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## Research Article

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# The Neolithisation of the Adriatic: Contrasting Regional Patterns and Interactions Along and Across the Shores

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**Abstract:** The beginning of the Neolithic in the Adriatic region dates back to approximately 6000 cal BC, and the appearance of Impressed Ware pottery marks its generic development. By combining lithic, economic, and paleoenvironmental data, we propose a new arrhythmic model for the chronology of Neolithisation in the Adriatic. On the one hand, the available data suggest that in the south-central part of the basin (Dalmatia and Apulia) the transition to farming was relatively quick, resulting from the colonisation of an open landscape (seemingly linked to the “8.2 ka event” and the onset of a drier climate). These newcomers mostly settled in the fertile plains of the Dalmatian and Apulian hinterlands, basing their subsistence almost exclusively on agriculture and livestock, while lithic blade production in cherts from Gargano (southern Italy) indicates important social aspects and complex management strategies (mining activities, more complex modes of pressure flaking, and specialised distribution networks). However, on the other hand, in the northern Adriatic (Istria, Karst, eastern Po Plain, and Marches), the Neolithic emerged somewhat later, possibly as a result of some form of acculturation. Although available data are still scarce, some evidence suggests that the last Mesolithic groups played an active role in the process of Neolithisation in these areas, where certain Castelnovian traditions have been identified in the lithic production accompanying Impressed Ware (the use of local cherts, lamellar production by indirect percussion, and “simpler” forms of pressure flaking) and in the economy, e.g. importance of fishing.

**Keywords:** Adriatic, Castelnovian, Impressed Ware, Gargano, lithic technology

The Early Neolithic of the Aegean and the Balkans (from ca. 6400 cal BC) is characterised by the development of mixed ceramic assemblages composed of painted and Impressed Ware pottery (Bonga, 2019). Yet, at the beginning of the sixth millennium BC, an important cultural reconfiguration occurred on the western shores of the Balkans: painted pottery, one of the most emblematic features of the Early Neolithic of the continental Balkans, was almost exclusively<sup>1</sup> replaced by Impressed decoration (Figure 1), a ceramic style that was adopted, mostly sporadically,<sup>2</sup> in Greece, Western Turkey, and the central Balkans (Benvenuti &

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**Special Issue:** THE EARLY NEOLITHIC OF EUROPE, edited by F. Borrell, I. Clemente, M. Cubas, J. J. Ibáñez, N. Mazzucco, A. Nieto-Espinet, M. Portillo, S. Valenzuela-Lamas, & X. Terradas

<sup>1</sup> Except rare *Figulina* style (Figure 1: 2); see Podrug et al., 2018, p. 66.

<sup>2</sup> However, Impressed decorations are sometimes predominant, as in Pavlovac-Kovačke Njive in southern Serbia where they represent 84% of total decorated specimens (Vuković & Svilar, 2016, p. 75).

