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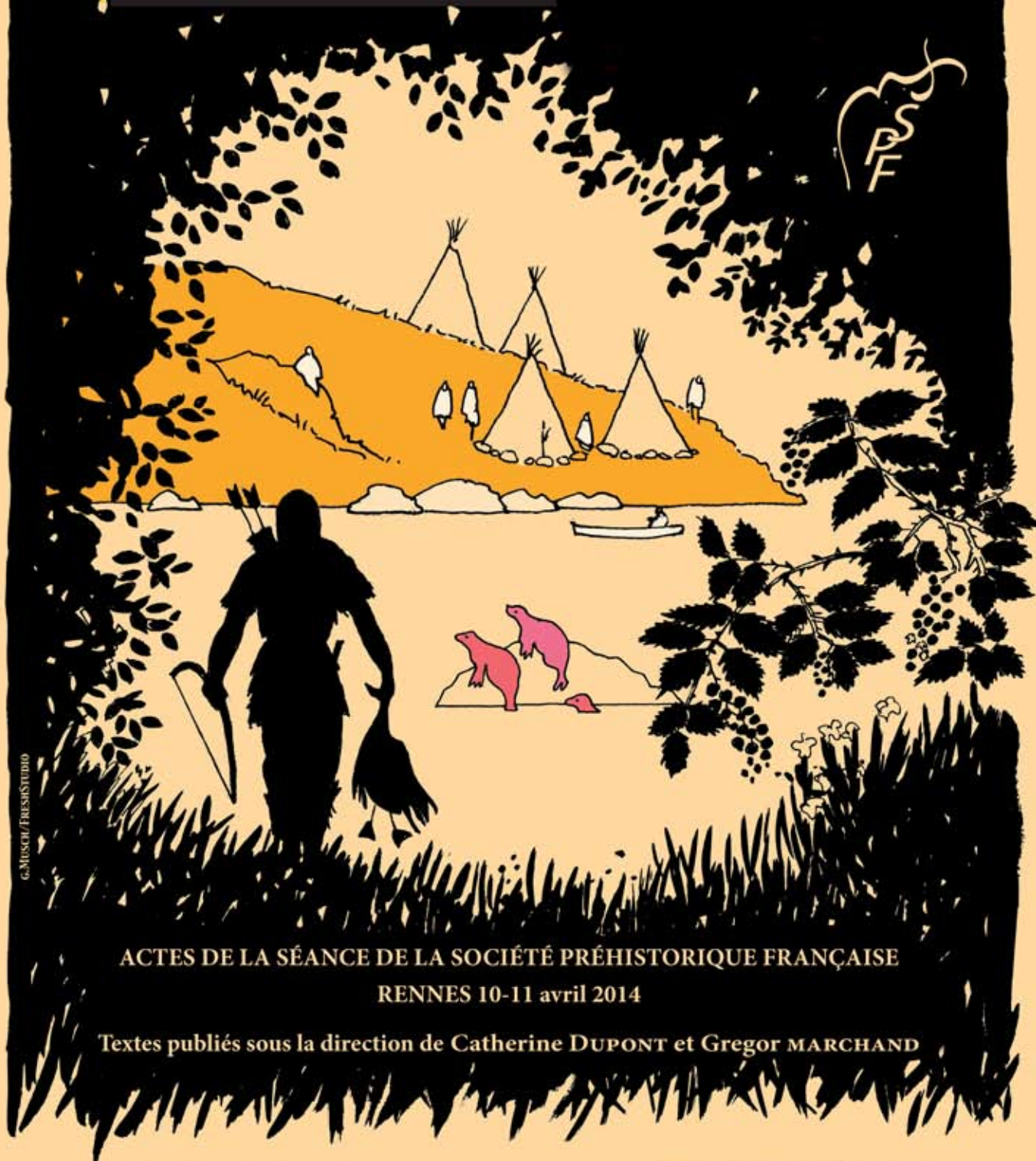
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# ARCHÉOLOGIE DES CHASSEURS-CUEILLEURS MARITIMES

DE LA FONCTION DES HABITATS  
À L'ORGANISATION DE L'ESPACE LITTORAL

ARCHAEOLOGY OF MARITIME HUNTER-GATHERERS

FROM SETTLEMENT FUNCTION  
TO THE ORGANIZATION OF THE COASTAL ZONE



ACTES DE LA SÉANCE DE LA SOCIÉTÉ PRÉHISTORIQUE FRANÇAISE

RENNES 10-11 avril 2014

Textes publiés sous la direction de Catherine DUPONT et Gregor MARCHAND

SÉANCES DE LA SOCIÉTÉ PRÉHISTORIQUE FRANÇAISE

6

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## Between Land and Sea

# Assessing Hunter-Gatherer Subsistence Practices and Cultural Landscapes in Southern Portugal during the Final Mesolithic

Mariana DINIZ

**Abstract:** The longstanding relationship between human groups and the sea continues to shape European culture today, as we can see from Eurostat data. A large proportion of the present-day population could be classified as maritime and the goals for Horizon 2020 reflect the major role of the sea in the contemporary economy, sciences and ways of life.

Among the questions to be addressed when looking at the relationship between the last hunter-gatherer groups and the sea—which means assessing how the sea and coastal regions were used and explored—we can ask what role the sea played in the cultural matrix of these groups?

In order to define some starting points for this analysis, it is important to briefly sum up some general assumptions relating to this subject: 1) along European coasts, Final Mesolithic hunter-gatherers were traditionally described as relying heavily on a maritime economy; a situation that is supposed to change with the Neolithisation process and the dominance of agro-pastoral and land-based economies. Therefore, a major breakdown in the long-term 'maritime relation' is assumed to be related to cultural factors as part of a chronological process; when domesticates arrived the sea lost its dominance; 2) traditionally, maritime hunter-gatherer economies are generally defined as an Atlantic phenomenon and groups in the Mediterranean Basin are thought to be characterized by less dense occupation patterns and a less marked maritime character. Debating why this major difference arose and why maritime economies are environmentally dependent – not only on the distance from the sea, which is an expected dependency—but mainly on which is the nearest sea, is a question to be explored in this paper. This assumption raises the problem as to how coastal zones were defined during the Final Mesolithic and how the different coastal hunter-gatherer groups settled along European shorelines, considering that recent data point to clear asymmetries between North Atlantic and Mediterranean hunter-gatherers.

Southern Portugal is a privileged area for discussing these questions on account of its Atlantic position, but also due to the fact that the clearly Mediterranean environment of this region makes it a pertinent territory for examining Final Mesolithic hunter-gatherer behaviour in a mixed landscape, between land and sea, between Atlantic and Mediterranean settings.

In order to understand the data from southern Portugal and to establish the 'maritime index' of this zone, it is necessary to compare Western Iberian hunter-gatherers with other Final Mesolithic groups in Atlantic and Mediterranean areas, by addressing topics such as site location patterns, site distance to the sea and dietary isotopic analysis. In this way, we can define a first comprehensive model of settlement purposes.

Differences in Atlantic and Mediterranean cultural patterns will be explored by relating archaeological data to environmental possibilities. The primary productivity of oceans is considered here to be a relevant issue to explain variances in Final Mesolithic hunter-gatherer behaviour.

**Keywords :** Final Mesolithic, hunter-gatherers, Mesolithic diets, North Atlantic, Mediterranean Basin.

**Résumé :** Les relations entre les groupes humains et la mer est une question ancienne que nous pouvons aborder désormais à partir des données de Eurostat qui montrent par exemple comment la mer façonne la culture européenne encore aujourd'hui. Ainsi, une grande partie d'entre nous peut être classée comme des personnes dépendantes d'un environnement maritime, et les objectifs adoptés par l'ERC dans l'Horizon 2020 reflètent le grand rôle attribué à la mer dans l'économie contemporaine, les sciences et les modes de vie. Parmi plusieurs questions qu'évoque ce thème chez les derniers chasseurs-cueilleurs, se pose celle de l'influence de la mer sur les populations des régions côtières et comment cet environnement a influencé leur matrice culturelle.

