13}C can also be used to estimate the relative dietary proportions of plants performing C_4 versus C_3 photosynthesis (Van der Merwe and Vogel, 1978; O'Leary, 1981). This is useful because all trees, shrubs and herbs, as well as temperate or shade-adapted grasses, are C_3 plants (^{13}C depleted), while C_4 plants (^{13}C enriched) include many important domesticated tropical grasses (e.g., maize, sorghum, millet, and sugar cane). However, because there is no clear evidence of C_4 plants in Europe during most of Prehistory (Sage et al., 1999), δ^{13}C values at the onset of farming are primarily used to distinguish between marine and terrestrial C_3 protein consumption, allowing assessing if Mesolithic peoples exploited intensively or not the sea (Lane, 2014).

Collagen nitrogen stable isotope ratios are typically used to estimate trophic level because δ^{15}N increases by approximately 3–5‰ with each step up an idealized food-chain (De Niro and Epstein, 1981; Minagawa and Wada, 1984; Schoeninger et al., 1983; Bocherens and Drucker, 2003), with some acknowledgement of inherent variation among these values (Hedges and Reynard, 2007; O'Connell et al., 2012). Although this can be further complicated by special cases in which plants have higher δ^{15}N values than expected (e.g. Warinner et al., 2013; Bogaard et al., 2007) or in cases of animal tissue enrichment due to urea-recycling under water stress (Ambrose, 1991; Balter et al., 2005), as well as due to the impact of aridity on animals conveyed through plants (Hartman, 2011; Murphy and Bowman, 2006), δ^{15}N values can still allow diets rich in plant proteins to be distinguished from those rich in animal proteins as showed in modern studies of known diets through hair (Bol and Pflieger, 2002; Petzke et al., 2005; Fahy et al., 2013). Additionally, because aquatic food chains tend to contain more trophic levels than terrestrial ones, individuals consuming diets rich in marine or freshwater resources typically have higher δ^{15}N stable isotope values than individuals consuming predominantly terrestrial food products (Schoeninger et al., 1983; Schoeninger and De Niro, 1984; Webb et al., 2017). Furthermore, when combined together, nitrogen and carbon isotope values can discriminate between the consumption of marine foods and C_4 terrestrial foods (both might have overlapping δ^{13}C values but different δ^{15}N ones) (Lee-Thorp, 2008), as well as between different micro-regional environments differentiated by specific climate, temperature, forest covers and soil compositions (e.g. Goude and Fontugne, 2016).

Even with their potential and methodological limitations, there is one important interpretive bias that carbon and nitrogen isotope ratio analyses on bone collagen possess: the detection of plant food consumption below a certain proportion. In order to do so, other techniques and approaches more useful to detect plant foods should be considered when addressing this and coupled when possible together with isotope analysis: dental microwear (e.g. El-Zaatari and Hublin, 2014; Salazar-García et al., 2016a), study of plant microremains in dental calculus (e.g. Power et al., 2015a; Salazar-García et al., 2013a), or biomolecular techniques on dental calculus (e.g. Warinner et al., 2014). However, and although it is possible that plant foods were critical for essential micro-nutrients to prehistoric Mediterranean humans, plant foods as main energy

sources (especially during the Neolithic) should not be assumed but rather demonstrated. It is because of these limitations that the role of plant foods in hunter-gatherer and early farming Western Mediterranean diets is beyond the scope of this paper and would require the combination of isotopes with the aforementioned other direct techniques directly on the human remains themselves.

2. Non-isotopic evidence of diet from last hunter-gatherers and first agro-pastroralists

2.1. Hunter-gatherer populations

The change from a hunter-gathering lifestyle to a farming one had, undoubtedly, an impact on many facets of daily life including subsistence patterns and diet. But there were other dietary changes before that were also of importance and made their way throughout the Mesolithic period in the Western Mediterranean. It has been noted, traditionally, that an increase in the amount and diversity of marine resources started at the beginning of the Holocene, during the Late Upper Palaeolithic and the Mesolithic of the Mediterranean basin (Cortés-Sánchez et al., 2008; Aura et al., 2009; Stiner and Munro, 2011). Cueva de Nerja (Malaga, Spain) is probably the best example of this in the Western Mediterranean, yielding an exceptional seafood assemblage. This site, located in the southern part of the Iberian Peninsula, has yielded plenty of different types of marine resources (different species of fish, molluscs, whale, seals, etc.), and surely shows the importance of aquatic resources in the diet of these hunter-gatherer populations (Morales-Muñiz and Roselló-Izquierdo, 2008). In other parts of the Mediterranean, technological advances on sea-faring suggest that they were already at the time able of arriving to islands such as Cyprus (Vigne et al., 2009). This maritime practice evidenced at more Eastern parts of the Mediterranean could have been associated to purported deep-sea fishing evidenced by specific types of pelagic fish remains that appeared on sites (e.g. Stiner and Munro, 2011; Trantalidou, 2008; Theodoropoulou, 2011), although some researchers suggest otherwise (Pickard and Bonsall, 2004).

Few data on animal resources and fishing are available in the Mediterranean part of France. The presence of groupers is attested in Provence and Languedoc coasts, but in minor quantity compared with the other Mediterranean areas (Desse-Berset and Desse, 1999). Even if the presence of grouper remains is low, the large size of the remains recovered attests to a preferential fishing of big-sized specimens. Mesolithic people also consumed molluscs and other fish species; however, they represent only a small part of subsistence activities compared with terrestrial mammals (Desse-Berset and Desse, 1999). Subsistence is based on these last, focused on red deer (*Cervus elaphus*), wild boar (*Sus scrofa*), roe deer (*Capreolus capreolus*), small game (e.g. rabbit and hare), and terrestrial molluscs inland, as well as ibex (*Capra pyrenaica*) and chamois (*Rupicapra* spp.) in altitude (Guilaine et al., 2007). Some sites are specialized, as at La Montagne (8298-7974 cal. BCE; Bouches-du-Rhône), were aurochs (*Bos primigenius*) represent 90% of the faunal remains; a few remains of European ass (*Equus hydruntinus*) are also attested (Helmer and Monchot, 2006).

In Corsica, first human occupations in the island are documented from the 70s thanks to studies carried on seven Mesolithic sites (8th-9th mill. BCE; Costa et al., 2003). Many of these sites are located close to the current coastline and show a local exploitation of both raw material and food resources (Costa et al., 2003; Vigne, 2004). *Prolagus sardus* (Corsican pika), a small terrestrial herbivore, dominates all the faunal assemblages, sometimes representing up to 80%; other small rodents, birds, shellfish and fish make up the rest of the animal remains. Despite the proximity to the sea, marine resources are often scarce (ca. 20%; Vigne and Desse-Berset, 1995).

Zooarchaeological analysis show seasonality in food resource acquisition: fish and bird preferentially caught during spring and summer, and *Prolagus* during the end of summer and autumn (Vigne, 2004). Until recently, archaeological studies demonstrated that settlements were temporary occupied by nomadic small human groups described as "trapper-fishers" (Costa et al., 2003).