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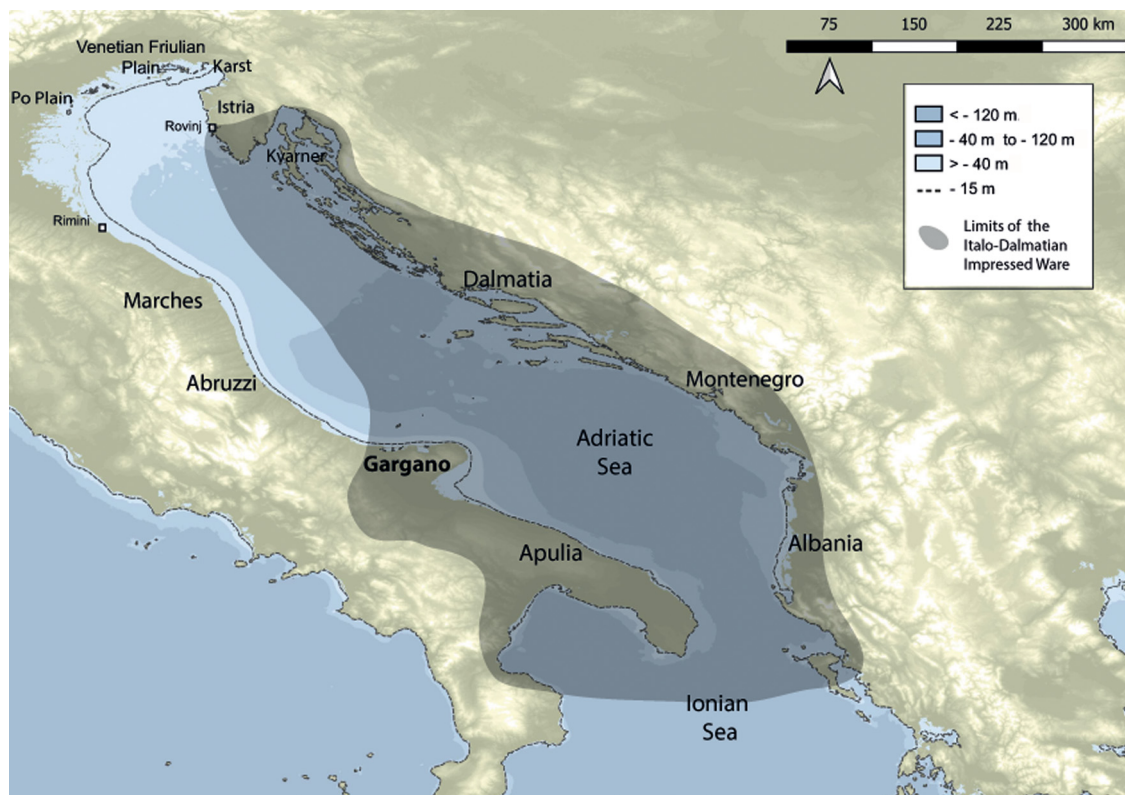


**Figure 1:** Impressed Ware pottery from the Adriatic-Ionian zone: (1) Pokrovnik (Dalmatia); (2) Rašinovac (Dalmatia): *figulina*; (3) Sidari (Corfu); (4) Kargadur (Istria); (5) Favella (Apulia); (6) Crno Vrilo (Dalmatia); (7) Fornace Cappuccini (Emilia-Romagna, Po Plain). Credits: 1, 2. E. Podrug, 3. Berger et al., 2014; 4. Komšo and Čuka in Visentini & Podrug, 2014, no scale; 5. Tiné, 2009; 6. Marijanović, 2009, no scale; and 7. Radi & Petrinelli, 2017.

Metallinou, 2002; Çilingiroğlu, 2016; Guilaine, 2007; Hameau, 1987; Pyke & Yiuni, 1996; Ruzi, 2019; Vuković, 2013; Vuković & Svilar, 2016). It is thus here, in the area between western Greece and southeast Italy, that a new cultural horizon emerged, the so-called Impressed ware/Cardial culture, which later became the main component of the maritime current of Neolithisation and the cultural marker of the Early Neolithic for the whole central-western Mediterranean (Guilaine, 2001).

Although the presence of Impressed ware pottery was reported on the island of Leucade in the Ionian Sea (Benvenuti & Metallinou, 2002, p. 18; Berger, Metallinou, & Guilaine, 2014, p. 229), the earliest clear evidence comes from the well-known open-air site of Sidari, situated somewhat further north, on Corfu Island. There, Impressed Ware pottery appeared around 6050–5950 cal BC, a few centuries after the emergence of the “monochrome” pottery associated with the initial Neolithic (Berger et al., 2014). However, given the fact that no such monochrome horizon has been recorded north of Corfu, we can deduce that Impressed ware represents the oldest known pottery in the Adriatic and that its diffusion is closely connected to the spread of the agro-pastoral economy (Forenbaher & Miracle, 2005).