À l'heure actuelle, plusieurs idées préconçues existent sur ce sujet : 1) le long des côtes européennes les chasseurs-cueilleurs du Mésolithique final ont été traditionnellement décrits comme ayant une économie maritime qui va changer avec le processus de néolithisation et la domination des économies agro-pastorales. Celles-ci vont établir une rupture majeure dans cette longue « relation maritime » : quand les espèces domestiquées sont arrivées, la mer a perdu sa position dominante dans l'économie des populations côtières ; 2) traditionnellement, ces chasseurs-cueilleurs des régions côtières basés sur une économie maritime sont définis en grande partie comme

un phénomène atlantique. En effet, les populations côtières du bassin méditerranéen révèlent une occupation moins dense et maritime de ces territoires.

Cet article débat de ces différences majeures et des raisons pour lesquelles cette dépendance se produit, non pas seulement la question de la distance à la mer mais plus généralement celle de la nature du proche océan. Il s'agit en effet ici de mieux définir les différents groupes de chasseurs-cueilleurs du Mésolithique final évoluant le long des côtes européennes, notamment en abordant l'origine des variabilités observées entre les chasseurs-cueilleurs de la façade atlantique et ceux du bassin méditerranéen. Pour répondre à ces questions, le Sud du Portugal constitue une aire privilégiée, en raison de sa position atlantique soumise à des conditions environnementales clairement méditerranéennes. On peut alors se demander comment les chasseurs-cueilleurs du Mésolithique final se sont comportés dans ce paysage mixte situé entre la terre et la mer, entre l'Atlantique et le Méditerranée.

Pour comprendre le contexte archéologique du Sud du Portugal et mettre en place son « indice maritime », il est nécessaire de comparer les derniers chasseurs-cueilleurs de la péninsule ibérique occidentale avec d'autres groupes du Mésolithique final de la façade Atlantique et des régions méditerranéennes, notamment du point de vue de la localisation des sites, de leur distance à la mer et du résultats des analyses isotopiques témoignant des régimes alimentaires. Cela devrait permettre d'obtenir des modèles de peuplement distincts. Pour débattre des causes complexes à l'origine de ces différences économiques et culturelles, la disponibilité des ressources environnementales, comme la productivité primaire des océans seront prises en compte.

**Mots-clés :** Mésolithique Final, chasseurs-cueilleurs, diètes mésolithiques, Atlantique Nord, Bassin méditerranéen.

**I**N EUROPE, the transition from a hunter-gatherer to an agro-pastoralist way of life is thought to entail major changes in lifestyles, particularly in food procurement strategies. A new and more distant relationship with the sea and sea resources is considered to emerge while domesticates—animals and plants—arrived and disseminated throughout the land. Thus, a major breakdown in the Holocene 'maritime relation' is assumed to be related to cultural factors as part of a chronological process; when domesticates arrived the sea lost its dominance.

The Neolithic economic system in Europe is predominantly based on farming, even though a complete change in the subsistence model could have taken several millennia to occur, particularly in some coastal areas where maritime resources continue to play a significant role in the local economy.

In addition, Final Mesolithic hunter-gatherers in coastal Atlantic and Mediterranean coastal regions show significant differences as regards their dependence on the sea. These differences persist today since Eurostat data show that the two areas do not display the same relationship with the sea (European Commission – Eurostat, 2014). Analysing the different behavioural patterns of Atlantic and Western Mediterranean Final Mesolithic groups as regards subsistence practices and landscape use is the main aim of this paper. For this purpose, isotopic data from human diets and regional settlement patterns will be used to determine how these groups interacted with their biological and cultural environments.

After more than 150 years of continuous and interdisciplinary research, Final Mesolithic maritime hunter-gatherer economies are largely defined as an Atlantic phenomenon and the distribution of large shell middens along coastal areas from Scandinavia to the Iberian Peninsula plays a key role in this depiction. This clear preference for Atlantic environments reflected by Mesolithic settlement maps (for a review see e.g. Gutiérrez Zugasti et al., 2011) points to sparser occupation and the decrease of maritime activities as regards the human groups that settled in the Mediterranean basin. These southern hunter-gatherers

seem to be peripheral to the 'dominant' Final Mesolithic cultural model (for a review of the Mesolithic Mediterranean shell middens, see e.g. Colonese et al., 2011) and debating why this major difference between Atlantic and Mediterranean areas arose is a central issue here.

Even if we assume that multiple biases could affect this image—in Mediterranean regions, archaeologists are traditionally more oriented towards other cultural periods than the Mesolithic period—differences in coastline dynamics during the Holocene period and the possibility that new data may modify the current situation—it is still possible to take into account a model that predicts that maritime economies are based on environmental dependency, not only in relation to their distance from the sea—which is an expected dependency—but also, and above all, depending on what is the nearest sea.

Therefore, the starting point of this discussion is to define how coastal dependencies were indeed different among the coastal hunter-gatherer groups established along European shorelines. It is essential to address to what extent environmental and/or cultural aspects are responsible for the differences in maritime behaviour between Atlantic and Mediterranean Final Mesolithic groups.

Southern Portugal is a privileged area for discussing these questions since this region presents a mixed character deriving from its geographical Atlantic position alongside a Mediterranean environment, due to geological, climatic, faunal-botanical and historical/sociological features. This region is therefore a relevant territory for analysing Final Mesolithic hunter-gatherer behaviour at this crossroads, between land and sea, and between the Atlantic Ocean and the Mediterranean Sea.

Differences in cultural patterns can be explained using different arguments, ranging from environmental determinism to systems theory, to symbolic and identity issues that post-modern archaeologists tend to adopt as the main proxy for interpreting human behaviour. Here, an intermediate position is proposed. Without arguing for *a priori* environmental determinism, landscape analyses are con-

sidered as being crucial for understanding archaeological records, in the same way as social choices and cultural patterns are essential for assessing past cultural diversity.

In order to comprehend the data from Southern Portugal and to establish the 'maritime index' of this region, it is necessary to compare western Iberian hunter-gatherers with other Final Mesolithic groups in Atlantic and Mediterranean areas, focusing on topics such as: 1) the primary productivity of coastal areas; 2) site location patterns and site distance from the sea and 3) isotopic analysis of human diets, so that a comprehensive model of group dependence on maritime resources can be defined.

### ON THE PRIMARY PRODUCTIVITY OF OCEANS AND SEAS

In order to establish the primary productivity (PP) of the North Atlantic Ocean and the Mediterranean Sea during the first millennia of the Holocene, contemporary marine phytoplankton data—the sustenance of marine food webs—can be used to define general values since marine environments present long-term trend values (Abrantes, 2000; Cermeño et al., 2010) and the main factors correlated to phytoplankton distribution—light and nutrients (Ramos Pereira, 2001, p. 29-31)—do not present major changes since the Atlantic climatic period. Historical data confirm that differences in ocean PP predate anthropogenic factors, such as pollution or overexploitation. This is corroborated by the virtual absence of Roman *cetariae* (fish salting installations) in the Mediterranean Sea. The examination of figure 1, presenting ocean primary productivity, reflects marked asymmetries between North Atlantic and Mediterranean areas, with environments such as the Scandinavian or British areas showing the highest global values of primary productivity, reaching more than 800 g C m<sup>-2</sup> y<sup>-1</sup>, whereas some Mediterranean coastal areas fall within the lower range with values between 226 and 103 g C m<sup>-2</sup> y<sup>-1</sup> (Longhurst et al., 1995).

This has environmental consequences on Final Mesolithic settlement distribution and it is no coincidence that the Mesolithic map corresponds to European coastal areas with higher primary productivity and that hunter-gatherer maritime economies were developed in primary productivity hot spots. Shell middens are a major archaeological marker of this link with the sea.