During the Mesolithic in Mediterranean Iberia, zooarchaeology suggests an increase in diversification in comparison with the Upper Palaeolithic and Epipalaeolithic. Studies point to large and medium-sized terrestrial mammals as the main part of the diet. Animals such as *Capra pyrenaica* and *Cervus elaphus* are a frequent and constant find in hunter-gatherer sites (e.g. Aura et al., 2009), mainly due to the environment and altitude of many of the Mesolithic settlements in the region. Some other recurrent species are *Sus scrofa*, *Rupicapra rupricapra*, or *Capreolus capreolus*, which are still minor taxa but whose relative importance increases during the Mesolithic. Remains from other large and medium-sized species such as *Bos primigenius* and *Equus* sp. are less frequently found. Small-game and plants were also an important part of the diet of the last hunter-gatherers in Mediterranean Iberia. For example, rabbit and hare (Fam. Leporidae) consumption is quite significant at several sites like Santa Maira and Penya del Comptador (Morales, 2016). Since rabbit was very abundant in the region, it was a recurrent part of the human diet. A variety of wild fruits, seeds and legumes have been also reported in Mediterranean Iberia (e.g. Aura et al., 2005), confirming that Mesolithic human food procurement was widely diversified food procurement at the time.

Regarding marine resource exploitation in Mediterranean Iberia, there are references prior to MIS 8 (older than ca. 300kyBP), but most are from post-MIS 5 (more recent than ca. 130kyBP), concentrated mainly between MIS 2 and 1 (from ca. 30kyBP to the present) (e.g. Aura et al., 2015; Jordá Pardo et al., 2010; Steele and Álvarez-Fernández, 2012). Most of the Iberian Mediterranean sites from the Epipalaeolithic and Mesolithic periods are caves and rock shelters, many of them located on the same coastline or a few kilometres away from it. Despite this, there is a great diversity in the type and amount of evidence for the consumption of marine resources. Mollusc remains are the most common, ranging from a small amount to tens of thousands in sites like Cueva de Nerja (Málaga, Spain) (Aura et al., 2009), but there is an overall smaller presence of fish, bird and marine mammal remains in the region. For most of these archaeological contexts there is no direct evidence of the techniques used to locate the fish (e.g. static and mobile traps, transport), the means used for their extraction (harvesting equipment, fishing gear, etc.), their processing and their consumption (traceology, residue analysis, preservation techniques, etc.). In this regard, the Iberian Mediterranean data are not comparable to those of northern Europe.

2.2. Agro-pastoralist populations

With the arrival of the Neolithic lifestyle to the Western Mediterranean, important changes in the economy and subsistence take place (Salazar-Garcia and García-Puchol, 2017). Overall, at all the Neolithic sites the zooarchaeological studies show that domestic animals dominate over wild ones. It seems that there was a general tendency for hunting to be an occasional practice. Although not as much evidence as from animal remains, it is also thought that plant domesticates would have been an important part of the diet. Of course, this does not mean that wild resources (both plants and animals) were abandoned, and mixed-economies existed. Even if wild resources are scarce in village-style settlements, wild resources contributed in a significant manner to the economy and diet at other types of settlements along the Mediterranean Sea (Manning et al., 2013). We should also not forget that domestic

animals were providing secondary products such as milk and other dairy products (Debono-Spiteri et al., 2016), boosting the reliance on domesticates for Neolithic peoples. Remains from aquatic resources are, similarly as in most of the Mediterranean Mesolithic, not very abundant at the Neolithic levels of the Western Mediterranean. This could suggest that fishing was a minor activity or, as later discussed, be result of the recovery and interpretation of the archaeological record itself (eg. Guillaud, 2014; Schulting et al., 2004).

The earliest Neolithic settlements in southern France are both in cave and open sites, and all of the 'Neolithic Package' is present early on (ceramics, domestic animals and plants, agricultural tools). Authors agree on a complementary function between the two types of settlements (Binder, 1991). Some caves are considered as seasonal hunting places and would be in relation with more permanent open-air sites where domestic activities took place (Binder and Sénépart, 2004). The domestic settlement size and diversification increase during the following phases of the Neolithic (Vaquer, 1990). Fishing activities are well attested on coastal sites. The high abundance of marine resources such as fish (sea bream species) and molluscs (Mytilus edulis and Cardium sp.) are evidence of the organisation towards this subsistence activity (Courtin, 1974). As well as during the Mesolithic, groupers are still found amongst fish remain assemblages, but in decreasing amounts from the beginning of the Neolithic onwards (Desse-Berset and Desse, 1999). On the site of Pendimoun (Castellar, Alpes-Maritimes, France), the great diversity of molluscs' species as limpets (Fam. Patellidae) or mussels (Fam. Mytilidae), and the evidence of smaller species, probably linked to algae gathering, and its persistence in all Early Neolithic layers, support the significant use of marine resources for both dietary and ornamental pruposes (Binder, 2003; Cade, 2004). However, marine activities are secondary compared with herding and hunting. Hunting focused mainly on red deer (Cervus elaphus), wild boar (Sus scrofa) and also rabbit and hare (Fam. Leporidae) and carnivorous species such as marten (Martes sp.). Game is a secondary resource compared with herding, and decreases during the Neolithic (Binder, 1991; Helmer, 1991). Following all these evidences, it seems that the Neolithic subsistence economy was mainly based on domestic animals and plants. Sheep and goat provide meat, milk and wool (Helmer et al., 2005). Cattle and pig are more or less important relative to other resources depending on the site.

In Mediterranean Iberia, the Late Mesolithic is defined as a period of population decline and relocation. With the arrival of the Neolithic to the easternmost and south-easternmost coast of Iberia, settlements appear abruptly in the archaeological record. These first settlements occupy limestone-based-soil coastal enclaves previously abandoned by hunter-gatherers. Even these early settlers apparently already had a full agro-pastoral economic system, as seen elsewhere in the Central and Western Mediterranean (Martí and Juan-Cabanilles, 1997). These populations and the Neolithic package expanded with time through the territory during the entire Neolithic period in a demic way, possibly thanks to cultural diffusion (Zeder, 2008). This Neolithisation spread pattern in Mediterranean Iberia might be behind the palaeoeconomical record in the region, which overall suggests a wide variety of resource exploitation but based in plant and animal domesticates. Semi-mobile communities practised cereal and legume horticulture, including a wide range of cereals and legumes, as early as 5600-5500 BCE in Eastern Iberia (Antolín, 2015). Later there is evidence of the development of extensive dry land agriculture as suggested by progressive forest clearances and the reduction of the number of cereal species cultivated, but eventually returning to a diversified horticultural system again from 2500 BCE onwards (Pérez Jordá and Peña-Chocarro, 2013). Besides domestic plants, the gathering of wild plants during the different stages of the Neolithic in Mediterranean Iberia also took place constantly through time (Antolín and Jacomet, 2015). However, direct consumption in the region by the study of plant microremains trapped in dental calculus has only been done so far in Late Neolithic-Chalcolithic populations (Power et al., 2014). Other than some endemic C_4 plants that constituted no important source for animals or humans, there is no evidence in the region yet as to the presence of C_4 crops during the Neolithic amongst archaeobotanical and calculus evidence.