The initial centre of the development and diffusion of Impressed Ware is still unknown (Figure 2), but the Neolithic spread throughout the Adriatic with a chronological South–North gradient. This initial dissemination was rapid, reaching both Eastern and Western Adriatic shores around 6000–5900 cal BC, but recent reliable radiocarbon dates (still) suggest that the Eastern Adriatic sites are slightly earlier (Binder et al., 2017; Forenbaher, Kaiser, & Miracle, 2013; McClure, Podrug, Moore, Culleton, & Kennet, 2014). Therefore, the same Impressed ware culture, with some regional differences that evolved over time (i.e. *Impressa medio-adriatica* in south-central Italy), characterises the earliest Neolithic of the Adriatic. It did not, however, reach the northernmost part of the Adriatic Basin (northern Istria, Karst region, Venetian Plain, and Po Valley), where the Neolithic occurred 500–600 years later, around 5500–5400 cal BC, and it comprises different regional ceramic styles: the Danilo-Vlaška culture in northern Istria and in the Karst,



**Figure 2:** Adriatic region, geographic position of the study area in relation to the post-glacial sea level rise. The –40 m bathymetric contour (light blue shading) depicts the hypothetical position of coastlines at the beginning of the Holocene, while dotted lines indicate the hypothetical position of Early Neolithic coastline (–15 m). Shaded surface depicts the limits of Italo-Dalmatian Impressed Ware. Background map by Guillaume Roguet.

Fiorano culture in the Po plain, and the “Friuli group” which includes several ceramic facies of the Veneto-Friulian plain. This diversified ceramic production reveals the co-existence of different cultural groups in the area around 5500–5400 cal BC, demonstrating varied and multidirectional networks of influences, and implying that an important Mesolithic substratum was in place (Binder, 2000; Perrin, 2009).

Important developments in archaeogenetics in the past two decades have confirmed the Near Eastern origins of both the first European farmers and most domesticated animal and plant species, thus supporting claims that technical transfers cannot be explained solely by “exchanges” and “contacts” (Hofmanová, Kreutzer, Hellenthal, Papageorgopoulou, & Burger, 2016; Mathieson et al., 2018; Perlès, 2009, 2017; Rowley-Conwy, 2003; Zohary, Hopf, & Weiss, 2012). Therefore, a migration of peoples (“colonisation”) is the most plausible hypothesis to explain the emergence of the Neolithic in south-eastern Europe and the Adriatic.

The Neolithisation of the Adriatic thus seems to be a complex, non-centralised, arrhythmic, and regionalised process involving multiple parameters and variables, entailing non-linear interplay between the movement of people and the transmission of ideas.

## 1 Late Mesolithic: Castelnovian Background

Prior to the arrival of Neolithic settlers, between the seventh and sixth millennia cal BC, the central-western Mediterranean was inhabited by the last indigenous groups of hunter–fisher–gatherer. They belong to the Castelnovian techno-complex, which is considered to be a regionalised manifestation of the greater Blade and Trapeze phenomenon that developed between the eighth and sixth millennia BC in Greater Eurasia (Biagi & Kiosak, 2010; Binder, 2000; Clark, 1958; Inizan, 2012; Kozłowski, 2009; Marchand & Perrin, 2017; Perrin et al., 2020). This Blade and Trapeze techno-complex is characterised by production systems focused on the manufacture of regular and standardised blades and bladelets, some of which were further transformed into typical Late Mesolithic-type tools: trapezes (obtained mainly via the microburin technique) and notched blades.

The main difference with the preceding period (i.e. the Early Mesolithic) is thus primarily observed in the lithic assemblages, which reveal a new conception of lithic production systems and a more complex operation scheme followed by the appearance of new production techniques, such as pressure flaking and indirect percussion. However, this technological shift may be accompanied by an economic shift given the fact that some data from the central Mediterranean region point towards an increase in the importance of aquatic resources at the beginning of the seventh millennium (Cristiani et al., 2018; Mannino et al., 2007; Rainsford, O’Connor, & Miracle, 2014; Van de Loosdrecht et al., 2020).