In addition to the marked asymmetry between North Atlantic and Mediterranean areas, primary productivity can be used to explain some trans-regional tendencies in the Western European and Maghreb Final Mesolithic archaeological record. A small-scale analysis shows that other productivity gradients in North Atlantic coastal areas should be highlighted in order to clarify some aspects of western Iberian Final Mesolithic archaeological data, in particular concerning shell middens in Southern Portugal.

In the North Atlantic, the 40°N parallel establishes a line in primary productivity that rises above that parallel

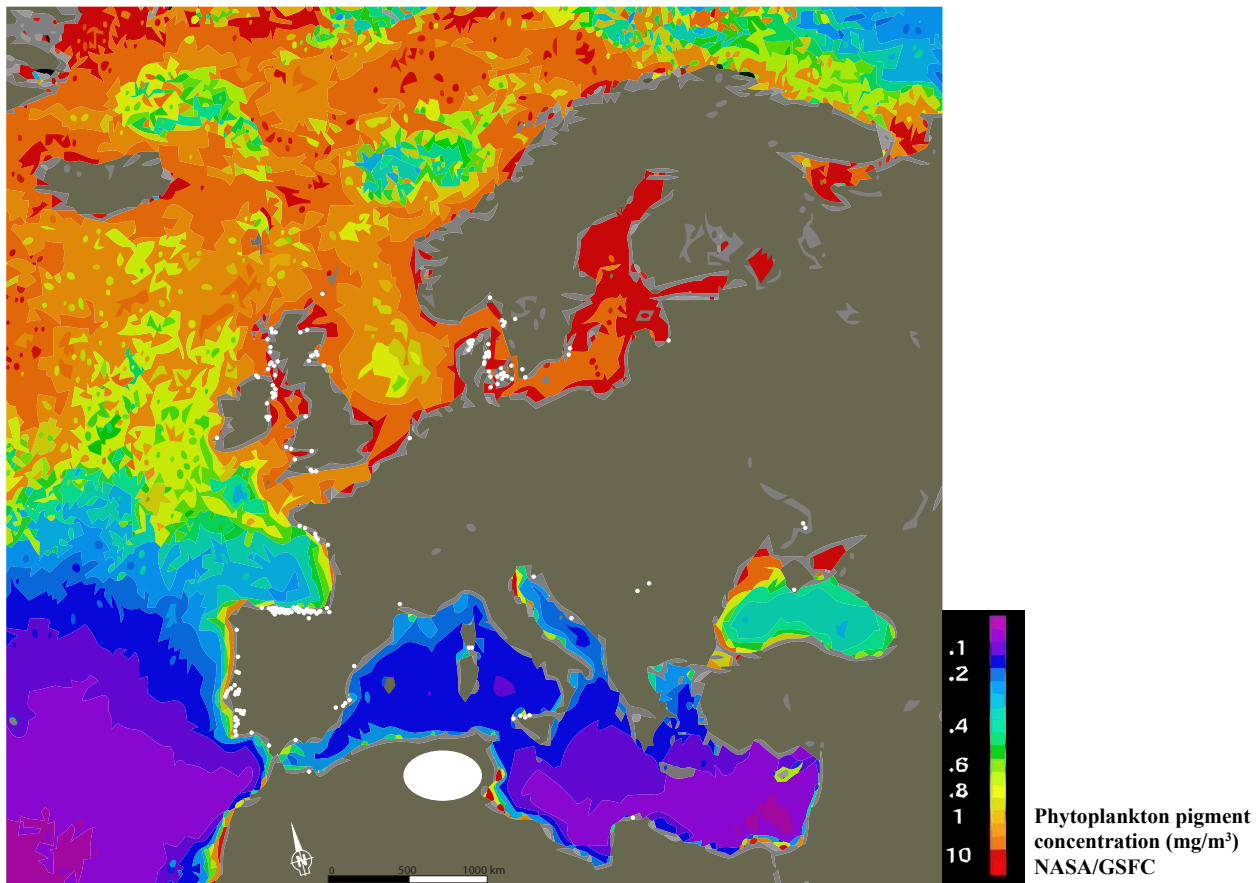
from 45 g to more than 90 g (Johnsen et al., 2010, p. 5). This line coincides with the boundary between “Mediterranean and Atlantic Portugal”, a distinction made several decades ago by O. Ribeiro (Ribeiro, 1991), who pointed out that in spite of a geographical Atlantic position, Southern Portugal is indeed geologically, climatically and culturally, a Mediterranean landscape. This northern increase in productivity along the Portuguese west coast may be considered as an explanation for Mesolithic diversity in the archaeological record. We will come back to this point below.

Thus, global scenarios relating to the PP of oceans can contribute to explaining why the Mediterranean Mesolithic is not correlated to an aquatic shell midden record and why the Maghreb *escargotières* (snail-shell middens)—even if they reflect the same broad spectrum economy as shell middens—depend on land species (Lubell, 2004a and 2004b). Even in coastal and slightly later occupations, such as the Cimetière des Escargots site (Bou-Sfer, Oran), marine shells are well represented but land snails abound (Goetz et al., 1964), reflecting the predominant role of land-based food procurement strategies in these coastal groups. Generally speaking, and considering that PP values from the southern Mediterranean coast (fig. 1) range from 98 g C m<sup>-2</sup> y<sup>-1</sup> to 193 g C m<sup>-2</sup> y<sup>-1</sup>, the scarcity of marine resources seems to be a reasonable argument to explain why large Caspian shell middens point towards inland sources and why these groups depend on land-dwelling mollusc exploitation (Lubell, 2004a and 2004b).

The outcome of the analysis of ocean primary productivity values reveals a very clear contrast between Atlantic and European Mediterranean environmental conditions. This enables or constrains the different dependencies on maritime economies shown by the Final Mesolithic settlement map. Within this area, the marked asymmetry detected between some of the most productive environments, like those recorded in Scandinavia with PP values reaching 800 g C m<sup>-2</sup> y<sup>-1</sup>, and the lowest along the southern Mediterranean shore, can be used as a proxy to predict that Final Mesolithic hunter-gatherers developing an opportunistic economy will adapt differently to landscape possibilities and produce an archaeological record where sea resources have different roles, as site location and dietary analysis—discussed below—reveal.

### ON SITE LOCATION PATTERNS

Discussing coastal European Final Mesolithic settlement patterns can be considered a difficult matter since postglacial transgression dynamics were still active during that period and detailed shoreline reconstitutions do not exist for the whole area under study. It is currently almost impossible to establish a general picture of where exactly the shifting coastline was during the Final Mesolithic (c. 7500-5500 cal. BCE), in different parts of Europe. Consequently, extreme caution is required in



**Fig. 1 – Map of the main Mesolithic settlements in Western Europe and the Maghreb with colour references to ocean primary productivity (after Lubell, 2004; Dupont et al., 2009; Fontanals-Coll et al., 2014; [http://geosci.sfsu.edu/courses/geo1103/labs/upwelling/images/world\\_summer.gif](http://geosci.sfsu.edu/courses/geo1103/labs/upwelling/images/world_summer.gif)).**

*Fig. 1 – Carte des principaux sites mésolithiques en Europe de l'Ouest et au Maghreb avec les couleurs des références de la productivité primaire des océans (d'après Lubell, 2004; Dupont et al., 2009; Fontanals-Coll et al., 2014; [http://geosci.sfsu.edu/courses/geo1103/labs/upwelling/images/world\\_summer.gif](http://geosci.sfsu.edu/courses/geo1103/labs/upwelling/images/world_summer.gif)).*

attempts to define the coastal/inland status of a particular site. Nevertheless, the bathymetry of the areas under analysis, together with some available regional coastline reconstructions, points to major changes in northern latitudes, particularly in Brittany and southern Scandinavia (fig. 2), with the first line of coastal Mesolithic sites now submerged (e.g. Fischer et al., 2007, fig. 1; Marchand, 2007, fig. 3). Minor effects are documented on Mediterranean coastal areas (fig. 3), where almost abrupt margins and the extension of former coastal platforms were not so strongly affected by the post-glacial rise in sea level. For instance, data from the Pleniglacial period for Mediterranean Spain—when differences in landscape were at their peak—predict a coastal strip 10–20 km wider than today on the Gulf of Valencia, but only 5 km wider in eastern Andalucía (Aura Tortosa et al., 1998, p. 97).