Regarding animal husbandry, evidence from Mediterranean Iberia suggests that the main resources were domesticated animals. Depending on the region and area, ovicaprids (Ovis aries and Capra hircus) or bovids (Bos taurus) were usually the main animal species exploited (López-Gila, 2009; Iborra and Martínez Valle, 2009; Martí et al., 1980; Pérez Ripoll, 1999, 2006). At the well-preserved site of La Draga (Banyoles, Spain), there is even direct evidence for the consumption of secondary animal products (Debono-Spiteri et al., 2016). Other domestic animals such as suids (Sus domesticus) also appear in the archaeological record of the region, but less frequently than the previous ones. There is also evidence for the consumption of wild animals. It seems that during the Neolithic in this region, the hunting of large-sized fauna (wild horse, aurochs), medium-sized mammals (red deer, chamois, Spanish ibex, wild boar) and small-game (mainly rabbit) was a constant but reduced part of their economic activities (García Atiénzar, 2010; Juan-Cavanilles and Martínez-Valle, 1998). Zooarchaeological remains attest that marine foods had undoubtedly a role in the Neolithic economy. At some Spanish sites such as Cueva de Nerja, Costamar, El Barranquet de Oliva or Cova de les Cendres there is evidence of fish consumption (e.g. Epinephelus guaza, Pagrus pagrus, Sparus aurata, Dicentrarchus labrax, Mugillidae sp., Pagellus erythrinus, Trochidae) and other sea resources (e.g. Patella sp., Monodonta turbinata, Mytillus galloprovincialis, Cerastoderma edule, Glycimeris sp.) (Carrasco, 2009; Pascual-Benito, 2009; Rodrigo and Marlasca, 2009). However, there is still debate about the degree of reliance on these types of resources compared with terrestrial ones; stable isotopes can help to solve this question.

However useful and informative, dietary information based on zooarchaeological studies gives only indirect evidence of the actual food past humans consumed. In the case of the traditional approach to study the ictiofaunal assemblages, the information on diet inferred from them is even more questionable. Firstly, as fish remains are more subject to taphonomic processes than other vertebrates, they preserve less and worse (e.g. Szpak, 2011). Secondly, past poor recovery techniques of small remains at excavation digs have maimed ictiofaunal archaeological assemblages. Scarce remains leads many times to: a) suggestions that past humans consumed small amounts of fish or no fish at all, or, b) over interpret the exceptional appearance of fish remains as portraying a diet based on aquatic resources. It is true that the presence of fish remains, even if scarce, might suggest that past prehistoric peoples were able to fish them. But the question regarding the actual exploitation either regularly or seasonally of marine resources is still evasive. Something similar occurs with the consumption of meat products. They consumed animal meats, as attested by zooarchaeological remains, but to what proportion? Considering the time paradigm and the formation of palimpsests in many Mesolithic and Neolithic sites, it is very difficult to know if the regularly abundant animal remains were consumed by a same population or a same generation, or even if they are spaced enough through time, as to only attest a very punctual consumption of meat resources. The generally poor preservation of plant remains, as well as the lack of technology at many excavations to retrieve them, is another example of how indirect dietary evidence should not be considered as an absolute way of interpreting prehistoric diet. The

amount of plant foods consumed in the Mesolithic and Neolithic is mainly unknown, as well as the different types of plants that were consumed.

Trying to bridge some of these problems, stable isotope analyses give direct evidence of the average protein diet consumed by the individuals analysed. In the following points we will summarize all human carbon and nitrogen isotopic analysis on bone collagen available to date from the Mesolithic and Neolithic periods in the Western Mediterranean, and discuss how they contribute to the study of dietary patterns amongst last hunter-gatherers and first farmers in the region.

3. What isotopes reveal about Mesolithic and Neolithic diets

3.1. Isotope evidence from the Mesolithic

Corsica and Eastern Iberia are the only represented regions in the Western Mediterranean with isotope studies (Fig. 1). In any case, and in contrast to later farming groups, few carbon and nitrogen isotope data are available for the last hunter-gatherer populations in the whole Mediterranean basin. These analyses on bone collagen suggest that the proportion of protein acquired from marine foods was slightly higher in the Mesolithic (e.g. Vigne, 2004; Lightfoot et al., 2011; Mannino et al., 2012; Salazar-García et al., 2014b), and perhaps the early Neolithic (e.g. Lelli et al., 2012), than in the late Upper Palaeolithic (Mannino et al., 2012). All human carbon and nitrogen Mesolithic isotope values from the Western Mediterranean are plotted together in Fig. 2 and separated by sites in Table 1.

The lack of Mesolithic human remains from the South of France and the necessity to perform new radiocarbon dates on remains from old excavations prevent a clear understanding of Mesolithic dietary habits in this area. The Corsican Island has provided material well preserved enough to carry out stable isotope analysis. First isotope analysis were performed on human bones buried in the Mesolithic sites of Araguina Sennola (a female; Duday, 1975) and Monte Leone (a male; David, 1999), as well as on animal remains from Monte Leone (Corsican pika, grouper, European pilchard, sea bream, seal and dolphin; Pouydebat, 1997). Isotopic results are consistent with zooarchaeological data, indicating a protein intake based on terrestrial game (Corsican pika) and a small consumption of marine food up to 30% (Pouydebat, 1997; Costa et al., 2003; Vigne, 2004). However, the recent excavation of *Campu Stefanu*, at ca. 6 km from the coast, allowed establishing a new insight on food patterns. Excavated from 2007 to 2011, the site delivered Mesolithic remains buried into a natural rockshelter (Courtaud et al., 2014). In this collective burial, only the first deceased buried yielded enough good collagen for a successful radiocarbon date (end of the 9th mill. BCE; Beta 318791; Poz 44201; Courtaud et al., 2014). Stable isotope ratios of this individual indicate a diet based on terrestrial animal proteins with no significant intake of marine fish/mammals (less than 10% if present). The same patterns were recently obtained on another Mesolithic human excavated in the north of the island at Torre d'Aquila (Goude et al., 2017a). New radiocarbon dates and stable isotope analysis, compared with the previous studies on coastal sites, support the hypothesis of an exploitation of the nearby environment during the Mesolithic in Corsica, involving the consumption of diverse marine
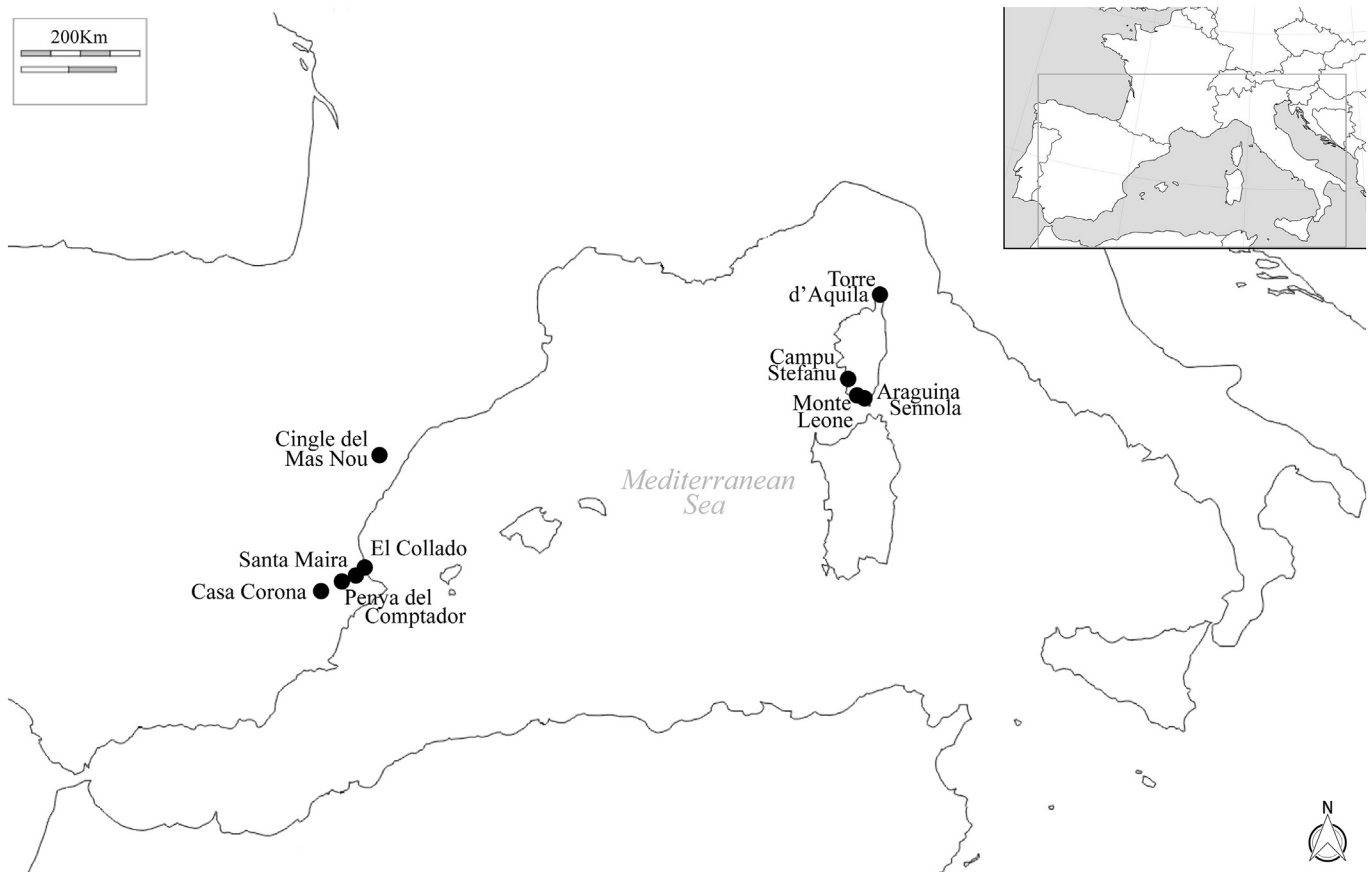