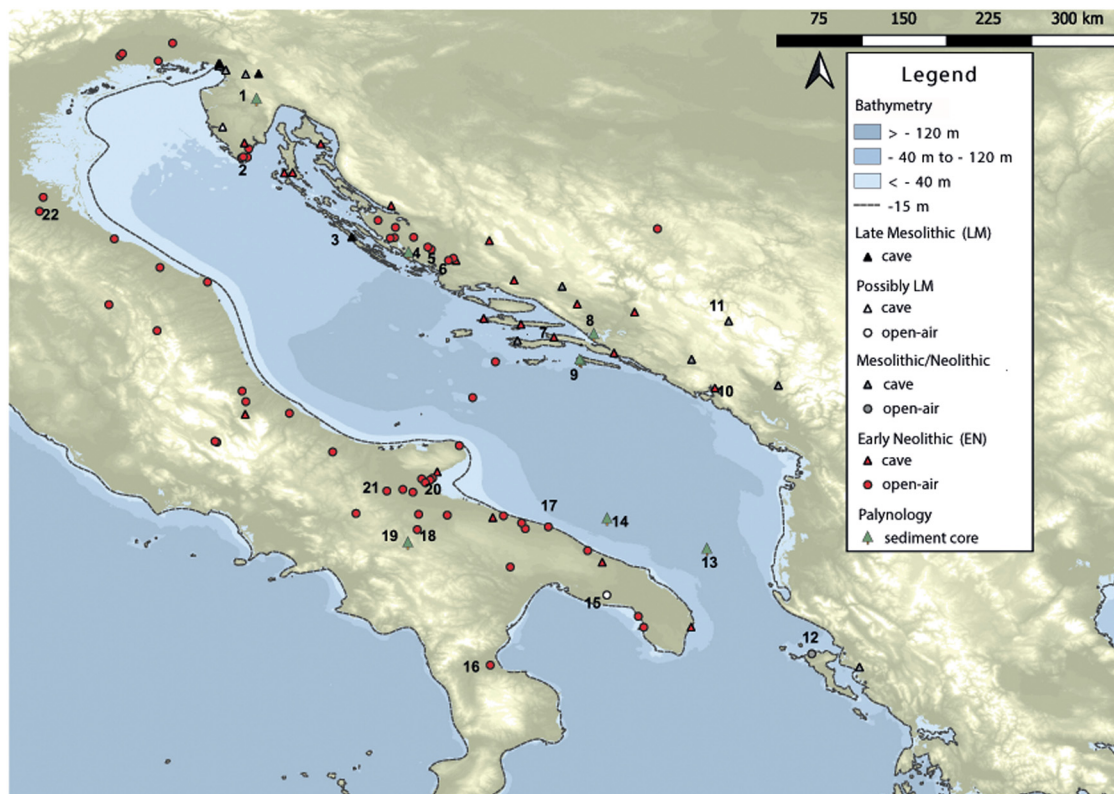
In the Adriatic, the Castelnovian is documented in the Karst plateau of Italy and Slovenia, in Montenegro and probably in Albania (Figures 3 and 5). On the western shore, according to the current state of knowledge, no sites can be attributed with certainty to the Castelnovian.

The Terragene site (southern Apulia) is reported to be Castelnovian (Fiorentino et al., 2013; Gorgoglione, Di Lernia, & Fiorentino, 1995), but unfortunately, the context is not clear and there may be a mixing of materials from upper Impressed Ware layers.

However, it is very likely that this absence/rarity of Castelnovian sites along the Adriatic coasts does not represent a historical reality, but is related to other factors, such as the lack of research, the absence of diagnostic traits, geological factors (loss of sites by marine transgression and tectonic activities), and shifts in settlement patterns (Kačar, 2020).

In this sense, the recent discovery of the first Castelnovian occupation in Dalmatia, in Žukovica cave on the island of Korčula (Vukosavljević & Perhoč, 2020), confirms that the former absence of the Castelnovian along the Croatian littoral (Dalmatia and Istria) (Kozłowski, 2009) was simply due to the lack of research and that Castelnovian sites have yet to be found on both sides of the Adriatic.

In the peri-Adriatic region, Castelnovian settlements were recorded in the interior of Montenegro, in poorly accessible mountainous areas (Plužine Municipality) (Cristiani & Borić, 2016; Kozłowski, Kozłowski, & Radovanović, 1994), and in the Fucino basin of central Italy, about 80 km from the sea (Boschian, Serradimigni, Colombo, Ghislandi, & Grifoni Cremonesi, 2017).