Moreover, the definition of coastal/inland areas can also be problematic, since geographic descriptions often involve qualitative criteria (for some discussion of this issue, see Arias Cabal et al., 2009, p. 304), with coastal/inland categories being defined on occasion using attributes other than just the physical distance to the sea. In this paper, the principles of the site catchment analysis model

will be followed to define coastal sites that should be no more than 10 km from the shore (Roper, 1979), meaning that to be considered a coastal site, seafood must be available in the immediate resource exploitation area.

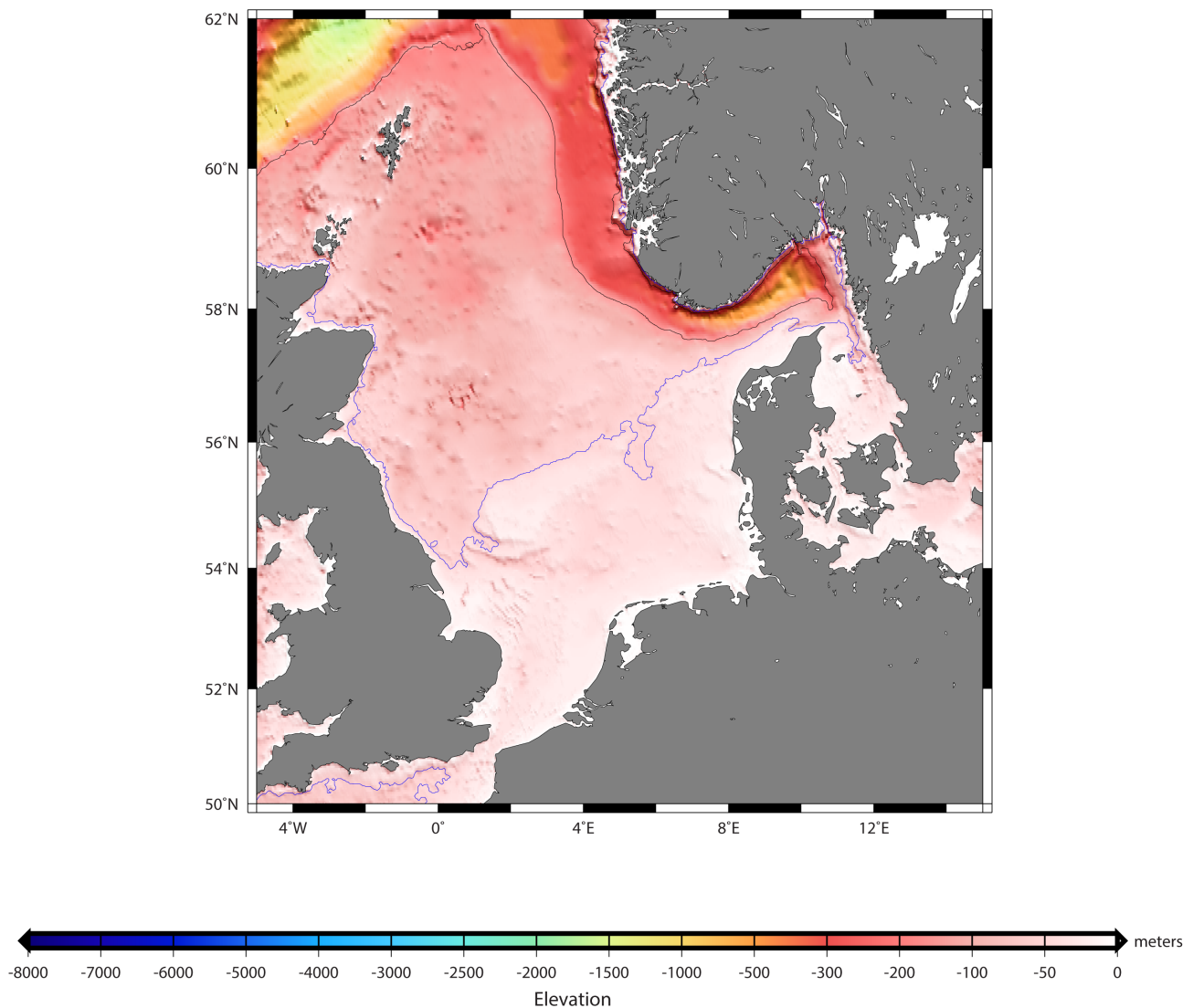
It becomes clear from this analysis that even if more detailed geomorphological analysis is required and more data concerning the regional contours of sea level rises are needed, a global and predictable trend emerges from the study of Atlantic and Mediterranean Final Mesolithic site location patterns.

The comparisons of data from some Final Mesolithic key settlement areas in both Atlantic and Mediterranean environments evidence an almost perfect correlation between ocean primary productivity values and the presence of coastal settlements.

If we consider Northwest Scotland, the Ertebølle region, and Brittany as North Atlantic case studies corresponding to red ocean primary productivity areas (fig. 1), intensive coastal exploitation is recorded and major sites with settlements and cemeteries are located near the sea.

Through the detailed examination of the cartography available for these regions, a clear picture emerges of North Atlantic hunter-gatherers intensively exploiting

## Bathymetry of North Sea



**Fig. 2 – Bathymetry of the North Sea (adapted from Bathymetry Maps of Continental Margins: [http://cmtt.tori.org.tw/data/App\\_map/maplist.htm](http://cmtt.tori.org.tw/data/App_map/maplist.htm)).**

**Fig. 2 – Bathymétrie de la mer du Nord (modifié d'après Bathymetry Maps of Continental Margins : [http://cmtt.tori.org.tw/data/App\\_map/maplist.htm](http://cmtt.tori.org.tw/data/App_map/maplist.htm)).**

coastal areas for logistic, residential and symbolic purposes. This implies that the classical post-glacial maritime/broad spectrum economy models developed since the 1960s (Binford, 1968; Flannery, 1969) are still valid for the archaeological record of the area.

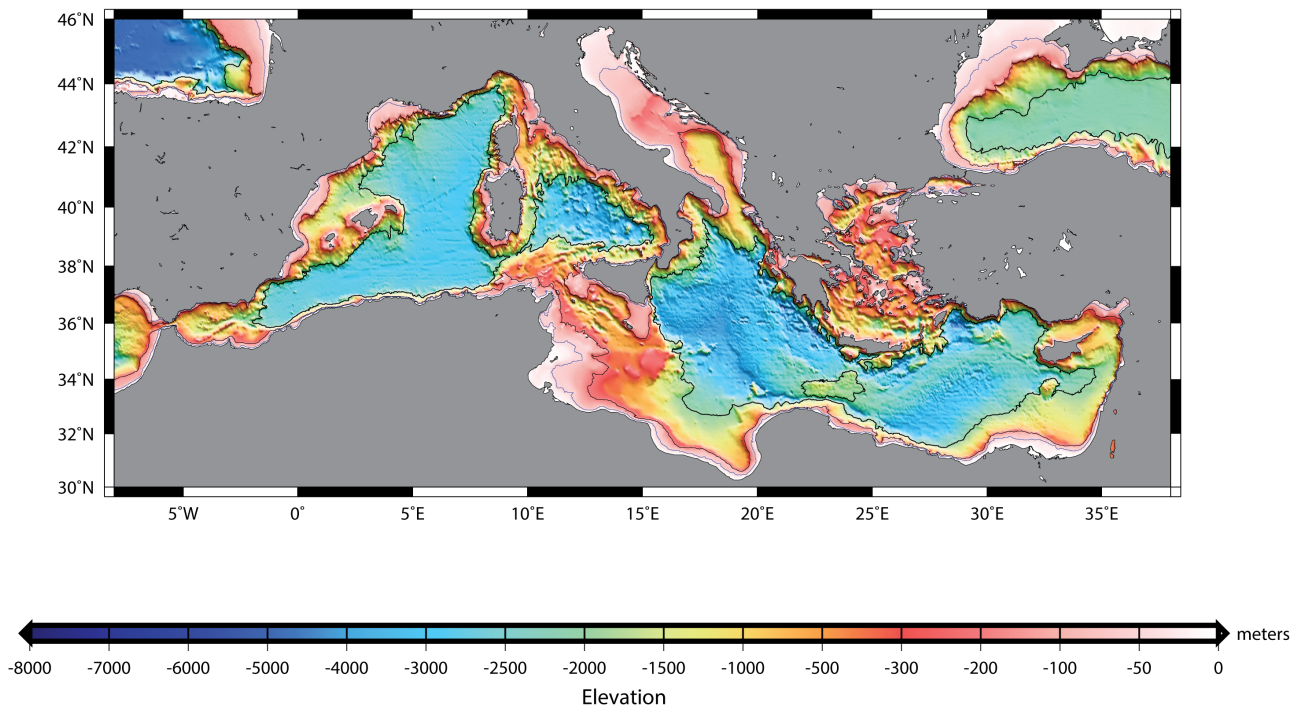
The distribution of sites in Western Scotland shows that Mesolithic settlement occupied a coastal fringe, almost without exception. As expected, the archaeological record indicates important links with the sea, and marine resources are a key element in shaping cultural patterns (Mithen et al., 2007).