Fig. 1. Map of Mesolithic archaeological sites from the Western Mediterranean with isotopic analysis carried out on.
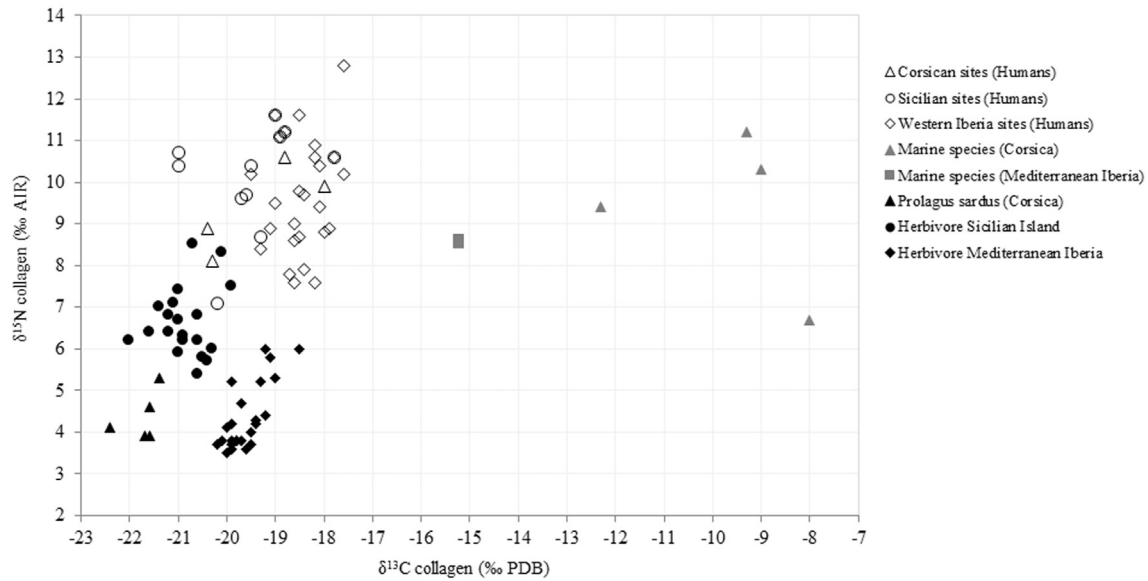
Fig. 2. Plot of human and fauna bone collagen δ¹³C and δ¹⁵N from all Western Mediterranean Mesolithic sites with isotopic data available.

species such as grouper, European pilchard and sea bream, but only by individuals living in coastline settlements. It is however difficult to understand if this pattern is linked to low mobility in the Island and/or to a different availability of resources between coastal and inland environments all year long, even if it is more consistent with the general pattern observed in the Western Mediterranean until now (Goude et al., 2017a).

The only other Western Mediterranean area for which isotopic data relative to the early Holocene has been published is the Iberian Peninsula. At different sites in the region around Valencia, numerous individuals consumed relatively high proportions of marine resources. This is particularly relevant in the case of the occupants of some sites, such as Santa Maira and Cingle del Mas Nou, which are tens of kilometres inland from the coast (Salazar-García et al., 2014b). Furthermore, relatively high levels (up to 25% of total protein input) are accounted for some individuals from the coastal site of El Collado (García-Guixé et al., 2006). That this could be due to the westernmost part of the Mediterranean being the more productive area of this oligotrophic sea (Fa, 2008) is discarded, since the sea area close to the Valencian coastal line has a low productivity (Cacho et al., 1999; Frigola et al., 2007; Jiménez-Espejo et al., 2007). Thus, other possibilities should be looked for. One of them is the generally higher-level of sophistication in the fishing techniques in Mediterranean Iberia than in other parts of the basin, as exemplified by the evidence from Cueva de Nerja (Aura Tortosa et al., 2016).

Nevertheless, it shouldn't be forgotten that in other sites of Mediterranean Iberia such as Penya del Comptador (Salazar-García et al., 2014b) and Casa Corona (Fernández-López de Pablo et al., 2013), as well as on some individuals from El Collado (García-Guixé et al., 2006), there is no isotopic evidence of the consumption of aquatic resources whatsoever. Perhaps this intake is masked by the types of fish chosen, as suggested by Salazar-García et al. (2014b) when referring to the "fish paradox" in the region, since many of the fish consumed in the region are from brackish environments (Aura et al., 2015) and thus have a less marine isotopic signature than usually expected (France, 1994).

3.2. Isotopic evidence from the Neolithic

There is abundant data available from the different stages of the Neolithic in both southern France and Eastern Iberia (Fig. 3). They are the two regions with highest number of human and faunal specimens analysed from the entire Mediterranean. While there are few Early Neolithic sites analysed yet that shed light on the diet of those farming peoples that arrived to the westernmost part of the Mediterranean from South West Asia and replaced the already declining-in-number last hunter-gatherer populations (Olalde et al., 2015), there is plenty of data from the Middle Neolithic onwards. All Neolithic human carbon and nitrogen isotope values from the Western Mediterranean are plotted together in Fig. 4 (Early-Middle Neolithic sites) and Fig. 5 (Late Neolithic-Chalcolithic sites), and separated by sites in Table 1 (Early to Late Neolithic-Chalcolithic sites).