**Figure 3:** Location of the main eastern Adriatic Mesolithic and Neolithic sites in relation to post-glacial sea-level rise. Sites mentioned in text: (1) Prapoče, (2) Kargadur, (3) Vlakno (Dugi Island), (4) Vransko lac, (5) Rašinovac, (6) Pokrovnik, (7) Žukovica (Korčula), (8) Neretva, (9) Veliko and Malo lake (Mljet island), (10) Crvena Stijena, (11) Odmut, (12) Sidari (Corfu), (13) AD91-17, (14) MD90-917, (15) Terragne, (16) Favella, (17) Scamuso, (18) Rendina, (19) Lago di Monticchio, (20) Coppa Navigata, (21) Ripa Tetta, (22) Fornace Cappuccini (Faenza).

All the sites are situated in caves, which is undoubtedly related to a significant research bias focusing on the survey and excavation of caves rather than open-air sites. However, it is also due to the fact that open-air sites are often less well preserved on account of taphonomic processes such as rises in sea level (*infra*), erosion, flooding, seismic activities, and/or burial under large quantities of alluvial deposits.

Likewise, the absence of open-air Castelnovian sites is not restricted to the Adriatic, but is also observed elsewhere in the Mediterranean.

In this sense, there is a lack of evidence of possible (semi-) permanent campsites, which, could eventually, in conjunction with the marine-oriented economy (*infra*) and more elaborate modes of lithic production, point to the increased social complexity of the Late Mesolithic groups (cf. Testart, 1982).

However, it is possible that certain sociocultural transformations affected the last hunter-gatherer societies in such a way that they became “ready” for the important changes that characterise Neolithisation (cf. Braidwood & Willey, 1962, p. 332).

## 2 Paleoenvironmental Setting

### 2.1 A Patchy Record: A Region Shaped by the Sea

The sea level has been rising steadily since the last Glacial Maximum, due to global warming and the consequent melting of glaciers, which has significantly transformed the Adriatic coastline. At the beginning of the Holocene, when the sea level was about 40 m lower than today (Fontana, Corregiar, & Juračić, 2014; Surić, 2006), the outlines of the former Great Adriatic Plain were limited to the approximate Rovinj–Rimini

line (Figures 2 and 3). Between 7000 and 6000 BC, during the Mesolithic/Neolithic transition, the sea level was between 10 and 30 m lower than today (Berger et al., 2014; Fontana et al., 2014; Surić, 2006). For the coastal plains of the northern Adriatic and around the Gargano peninsula, where the sea is particularly shallow, this rise in sea level resulted in the significant loss of the coastal strip,<sup>3</sup> meaning that much archaeological evidence of coastal occupation would be currently submerged and/or covered by the significant accumulation of Holocene deposits. Our interpretation of the Neolithisation process in this tectonically active region is, therefore, further limited by climatological and geomorphological factors.

## 2.2 Early Holocene Vegetation and Climate Dynamics

Around 6800–6500 cal BC, two major prehistoric events occurred almost simultaneously: the arrival of the first Neolithic settlers on the western and northern shores of the Aegean (Guilbeau, Kayacan, Altınbilek-Algül, Erdoğan, & Çevik, 2019; Horejs et al., 2015) and the spread of the Castelnovian in the central Mediterranean (Sicily and southern Italy), which also implies the movements of peoples, at least to some degree (cf. Van de Loosdrecht et al., 2020). This coincides with the beginning of the Atlantic climatic phase (6900–6200 cal BC), a period characterised by warmer and moister conditions, with significantly higher temperatures than today (“Holocene Climatic optimum”), which favoured the maximal extension of mixed oak forests.

However, around 6200 cal BC (“8.2 ka event”), climatic deterioration occurred across large parts of the Northern Hemisphere and the sudden decrease in temperatures of 1–3°C lasted for about 160 years. Since this deterioration coincided with the Neolithic dispersal in most parts of south-eastern Europe,<sup>4</sup> the role of the climate in the Neolithisation process is often cited (for details see Berger & Guilaine, 2009; Weninger et al., 2009). Nevertheless, the nature, intensity, and consequences of this climatic anomaly on both the environment and populations varied widely from one region to another.