This same image also emerges in Southern Scandinavia, where, as notes L. Larsson, “an intensive use of the coastline is well known from the Late Mesolithic

when most sites are situated above present sea level.” (Larsson, 2003). In Southern Scandinavia and considering local bathymetry, the Final Mesolithic landscape included territories that are now submerged but the available archaeological record reflects strong relationships between groups settled near the coast and the sea, marking an important split with groups established inland (Larsson, 2003, p. 10).

The third North Atlantic area considered here reinforces this pattern. In Brittany, settlement patterns show that Final Mesolithic groups selected coastline areas or territories between 20 m and 1 km from the sea for implanting large settlements and cemeteries, whereas they developed a more mobile way of life in inland zones,

## Bathymetry of Mediterranean Sea



**Fig. 3 – Bathymetry of the Mediterranean Sea** (adapted from *Bathymetry Maps of Continental Margins*: [http://cmtt.tori.org.tw/data/App\\_map/maplist.htm](http://cmtt.tori.org.tw/data/App_map/maplist.htm)).

**Fig. 3 – Bathymétrie de la mer Méditerranée** (modifié d'après *Bathymetry Maps of Continental Margins* : [http://cmtt.tori.org.tw/data/App\\_map/maplist.htm](http://cmtt.tori.org.tw/data/App_map/maplist.htm)).

with no burial places (Ghesquière and Marchand, 2010, p. 49).

A cultural and settlement model developed in these North Atlantic areas, where populations exploited local features, revealing opportunistic behaviour, particularly in rich coastal landscapes. The sea was thus clearly a decisive factor in North Atlantic settlement patterns.

The comparison of these data with Western Mediterranean settlement patterns, and in particular the Iberian Peninsula archaeological record, yielded a less maritime picture, where site locations point to different strategies of resource exploitation and land use.

In southern Mediterranean regions, as already mentioned above, coastal areas seem to be peripheral to dominant settlement patterns and Capsian site distribution clearly reveals a terrestrial economic system. It is important to recall that the lowest levels of ocean primary productivity are registered in this area, making coastal environments less attractive to human settlement than inland locations.

For the northern Mediterranean margin, based on the Final Mesolithic record in Liguria (Nisbet, 2008, p. 196) and Southern France, it is clear that this particular period is practically unknown in the region and available data do not point to any particular link to coastal areas. In fact, recent evidence points towards a land-based economy,

with shell consumption at the Laverune (Pouget, Hérault) open-air site, located around 8 km from the sea. However, given the scarcity of shell remains, it is not possible to classify this occupation as a shell midden (Guilbert-Berger et al., this meeting).

It is impossible to define Final Mesolithic settlement in Mediterranean Spain, on account of many gaps in the record. As Juan Cabanilles and Martí Oliver emphasize: "(...) el Epipaleolítico reciente es prácticamente desconocido en Cataluña, así como en la Andalucía mediterránea, si exceptuamos el foco interior y aislado de la Sierra de Cazorla." (Juan Cabanilles and Martí Oliver, 2007-2008, p. 618).

In Central Catalonia, coastal areas do not reveal any particular Final Mesolithic occupation, and most of the currently available data come from further inland (Utrilla and Martínez-Béa, 2007; Arias Cabal et al., 2009; Fernández López de Pablo and Gómez Puche, 2009). Final Mesolithic groups are not linked to an aquatic economy and the dominance of land-based hunter-gatherer behaviour is reflected in the archaeological material, as documented by the geometric projectiles stemming from the Costalena and Botiqueria sites (Martínez Béa, 2004).

In Valencia, which is a key area for understanding the process of neolithisation in the Iberian Peninsula due to chronometric and cultural data available for the Early

Neolithic groups, the picture is even clearer. Apart from El Collado, the other Mesolithic sites are located inland (Aura Tortosa et al., 2009), and the eponymous Final Mesolithic site in Valencia, Cueva de la Cocina, is situated around 30 km from the sea.

In Andalucía, a mixed picture emerges with no clear preference for the exploitation of coastal or inland areas (Ramos Muñoz, 2007).

In Nerja Cave, intense maritime exploitation is documented (Aura Tortosa et al., 2009, p. 356), but it is important to be cautious when extrapolating these behaviours to other areas as aquatic resources do not appear to play a major role in diets in other Mediterranean coastal caves, such as at Arene Candide or Grotta del Uzzo (Craig et al., 2006, p. 71).

In Western Andalusia, at open air sites like El Embarcadero del Rio Palmones, marine faunal remains are very rare in spite of its coastal location (Casimiro-Soriguer et al., 2005, p. 338). At El Retamar (Cádiz), marine resources were exploited but the overall picture from

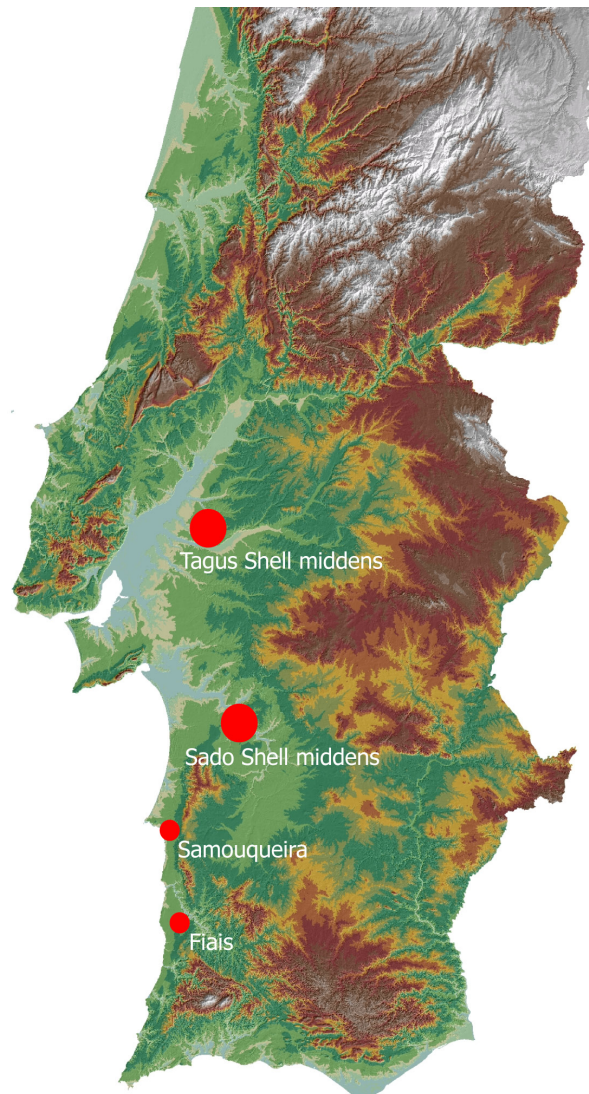
these sites does not correspond to that of Atlantic shell middens (Ramos Muñoz and Lazarich González, 2002).