The Neolithic palaeodiet research in southern France started ca. fifteen years ago and is still actively continuing. Few human remains are dated to the first phases of the Neolithic, and most of them are located in the southeastern area including Liguria region in Italy. The several sites from the Cardial and Squared Mouthed Pottery periods (ca. 5500-4500 cal. BCE) delivered almost 50 individuals and 50 wild and domestic animal remains that were analysed. Although a major part of these sites are located close to the sea, in the shoreline as at Bergeggi (Liguria), current data are consistent with a diet based on terrestrial resources with an important intake of animal protein (Goude, 2007; Le Bras-Goude et al., 2006a, 2012, 2006b). The orography of this area, steep and mountainous, is more favourable for herding and less appropriated for extendible agricultural practices; the natural environment explains also that burial places are mainly in caves. The dietary pattern of these individuals is very similar; only few marginal data, indicating less animal protein consumption, were recorded for individuals with specific status, as at Pendimoun, and/or with disease, as at the Arene Candide for example (Le Bras-Goude et al., 2006a; Goude et al., 2011–2013). Slight differences are nevertheless observed between adults and subadults and between males and females; the adult males having probably more access to animal resources (Goude, 2007). These differences, even if small, are in line with funerary records, particularly on the site of Arene Candide

Table 1
List of all Western Mediterranean sites with published carbon and nitrogen isotopic ratio analysis on human bone collagen from the Mesolithic up to the Late Neolithic-Chalcolithic period. Only samples from human adults (>15yo) for which both C and N results are available and with good published collagen quality controls have been considered here.

Region	Site	Archaeological chronological attribution	n	$\delta^{13}C$ m ± 1σ (‰)	$\delta^{13}C$ Max (‰)	$\delta^{13}C$ Min (‰)	$\delta^{15}N$ m ± 1σ (‰)	$\delta^{15}N$ Max (‰)	$\delta^{15}N$ Min (‰)	Reference
Mediterranean Iberia	El Collado	Mesolithic	9	−18.4 ± 0.7	−17.6	−19.5	10.3 ± 1.2	12.8	8.9	García-Guixé et al., 2006
	Santa Maira	Mesolithic	2	−18.1	−18.0	−18.1	9.1	9.4	8.8	Salazar-García et al., 2014a, b
	Penya del Comptador	Mesolithic	3	−18.5 ± 0.3	−18.2	−18.7	7.7 ± 0.1	7.8	7.6	Salazar-García et al., 2014a, b
	Casa Corona	Mesolithic	1	−19.3	*	*	8.4	*	*	Fernández-López de Pablo et al., 2013
	Cingle del Mas Nou	Mesolithic	4	−18.5 ± 0.1	−18.4	−18.6	8.8 ± 0.8	9.8	7.9	Salazar-García et al., 2014a, b
	Costamar	Early Neolithic	2	−19.1	−19.0	−19.1	8.2	8.5	7.9	Salazar-García 2009
	Cueva de Nerja	Early-Middle Neolithic	3	−19.1 ± 0.5	−18.5	−19.4	9.0 ± 0.2	10.3	8.2	Salazar-García et al., 2017
	Feixa del Moro	Early-Middle Neolithic	2	−20.3	−19.8	−20.7	8.7	9.1	8.2	Remolins et al., 2016b
	Tossal de les Basses	Middle Neolithic	11	−18.1 ± 0.6	−17.5	−19.1	11.2 ± 1.2	13.1	9.0	Salazar-García et al., 2016a
	Pujolet de Moja	Middle Neolithic	3	−19.3 ± 0.2	−19.2	−19.5	10.0 ± 0.5	10.3	9.4	Fontanals-Coll et al., 2017
	Hort d'en Grimau	Middle Neolithic	3	−19.8 ± 0.3	−19.5	−20.1	9.2 ± 0.9	10.2	8.6	Fontanals-Coll et al., 2017
	Can Roqueta-Can Revella	Middle Neolithic	6	−19.9 ± 0.5	−19.4	−20.4	8.4 ± 1.2	9.7	6.3	Fontanals-Coll et al., 2017
	Horts de Can Torras	Middle Neolithic	2	−19.7	−19.6	−19.7	8.8	9.0	8.5	Fontanals-Coll et al., 2017
	Ceuró	Middle Neolithic	3	−19.9 ± 0.2	−19.6	−20.1	8.9 ± 0.3	9.3	8.6	Fontanals-Coll et al., 2017
	Costa dels Garrics del Caballol	Middle Neolithic	2	−20.0	−19.7	−20.2	8.3	8.5	8.1	Fontanals-Coll et al., 2017
	El Llord	Middle Neolithic	2	−19.8	−19.8	−19.8	9.9	10.2	9.6	Fontanals-Coll et al., 2017
	Puig d'en Roca	Middle Neolithic	5	−20.3 ± 0.4	−20.0	−21.0	8.0 ± 1.2	9.1	6.1	Gibaja et al., 2016
	Can Gelats	Middle Neolithic	1	−20.7	*	*	9.2	*	*	Gibaja et al., 2016
	Bòbila Madurell	Middle Neolithic	36	−19.7 ± 0.3	−19.0	−20.6	9.2 ± 0.6	10.5	8.1	Fontanals-Coll et al., 2015a
	Can Gambús	Middle Neolithic	38	−19.6 ± 0.6	−16.8	−20.7	9.0 ± 0.5	10.2	7.9	Fontanals-Coll et al., 2015a
	Costamar	Late Neolithic	2	−18.0	−17.8	−18.2	10.1	10.4	9.8	Salazar-García 2009
	Cova dels Diablets	Late Neolithic-Chalcolithic	8	−18.9 ± 0.3	−18.7	−19.5	10.0 ± 0.6	10.8	8.8	Salazar-García 2014
	Cova de la Pastora	Late Neolithic-Chalcolithic	7	−19.3 ± 0.2	−19.0	−19.6	9.5 ± 0.8	10.6	8.1	McClure et al., 2011
	Avenc dels Dos Forats	Late Neolithic-Chalcolithic	2	−19.1	−19.1	−19.1	10.2	10.4	10.2	McClure et al., 2011
	Coveta del Frare	Late Neolithic-Chalcolithic	2	−19.0	−19.0	−19.0	9.7	9.8	9.6	García-Borja et al., 2013
	La Vital	Late Neolithic-Chalcolithic	3	−18.7 ± 0.5	−18.3	−19.3	9.5 ± 0.8	10.3	9.0	Salazar-García 2011
Corsica	Monte Leone	Mesolithic	1	−18.0	*	*	9.9	*	*	Pouydebat 1997
	Araguina Sennola	Mesolithic	1	−18.8	*	*	10.6	*	*	Bocherens 1999
	Campu Stefanu	Mesolithic	1	−20.4	*	*	8.9	*	*	Goude et al., 2017a
	Torre d'Aquila	Mesolithic	1	−20.3	*	*	8.1	*	*	Goude et al., 2017a
Mediterranean France	Gazel	Early Neolithic	2	−20.0	−19.9	−20.0	9.7	10.2	9.1	Goude and Fontugne, 2016
	Baume Bourbon	Early Neolithic	3	−20.1	−19.8	−20.3	10.1	10.2	8.9	Goude and Fontugne, 2016
	Fontbrégoua	Early-Middle Neolithic	9	−19.8	−19.8	−20.4	9.4	9.8	9.2	Le Bras-Goude et al., 2010
	Pendimoun	Early-Middle Neolithic	5	−19.9	−19.5	−20.1	8.1	8.5	6.8	Le Bras-Goude et al., 2006a
	Montou	Middle Neolithic	6	−18.8	−18.2	−19.1	8.4	11.2	7.3	Le Bras-Goude and Claustre, 2009
	Champ du Poste	Middle Neolithic	5	−19.7	−18.9	20.8	8.8	9.7	6.8	Goude and Fontugne, 2016
	Najac	Middle Neolithic	4	−19.7	−19.5	−19.8	9.5	10.3	8.7	Le Bras-Goude et al., 2013
	Le Crès	Middle Neolithic	32	−19.4	−18.6	−20.6	8.1	11.1	6.6	Le Bras-Goude et al., 2009
	Le Pirou	Middle Neolithic	8	−19.7	−19.1	−20.6	9.5	10.5	8.4	Gleize et al., 2009
Liguria	Pian del Ciliego	Middle Neolithic	2	−20.5	−20.2	−20.8	8.4	8.8	8.1	Goude et al. 2011−2013
	Bergeggi	Middle Neolithic	5	−20.0	−19.6	−20.3	8.8	9.1	8.6	Goude et al. 2011−2013
	Pollera	Middle Neolithic	12	−20.3	−19.9	−20.6	8.5	9.4	7.1	Goude et al. 2011−2013
	Arene Candide	Middle Neolithic	8	−20.0	−19.4	−21.1	8.9	9.4	6.2	Goude et al. 2011−2013