Climate reconstructions suggest that the “8.2 ka event” in the southern Mediterranean (below ca. 43°N) is marked by a drier climate, as shown by a decrease in *Quercus* and other arboreal pollen, followed by an increase in *Artemisia* and *Pinus*, while the northern Mediterranean (and temperate Europe) experienced a wetter and colder climate demonstrated locally by the short-term rise in lake levels and by an expansion of *Fagus*, *Abies*, and other mesophilic species (Berger & Guilaine, 2009; Magny, Bégeot, Guiot, & Peyron, 2003; Peyron et al., 2013).

Data from the Adriatic, although patchy, show a similar pattern.

In the central Adriatic, the 8.2 ka event is recorded by core sampling in Lake Vransko (43°53'N, 15°34'E) and marked by the decline in *Quercus* and *Corylus* and an increase in *Juniperus* and *Pistacia*, clearly indicating the development of drier climate conditions (Bakrač, Ilijanić, Miko, & Hasan, 2018).

In the northern Adriatic, in Istria, palynological data (Andrić, 2006) show cooler and wetter conditions around the same period. *Corylus*, a genus that cannot withstand aridity, reaches its peak around 6200 cal BC, while at the same time, pollen diagrams show a minimum value of *Pinus*. Similarly, anthracological data from Edera 3 (Trieste) indicate a definitive disappearance of pine and the dominance of oak (85%) at the end of the sixth millennium BC (Nisbet, 2000).

Furthermore, palynological data indicate that, in the south-central Adriatic, this relatively drier period which started around ca. 6200 cal BC continued: at Lake Vrana (Bakrač et al., 2018), a short cool and dry episode interrupted the formation of sapropel S1 around 5950–5450 cal BC when the pollen record points to an increase in *Ericaceae*, *Juniperus*, and *Pistacia* together with the presence of anthropogenic indicators (*Cerealia*, *Poaceae*, and *Plantago lanceolata*). Pollen records from Dalmatia indicate a decrease in oak pollen during the sixth millennium BC, suggesting an open vegetation environment dominated by *Juniperus* (Beug, 1967; Grüger, 1996; Jahns & van der Bogaard, 1998). A marine core MD90-917 (41°10'N, 17°37'E) recorded a change in the composition of forests at the dawn of the Neolithic (6350–5500 cal BC), when oak

<sup>3</sup> Which would mean that an approximately 15 km wide coastal belt has been submerged in the Gargano area while the loss of land in the northeastern Adriatic was particularly dramatic.

<sup>4</sup> Except in Eastern Greece where the beginning of the Neolithic precedes the 8.2 ka event.

forests were replaced by mixed forests, which means a slight change in temperatures and/or precipitation resulting in the opening of the forest (Combourieu-Nebut et al., 2013).

This change in vegetation, notably correlated with the presence of *Cerealia* pollen, could be interpreted either by natural causes or by human actions on the environment (cf. Bradshaw, Hannon, & Lister, 2003; Sadori, Jahns, & Peyron, 2011). However, since this opening of the forest was documented on a large scale (Beug, 1967; Grüger, 1996; Jahns & van der Bogaard, 1998), it is more plausible to evoke natural causes, i.e. the drier period predates/coincides with the introduction and development of the Neolithic in Dalmatia (6000–5400 cal BC).