Thus, a pattern of more limited coastal settlement emerges from the Western Mediterranean data, and it is important to emphasize that even if coastal locations are included in these distribution patterns, the sea does not play a crucial role in food procurement strategies.

In Southern Portugal, like in other Mediterranean areas, the current shoreline was not predominantly selected for settlement purposes. In fact, apart from the open air site of Samouqueira, Sines (Soares, 1995), other settlement sites, like Muge, Sado and Mira, with large shell middens, are located in former estuaries in inland areas, ranging from 40 km to 10 km from the sea (fig. 4).

This estuarine pattern fits well with an aquatic economy, but shows however important differences in relation to North Atlantic areas, which require further discussion.

Using only settlement pattern data, it appears that, like with primary productivity, North Atlantic and Mediterranean hunter-gatherers behave differently when



**Fig. 4 – Final Mesolithic sites in Southern Portugal mentioned in the text.**

*Fig. 4 – Les sites du Mésolithique final du Sud du Portugal mentionnés dans le texte.*

choosing site locations. During the Final Mesolithic, proximity to the sea does not influence the human settlement of North Atlantic and Mediterranean areas in the same way, and even when the sea is close by, this does not necessarily mean that food acquisition is focused on marine products. Again, North Atlantic and Mediterranean areas exhibit different cultural patterns as regards settlement locations. Submerged landscapes seem to hardly provide an explanation for this, since greater changes in coastlines due to postglacial transgressive dynamics are known to have occurred in North Atlantic areas where the first line of Final Mesolithic settlement is now submerged. However, the archaeological record documents close relationships with the sea, indicating sharp contrast with Mediterranean economic patterns.

### ON DIET AND ISOTOPE ANALYSIS

Reconstructing human diets from the archaeological record was traditionally approached through the analysis of faunal and botanic remains, combined with lithic typo-technological descriptions, micro-wear studies and considerations of site locations and environmental possibilities, in order to obtain a more accurate image. In southern European records, and in particular those from the Iberian Peninsula, faunal remains are abundant but plant-based food was not directly documented until the beginning of the Sado-Meso (Diniz and Arias Cabal, 2012) and Muge (Bicho et al., 2011) team projects. The latter supply new data on a predictable major group of food resources in Mediterranean areas, as argued by D. Clarke (Clarke, 1978), and reveal by trace element analysis of populations from Sado (Soares Umbelino, 2006).

It was however difficult to apply quantitative analysis to earlier data relating to human diets, due to multiple factors: samples recovered from former excavations with unknown field procedures generate data with uncontrolled biases and the taphonomic conditions differentially affecting distinct food remains were not always observed and recorded.

Since the 1980s, it has become clear that the archaeological record can lead to misinterpretations of human behaviour as regards the diet and food remains. The classic calculation establishing that a single red deer has the same caloric value as 52,267 oysters (Osborn, 1980), leaves no doubt—even if in reality a red deer corresponds to only 8,522 oysters and not to 52,267 (Churchill, 2014, p. 190)—as to how careful we should be about identifying human diets from archaeological remains. Over the past decades, stable isotope analysis has confirmed some scenarios and reordered some local trends, but it has also provided new insights into human behaviour even for archaeological contexts where organic material is preserved. From this perspective, recent data (Fontanals-Coll et al., 2014) yield a comprehensive picture of the stable isotopic panorama in Final Mesolithic diets. But it is considered here that further debate is possible con-

cerning both the evidence from Southern Portugal and the Atlantic/Mediterranean discrepancy.

Results obtained on North Atlantic diets clearly revealed that settlement patterns developed around very rich coastal ecosystems and the analysis of stable carbon and nitrogen isotopes ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) from human remains, reflects the importance of seafood in diets. In Western Scotland, seafood percentages could account for more than 90% of the diet (Mithen et al., 2007, p. 516).

The same situation is observed in Scandinavia, where the Ertebølle groups also show high dependency on aquatic products, and a real shift in the Neolithic diet is also visible through stable isotope analysis (Fisher et al., 2007, fig. 5; Robson et al., 2012). Even so in Scandinavia, like in Scotland, terrestrial products are well represented in the diet of hunter-gatherers buried in inland sites, suggesting a less mobile way of life than expected among Mesolithic groups, as reflected in the regionalisation of diets.

In Brittany, as in other North Atlantic coastal necropolises, stable isotopic analysis yielded a similar outcome: “At Tévéc and Hoëdic, the previously reported average values on human bone collagen indicated a high reliance on marine protein, estimated at 60–80%” (Schulting and Richards, 2001).

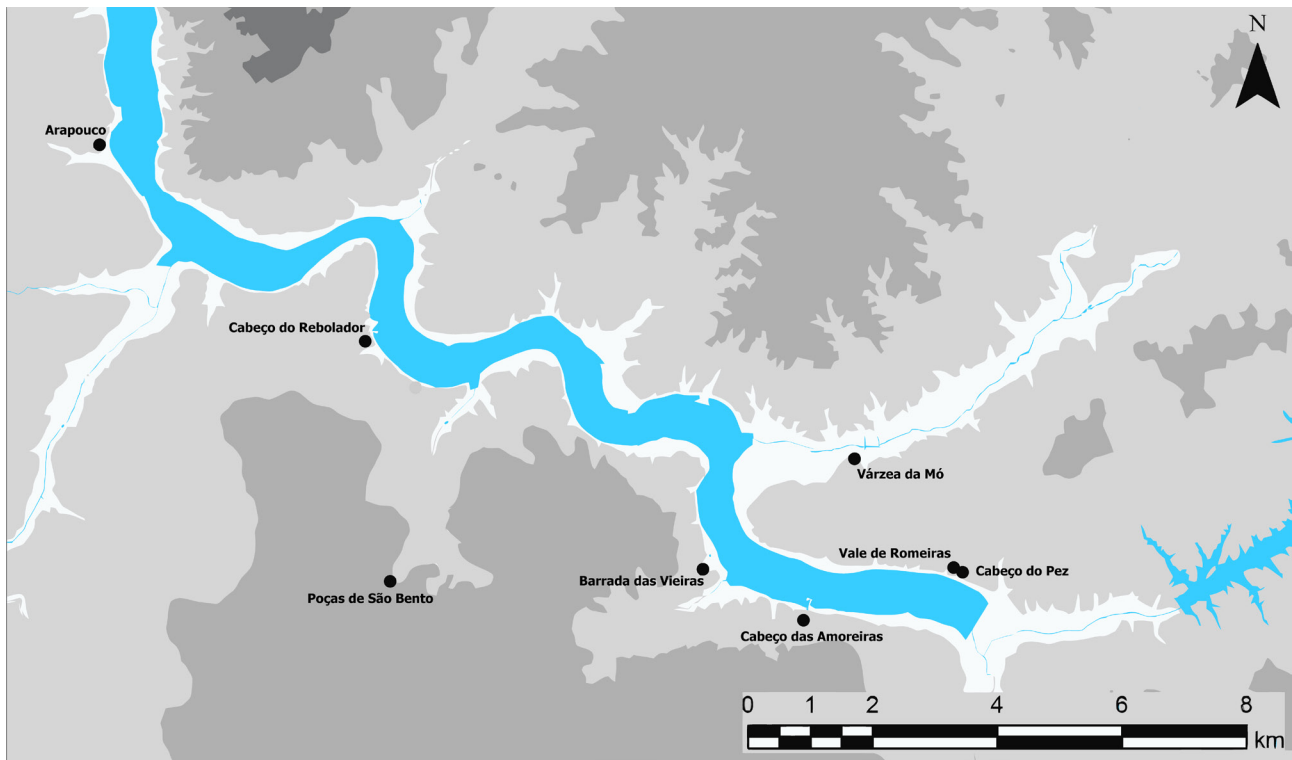
These results are in accordance with most of the results from the European Atlantic coast, from Britain and Ireland “in showing a high dependence of coastal Mesolithic populations on marine (...) resources.” (Dupont et al., 2009, p. 100). This scenario represents a global and predictable trend among European Atlantic Final Mesolithic hunter-gatherers where ocean primary productivity, settlement patterns and diets match perfectly in a coherent way to define a world of sea people.