(Liguria) where immatures were buried without cists, a possible expression of their social position (Formicola, 1999). The relative absence of marine resources in the daily diet contrasts with other archaeological evidence. Molluscs, fish remains or hooks are part of burial grave goods in coastal sites (Desse-Berset and Desse, 1999), suggesting the status of individuals buried in these caves must be further questioned and could be in relation with a specific diet. Recently, new investigation and multi-disciplinary analyses on bones from the Early Neolithic site of Les Breguières located close to the seashore (ca. 5 km, Mougins, near Cannes) allowed new insights into the dietary component and food choice variability of first farmers in this area, including the impact of marine resources (Goude et al., 2017b; Pruvost et al., 2017).

Site distribution in Southern France tends to follow environmental micro-regions. In the southwestern coast of the Mediterranean, the absence, or possible underwater location, of the early Neolithic sites does not allow comparison with the Provence-Ligurian side. On the other hand, the Chasséen Middle Neolithic period is better represented (ca. 4400-3900 cal. BCE) in this area where plains offer ideal conditions for agricultural expansion. Here, stable isotope studies concerned mainly four sites including ca. 50 humans and almost 40 wild and domestic animals. Compared with the Early Neolithic, data revealed two main differences: a wider variability in dietary patterns, and the importance of cereal and probably also legumes in the daily diet even if zooarchaeological data indicate significant herding practices (Goude, 2007; Le Bras-Goude, 2008; Blaise et al., 2005; Bréhard, 2011). No fish remain is attested and the few marine shells found in graves are ornaments or tools (Loison et al., 2004), which is in line with stable isotope records showing no marine resource consumption. The intra-group
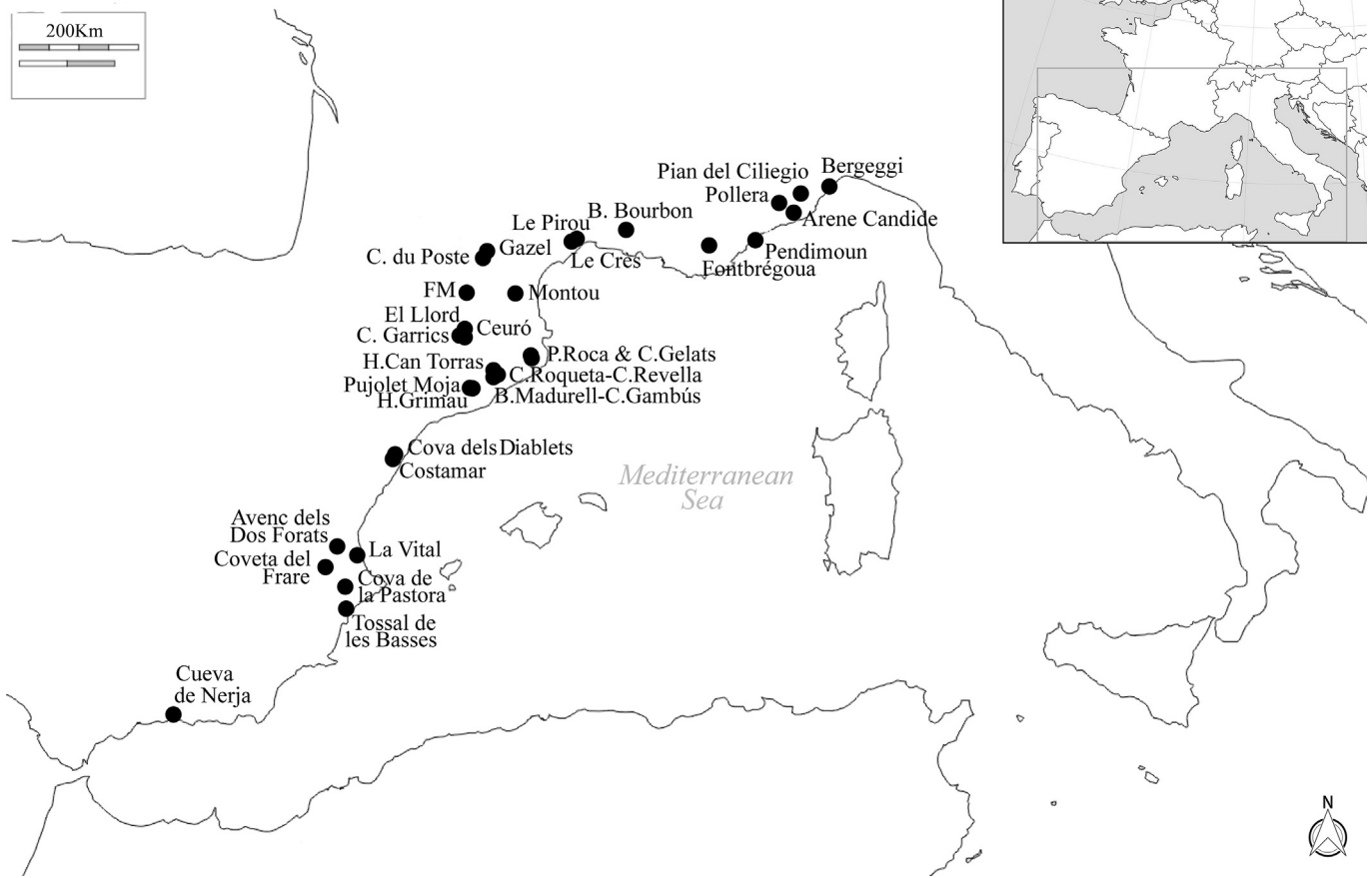
Fig. 3. Map of Neolithic-Chalcolithic sites from theWestern Mediterranean with isotopic analysis carried out on.
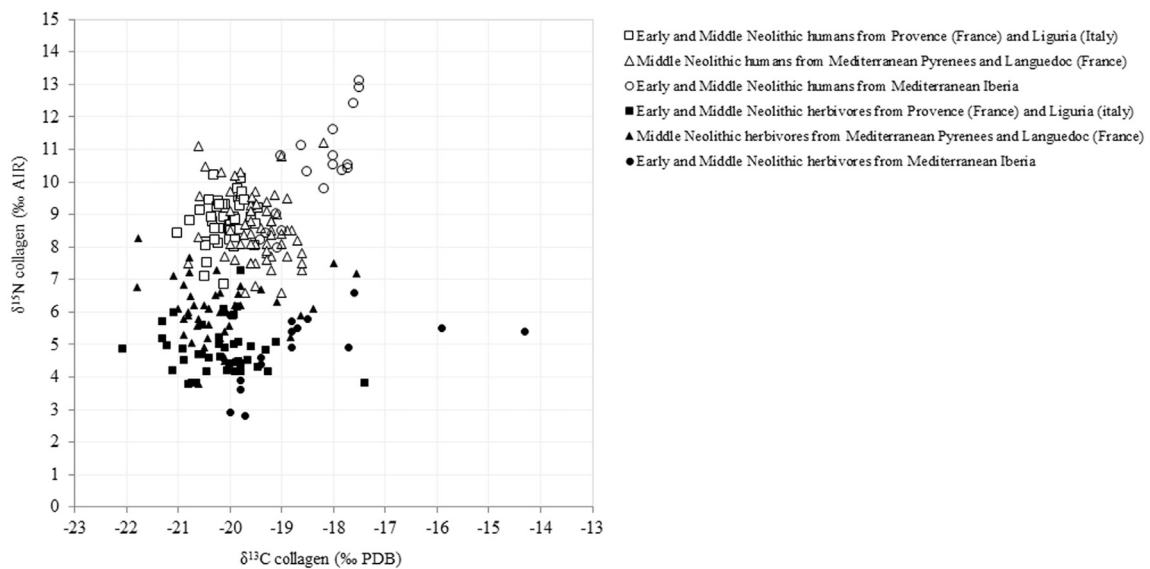
Fig. 4. Plot of human and fauna bone collagen $\delta^{13}C$ and $\delta^{15}N$ from all Western Mediterranean Early and Middle Neolithic sites with isotopic data available.