Considering Mediterranean data relating to Final Mesolithic diets, a completely different picture emerges. The  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values mainly reflect terrestrial diets not only from inland sites, but also from coastal occupations, like Arene Candide, Grotta del Uzzo or El Colado (García Guixé et al., 2006, p. 554), where marine resources were never predominant, even if they were consumed.

Thus isotope analysis reveals a clear division between Atlantic and Mediterranean hunter-gatherer lifestyles and diet. The sea does not play a key role in the economy of Mediterranean groups, and this appears to be connected to the low levels of Mediterranean primary productivity.

If we consider the available data from the southernmost North Atlantic Final Mesolithic settlement area in Southern Portugal, a more complex situation emerges with  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values reflecting different trends between two core areas: Tagus and Sado shell middens. Both shell middens are respectively located at 40 km and 30 km from the coast, and occupy the inner area of the Tagus and Sado paleoestuaries, where high levels of primary productivity were expected (Clarke, 1978, p. 20; Rowley-Conwy, 1986, p. 118) and where marine/estuarine resources should accordingly play a central role in human diets. The first stable isotope analysis on humans from the Moita do Sebastião shell midden (Tagus cluster)





**Fig. 5 – Sado valley Final Mesolithic shell middens (map E. Cerrillo, adapted from Diniz and Arias Cabal, 2012).**

*Fig. 5 – Amas coquilliers du Mésolithique final de la vallée du Sado (carte E. Cerrillo, d'après Diniz et Arias Cabal, 2012).*

goes back to 1986 (De Niro, 1986), and indicated a clear mixed economic pattern. Moita do Sebastião individuals associated with marine carnivores feeding on vertebrates and invertebrates, reflecting a true aquatic and North Atlantic diet which will be described here under the 'seal index' label. Further analysis carried out by C. Soares Umbelino (Soares Umbelino, 2006) corroborates these first results and a balanced land and sea economy characterises Tagus shell midden subsistence practices.

Further south, data from the Sado shell midden reveal a totally different situation (fig. 5). The first stable isotope analyses were presented by Cunha and Soares Umbelino (Cunha and Soares Umbelino, 2001), but the contrast between the Tagus and Sado diets, with average marine diet values of 50% and 30% respectively, was only mentioned later by C. Soares Umbelino in his PhD thesis, in 2006 (Soares Umbelino, 2006, p. 16). This contrast appears to be even stronger if we take into account recently published data by M. Fontanals-Coll and co-workers (Fontanals-Coll et al., 2014, p. 543) concerning Sado diets. The marine signal drops, pointing to a predominantly terrestrial diet among these riverside hunter-gatherers, described here under the 'olive index' label. The average  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values from the Sado shell middens (Cunha and Soares Umbelino, 2001; Soares Umbelino, 2006; Fontanals-Coll et al., 2014) are much closer to other Mediterranean assemblages than to the nearby Tagus shell middens. In the Sado valley, the average  $\delta^{13}\text{C}$  value from human bones is  $-18.7 \delta^{13}\text{C}$  (table 1), placing

Sado hunter-gatherer diets between those of terrestrial carnivores and terrestrial herbivore consumers, and detaching them from those of marine fauna consumers (Fontanals-Coll et al., 2014, fig.3).

In fact, the Tagus and Sado inner estuary shell middens reveal—as J. Moráis Arnaud already pointed out in 1987 when discussing similarities and discrepancies between Tagus and Sado (Moráis Arnaud, 1987)—differences in resource exploitation and diet connected with the different ecological conditions of both paleoestuaries. Whether the northern latitude of the Tagus shell middens closer to the  $40^\circ\text{N}$  parallel—where an important North Atlantic primary productivity increase occurs—and/or some geomorphological features of Sado Valley were responsible for this different dietary pattern is for the moment an open question, currently under study as part of the Sado-Meso project (Diniz and Arias Cabal, 2012).

### ON DEPENDENCY ON MARINE RESOURCES

Final Mesolithic cultural patterns are more than a strictly environmental solution; they also point to the capacity to deal with environmental opportunities. In Western Europe, Final Mesolithic sea people emerged when the neighbouring sea was rich enough to sustain the economic dependency of the group, and several proxies, such as site locations, shell middens, the main domestic

Skeleton	$\delta^{13}\text{C}$ ‰ VPDB	$\delta^{15}\text{N}$ ‰ AIR	C:N	Reference
<b>Arapouco</b>				
5	-20.0	9.0	3	Fontanals-Coll et al. 2014
2A	-16,9	n/p	n/p	Cunha and Umbelino 2001; Umbelino 2006
<b>Poças de S. Bento</b>				
3	-17,6	11,7	n/p	Umbelino 2006
<b>Cabeço das Amoreiras</b>				
3	-19.3	9.3	2.9	Fontanals-Coll et al. 2014
3	-18.5	9.5	–	Umbelino 2006
5	-20.8	n/p	n/p	Cunha and Umbelino 2001
5	-19.0	9.5	2.9	Fontanals-Coll et al. 2014
7	-18.9	9.7	2.9	Fontanals-Coll et al. 2014
<b>Vale Romeiras</b>				
4	-18.4	n/p	n/p	Umbelino 2006
<b>Cabeço do Pez</b>				
4	-22.6	n/p	n/p	Cunha and Umbelino 2001
4	-19.3	n/p	n/p	Cunha and Umbelino 2001
11	-20.7	6.7	2.8	This study
A	-20.0	9.3	2.9	Fontanals-Coll et al. 2014
B	-20.0	8.2	2.9	Fontanals-Coll et al. 2014
9	-20.0	9.0	2.9	Fontanals-Coll et al. 2014
27	-19.5	10.0	2.9	Fontanals-Coll et al. 2014
27	-18.7	9.8	n/p	Umbelino 2006
17	-19.4	9.4	2.9	Fontanals-Coll et al. 2014
21	-19.3	9.2	2.9	Fontanals-Coll et al. 2014
2	-18.4	11.9	3.2	Fontanals-Coll et al. 2014

**Table 1 – Stable isotopic  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values from human remains of the Sado valley.**

*Tabl. 1 – Valeurs des isotopes stables de  $\delta^{13}\text{C}$  et  $\delta^{15}\text{N}$  des restes humains de la vallée du Sado.*

refuse sites and isotopic values from human diets, reflect this deep connection with the sea.

In addition to this pragmatic relationship with the sea visible in the archaeological record, marine objects such as shells—used as adornments, as kitchen waste, as material to cover the dead—also served as an identity marker for these Final Mesolithic hunter-gatherers, in addition to their economic/non-economic value as suggested by North Atlantic and Mediterranean data.

As a case study, the Sado Valley Final Mesolithic exhibits complex behaviour blending both Mediterranean and Atlantic cultural and environmental traits, producing an almost unique situation where shells – which made up a minor part or were even absent from human diets – were nevertheless accumulated in shell mounds covering the dead, thereby representing qualitative territorial land use inextricably linked to prehistoric necropolises.