variability is not linked to sex, age or grave goods, but the widest isotopic variability is often recorded in females, potentially linked to an important mobility (Goude et al., 2012, 2013). The Middle Neolithic period is considered as an agropastoralism development

(Vigne and Helmer, 1999), and the isotopic data support this hypothesis.

During the last years, there has been a boost of carbon and nitrogen isotope data published from different stages of the Neolithic
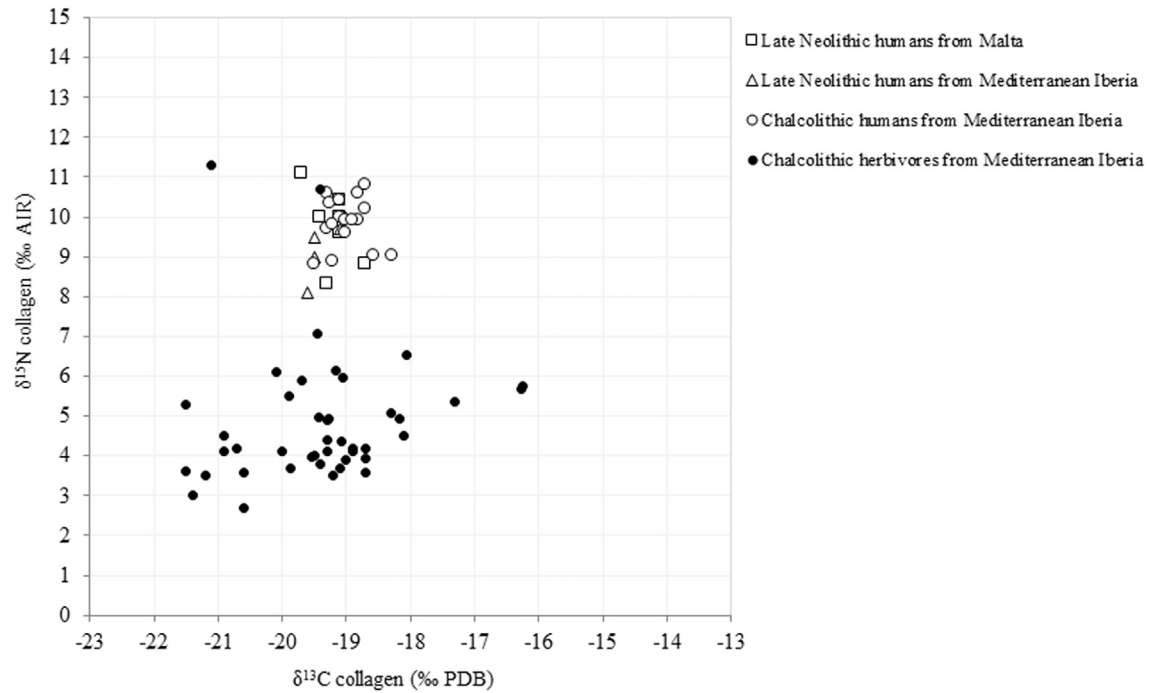
Fig. 5. Plot of human and fauna bone collagen δ¹³C and δ¹⁵N from all Western Mediterranean Late Neolithic-Chalcolithic sites with isotopic data available.

in Mediterranean Iberia. The first publication, carried out on two Neolithic phases of the coastal site of Costamar (Castellón), confirmed for the earliest stage what happened in other parts of the Mediterranean and the Atlantic façade with the arrival of the Neolithic: a protein diet based on C_3 terrestrial resources, showing the isotopic signal in collagen no evidence of marine resource consumption (Salazar-García, 2009). Recent studies on Neolithic specimens in this region confirmed this tendency. The Neolithic and Chalcolithic sites from Mediterranean Iberia of La Bóbila Madurell and Can Gambús (Fontanals-Coll et al., 2015a); Pujolet de Moja, Hort d'en Grimau, Can Roqueta-Can Revella, Horts de Can Torras, Ceuró, Costa dels Garrics del Caballol and El Llord (Fontanals-Coll et al., 2015b), Puig d'en Roca and Can Gelats (Gibaja et al., 2016), Feixa del Moro (Remolins et al., 2016a, 2016b), Cova dels Diablets (Salazar-García, 2014), La Vital (Salazar-García, 2011), Coveta del Frare (García-Borja et al., 2013), Cova de la Pastora and Avenc dels Dos Forats (McClure et al., 2011), all show a quite homogeneous diet based on terrestrial C_3 resources and without isotopic evidence of marine resource consumption, aside from the exceptional case of an old male individual from Can Gambús (Fontanals-Coll et al., 2015a). The same absence of isotopic marine signature is observed on the Early and Middle Neolithic individuals from the coastal site of Cueva de Nerja (Salazar-García et al., 2017). However, this dietary tendency contrasts with the analysis done on the Middle Neolithic coastal settlement of Tossal de les Basses (Alicante) that shows an interesting consumption of marine resources (Salazar-García et al., 2016a). Furthermore, we cannot rule out the consumption of freshwater resources, especially from sites near water courses (e.g. Gibaja et al., 2016; Fontanals-Coll et al., 2017).

As we can see, the Neolithic in Mediterranean Iberia portrays dietary patterns in which terrestrial resources are the main input in the diet during all Neolithic periods for which data is available (Salazar-García, 2016; Fontanals-Coll et al., 2015a; 2017), and similar to evidence found in Central Iberia (e.g. Salazar-García et al., 2013b; Fontanals-Coll et al., 2015b). However, the commented

evidences from some of the sites suggest that during both the Middle and Late Neolithic there was, at some points, enough marine food consumed (>20%) as to be traced through collagen by isotopic analysis, highlighting the possibility to find traces of aquatic resources using stable isotope methods to help discriminate this kind of resources through the whole diet. It could be argued that since the two sites that show isotopic evidence for the consumption of marine resources are coastal, this could reflect an adaptation to the exploitation of the types of resources available in the immediate environment of the sites. Nevertheless, since other coastal Neolithic sites from the region, as is the case of La Vital or Cueva de Nerja, show no evidence of marine exploitation, other explanations could be also put forward. Unfortunately, there is still not enough data yet available for Eastern Iberia from the Early Neolithic, but on-going work on Cova de la Sarsa and Cova de l'Or in Eastern Iberia will undoubtedly soon clarify this picture (Salazar-García, 2012).

4. And now what? Sum-up and future perspectives

It is clear that both Mesolithic and Neolithic populations in the Western Mediterranean were aware of the sea. And not only aware, but both lived directly at it and used it as a source of different raw materials and as a means of transport (Zilhão, 2001). For example, evidence of the use of shell beads as ornaments appearing inland attests this, as well as coastal sea-faring of both hunter-gatherer and farming communities. However, there has been in the last decades some "labels" placed on these two lifestyles regarding marine resource exploitation for consumption. This labelling might have been correctly argued for other European regions such as the Atlantic façade, where a real food shift seemed to occur between the last Mesolithic and first Neolithic peoples (Richards et al., 2003b). This seems not to be the case for the Western Mediterranean. Indeed, the word "food transition" is not really relevant in this case as many coastal places during the Mesolithic show also a terrestrial based food economy. As we have seen, aquatic resource

consumption was not as high in the Mediterranean as in the Atlantic or the Baltic regions, for example. Furthermore, new isotopic evidence seems also to point out that at least some Early and Middle Neolithic peoples consumed similar quantities of marine protein than last hunter-gatherers from the Western Mediterranean (Goude et al., 2017; Salazar-García et al., 2016a). Therefore, talking of a dietary "shift" between these two periods in the Western Mediterranean, at least regarding marine resource exploitation, is probably premature. Something different is observed when comparing the use of wild and domesticated resources. Even if at some early stages of the Neolithic there is a high proportion of wild animals present in the zooarchaeological assemblage (e.g. Le Bras-Goude et al., 2010), the norm is that there is still an overall consumption of domesticated resources since evidences of agropastoralism appear in the archaeological record, especially in consolidated Neolithic phases. An increase in the consumption of domesticated over wild plants is observed as a result of the implementation of cultivation techniques, and domesticated animal resources and their secondary products also seem to be consumed more intensively than hunted wild game (e.g. Debono-Spiteri et al., 2016; Martí and Juan-Cabanilles, 1997). This tendency seems clear in most of the Western Mediterranean sites, but the need of further stable isotope analysis from faunal assemblages is necessary to properly assess this hypothesis. For now, it is important to keep to the suggested idea that there might not be a so clear dietary "transition" between these two lifestyles in the region as previously thought, at least as far as direct isotopic dietary evidence suggests.

Models of food exchanges between the Mesolithic and Neolithic in the north of Europe (Baltic Sea and North Atlantic) are not applicable in the Western Mediterranean, where paleoclimatic and biogeographic data indicate that the environments were different and, hence, the type and availability of food resources. During the so-called "Mesolithic-Neolithic transition", the changes of vegetation in the Mediterranean due to climatic changes are less abrupt since the environments are more similar between these two periods and food resources are more available. The apparent continuity in vegetation between these cultural periods could help to explain the before mentioned lack of a clear discontinuity in the diet. At the same time, it could also put in evidence what some hypotheses suggest: that cultivation and agriculture would have already begun during the Mesolithic.

Looking at the isotopic data above mentioned for the region, geography clearly influenced the amount of marine resource consumption by both Mesolithic and Neolithic populations from the Western Mediterranean. For example, many individuals buried at coastal sites show a higher amount of marine protein consumption, even if overall low compared to other European environments. It is true that, so far, only some Mesolithic inland sites show some marine input on the diet of some of its individuals: no inland Neolithic sites do so significantly. However, this pattern observed on inland individuals could be associated more to the higher mobility of hunter-gatherers than to their food culture. The marine bioavailability of the different parts of the Mediterranean Sea could also affect the amount of sea resources consumed depending on their availability. The specific and variable orography of the different parts of the Western Mediterranean coastline might also have played a role in accessibility to these types of resources and therefore on food choices (Fa, 2008).

Undoubtedly, one of the main problems limiting a precise reconstruction of dietary isotopic good time-resolution at the moment of change from hunter-gathering to farming in the Western Mediterranean is the archaeological record itself. Specifically, Mesolithic and Early Neolithic human remains are scarce in the region. This is especially unfortunate because of the reduced numbers of actual first Early Neolithic individuals, which limits the possibility to clearly assess first agropastoralist food choices. Furthermore, high-resolution radiocarbon studies that might shed light on temporal resolution of the different Neolithic phases (e.g. Salazar-García et al., 2016b) are overall missing in this region. Chronology ambiguity is heightened in material from old excavations, as apparent stratigraphic associations of human remains with material culture might not be correct (e.g., García-Borja et al., 2011). Direct radiocarbon dates on human remains will undoubtedly help to understand the origin of dietary modifications or continuity at this important moment of human Prehistory.

The routine process of stable isotope analysis allows nowadays to expand past dietary studies and to re-examine human bone series, even from early excavations. The on-going increase of data in specific locations, particularly those located very close to the coastline, will probably better document our view on the Neolithisation food patterns in the future. In this regard, it seems that efforts should be focused on the re-examination of collections stored for many years, on which new multi-proxy studies could be performed (e.g. Pruvost et al., 2017). In this sense, besides high-resolution new excavations, it is necessary to restudy material from old excavations, as few human remains are available from recent excavations. These studies shouldn't be based exclusively on morphological and stable isotope analysis. They should also include traditional environmental proxies such as the study of vegetal and zooarchaeological remains, but coupled with new analytical procedures to better define the role of plant versus animal foods in the diet. For one, the stable isotope analysis of seed remains would also help to better define the dietary signal background. As mentioned before, studies of plant micro-remains on dental calculus definitely have the potential to fill qualitatively, and even quantitatively, the gap of vegetable consumption (Power et al., 2014, 2015b). Regarding a better isotopic detection of aquatic resources, bulk analysis of sulphur stable isotopes (Nehlich, 2015) as well as compound-specific carbon and nitrogen isotope analysis (Naito et al., 2013; Smith et al., 2009; Styring et al., 2015) could redefine its consumption during these chronologies. Other novel biomolecuar techniques could potentially also help with qualitative food type detection, such as proteomics and metagenomic analysis on dental calculus (e.g. Warinner et al., 2014), where proteins and DNA from plant and aquatic resources could be found.

Last but not least, we should be reminded that traditional paradigms and interpretive frameworks should be constantly retested, as well as contested when necessary. Since early applications of Archaeological Sciences in Europe were based on the Prehistory of northern countries, many times early theories and models for broader prehistoric themes such as "Neanderthal dietary ecology" (Fiorenza et al., 2015) or the "Transition to farming" (Salazar-García and García-Puchol, 2017) are developed with a northern-environment perspective and later transferred in a simple manner to elsewhere in Europe. In this sense, we should remember that the Mediterranean region is not a micro-cosmos of the Atlantic and Baltic regions. The Mediterranean, being a natural crossroad for human cultures and having a temperate and more diverse environment, has its own dynamics; dynamics that should not be ignored if aiming to study and understand its past.

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