For instance, in the Sado Valley, aquatic resources were exploited in particular at the Arapouco site (fig. 5), and *Scrobicularia plana* and *Cerastoderma edule* shells were discarded after being consumed, giving rise to small mounds that covered habitat remains and funerary deposits, just like in any other North Atlantic Final Mesolithic

shell midden. Simultaneously, in Sado Valley, hunter-gatherer bone collagen displays very low proportions of marine protein, and some skeletons reveal a total absence of marine resources in their diet, as attested in other Mediterranean groups (table 1). Environmental conditions related to the Sado paleoestuary marine signal—currently under study as part of the Sado-Meso project (see Arias Cabal et al., this volume), seem for the moment to represent the most plausible explanation for these dietary values. These values situate the Sado hunter-gatherers in a Mediterranean circle with an 'olive index', which indicates the importance of land-based resources in the diet (fig. 6).

Neighbouring and contemporaneous Tagus shell middens just 40 km to the north—and closer to the 40°N parallel—depict a different scenario. Here, diets are balanced between terrestrial and marine proteins and shell mounds can attain heights of several meters. An Atlantic pattern is perceptible and Tagus paleo-estuary primary productivity, reflected in the shell midden faunal list, sustains a marine strategy, which is responsible for the inclusion of these shell middens in the Atlantic circle where hunter-gatherer consumption behaviour could be described under a 'seal index'.

## CONCLUSION AND FINAL REMARKS

As anticipated, data from Southern Portugal data are crucial for establishing a connection, although it is a discontinuous one, between Atlantic and Mediterranean Final Mesolithic hunter-gatherers, settling in cultural spheres associated with different environmental conditions related to ocean primary productivity. Although human groups tend to develop cultural strategies to overcome landscape bias, environmental conditions still played a major role in establishing economic patterns among predatory groups depending solely on the natural *status quo*.

Another set of questions related to diet, resources and territoriality, can be tested on Mediterranean Final Mesolithic cemeteries, like those detected in the Sado or El Collado shell middens. It is also a possibility to explain the presence of individuals with terrestrial diets in coastal/estuarine necropolises that these middens do not contain 'locals only', but also individuals from inland areas who exploited the estuaries or coastal facades for symbolic purposes, creating a cosmogony where shells

and dead people are entangled, even if the sea does not play a major economic role in their lives below the 39°N parallel. To sum up, we want to point out the following conclusions:

– Atlantic hunter-gatherers are much more marine-oriented than their Mediterranean counterparts. This cultural facet seems to rely heavily on different environmental opportunities related to ocean primary productivity.

– Land-based diets, correlated in North Atlantic Europe to a major transition phase, like the shift caused by the Neolithisation process (Schulting and Richards, 2001; Fischer et al., 2007), are not a Neolithic trait in the Western Mediterranean region, since they prevailed among Final Mesolithic hunter-gatherers. Sweeping presumptions about changes in diet from the Mesolithic to the Neolithic (Carvalho and Petchey, 2013, p. 379) regarding Southern Portugal can no longer be upheld given the major contribution of land-based food recorded in Sado Mesolithic diets.

– Southern Portugal is indeed a core area for enhancing our understanding of this process due to its Atlantic position combined with a Mediterranean environment, which produced a mixed archaeological record pointing to

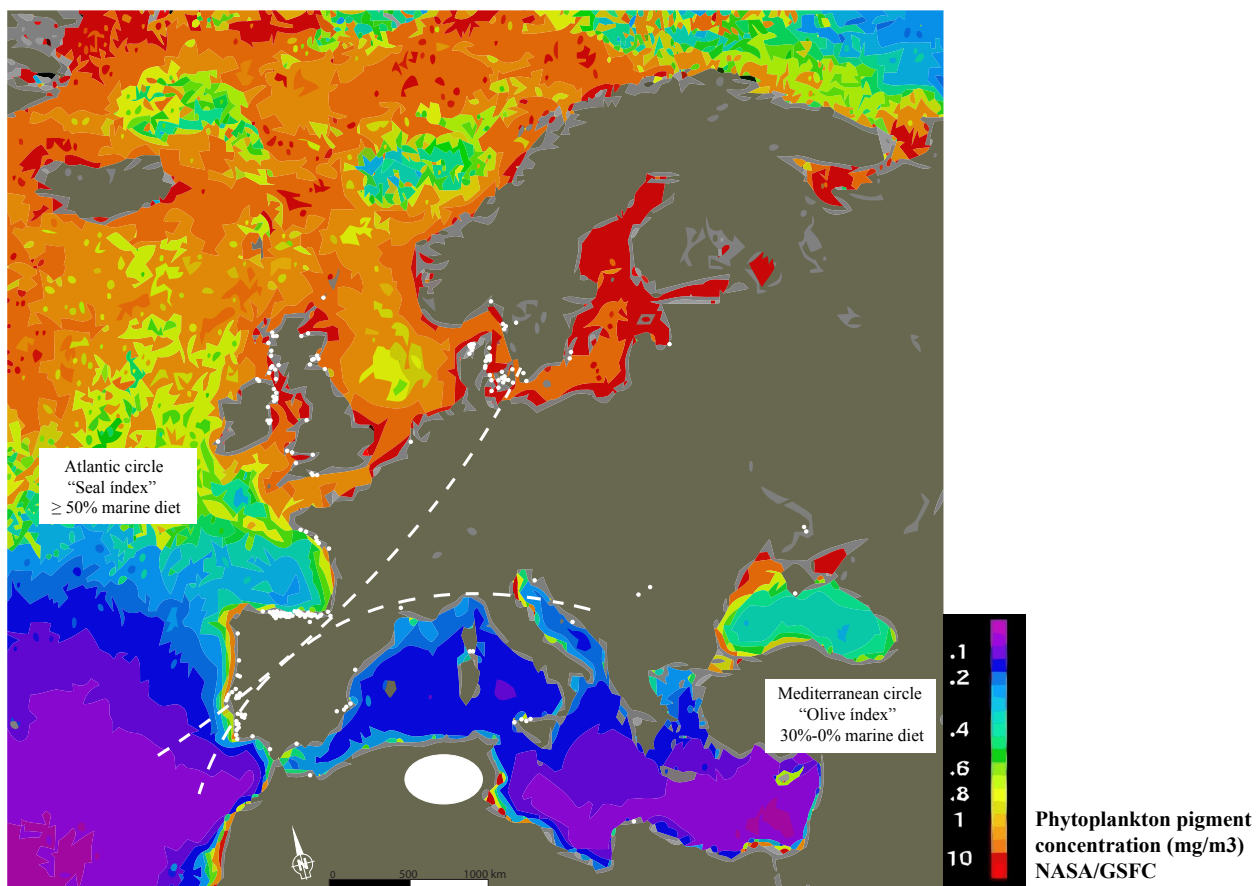


Fig. 6 – Atlantic and Mediterranean circles plotted on the map of the main Mesolithic settlements in Western Europe and the Maghreb with colour references to ocean primary productivity (after Lubell, 2004; Dupont et al., 2009; Fontanals-Coll et al., 2014; [http://geosci.sfsu.edu/courses/geol103/labs/upwelling/images/world\\_summer.gif](http://geosci.sfsu.edu/courses/geol103/labs/upwelling/images/world_summer.gif)).

Fig. 6 – Cercles de l’océan Atlantique et de la mer Méditerranée reportés sur la carte des principaux sites mésolithiques en Europe de l’Ouest et du Maghreb avec les couleurs des références de la productivité primaire des océans (d’après Lubell, 2004; Dupont et al., 2009; Fontanals-Coll et al., 2014; [http://geosci.sfsu.edu/courses/geol103/labs/upwelling/images/world\\_summer.gif](http://geosci.sfsu.edu/courses/geol103/labs/upwelling/images/world_summer.gif)).

Atlantic and Mediterranean ways of life. A more detailed analysis of subsistence practices and economic relations with the sea shows that an Atlantic/Mediterranean border line can be traced between the Tagus and Sado shell midden complexes—with the first primarily belonging to an Atlantic circle and the second to a Mediterranean one.

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## NOTE

After this paper was written Rita Peyroteo-Stjerna has presented her PhD thesis where new data on this subject is published.

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