With regards to southern Italy, there are no pollen records for the Tavoliere Plain (Apulia), a densely settled area during the Early Neolithic, prior to ca. 4500 cal BC (Di Rita & Magri, 2012; Di Rita, Simone, Caldara, Roland Gehrels, & Magri, 2011). Further inland, in Basilicata, situated about 10 km from Rendina,<sup>5</sup> the pollen sequence obtained from Monticchio lake, at 656 m above sea level, indicates an increase in *Abies*, which points to a probable wetter and/or cooler climate from ca. 6200 to ca. 6000 BC (Allen, Watts, McGee, & Huntley, 2002, p. 77; Fiorentino et al., 2013, p. 14). Further south, at the Scamuso site (Murge, southeast of Bari), palynological analysis, despite taphonomical problems involving the preservation of pollen, shows that the percentage of arboreal pollen (including the presence of *Olea*, *Phillyrea*, and *Pistacia*) is less than 5%, suggesting an open landscape with characteristic coastal features during the early Neolithic (Caldara, Muntoni, Fiorentino, Primavera, & Radina, 2011, p. 187, cite Renault-Miskovsky & Bui-Thi-Mai, 1997). A marine core AD91-17 recovered in the Otranto Strait registered a well-developed sapropel (S1) layer containing a distinct interruption that occurred at ca. 6150–5950 cal BC, but the cooling episode could not be confirmed using a multiproxy approach (dinocysts, oxygen isotopes, and pollen)<sup>6</sup> (Sangiorgi et al., 2003). This heterogeneity of data from southern Italy could suggest that the environmental conditions varied locally at the onset of the Neolithic.

Although dry conditions began to predominate in Apulia after ca. 5600 cal BC (Fiorentino et al., 2013, p. 16), according to Di Rita et al., the regional ecological setting of the coastal Tavoliere was particularly favourable for the early settlement of Neolithic populations, which could easily introduce cereal cultivation thanks to the relatively open landscape of the plain (Di Rita et al., 2011, p. 150).

The idea that the climate in some way directs human dynamics and thus the rhythm of Neolithisation was underlined by Berger and Guilaine (2009): wide open spaces favoured expansion while denser wet forests represented a barrier. Therefore, the rapid spread of the Neolithic in the central Adriatic (Dalmatia and Apulia?) could be explained by a relatively open landscape due to the 8.2 ka drier conditions, while in the north (northern Istria, Karst) the cooler and moister conditions favoured the development of denser mixed oak forests which discouraged settlers from moving further north. However, it is important to note that such a scenario does not imply any ecological determinism. On the contrary, the response of societies to climatological constraints and their capacity to adapt to environmental settings is crucial (Berger & Guilaine, 2009, p. 43). In the context of Neolithisation, newcomer farmers needed to adapt their agricultural practices to new and diversified environments meaning that this process must have taken time. Moreover, the density of local hunter-gatherer groups in certain areas and their resistance to Neolithic novelties cannot be neglected.

### 3 Mesolithic and Neolithic Socio-Economic and Technical Systems

#### 3.1 The Role of Hunting, Fishing and Gathering

While Mesolithic subsistence strategies are often described as a broad-spectrum economy (Flannery, 1969), integrating hunting, fishing and gathering various species, growing archaeological evidence from the central

<sup>5</sup> One of the westernmost Italo-Dalmatian Impressed Ware sites, situated at 201 masl.

<sup>6</sup> The sediment sample indicates a slight increase in *Abies* and *Picea* (possibly related to a slight decrease in temperature), the presence of *Pistacia* (indicating that winter temperatures did not drastically decrease), relatively high values of warm-water dinocysts and alkenons (indicating modest warming), and the relative abundance of semi-desert pollen during the sapropel interruption (Sangiorgi et al., 2003).



Mediterranean and the Balkans points to an increase in the importance of aquatic resources during the Late Mesolithic (Cristiani et al., 2018; Mannino et al., 2007; Rainsford et al., 2014; Van de Loosdrecht et al., 2020).

In the Adriatic region, Castelnavian sites are generally situated near rivers and some assemblages contain the remains of fish, shellfish, and, more rarely, bone harpoons (Cristiani & Borić, 2016). Late Mesolithic sites on the Dalmatian coast, although not attributed to the Castelnavian, clearly demonstrate the importance of aquatic resources during the seventh millennium BC (Lightfoot, Boneva, Miracle, Šlaus, & O'Connell, 2011; Rainsford et al., 2014) and even point to a marine protein-based diet (Cristiani et al., 2018). The latter is supported by recent evidence from Vlakno (Dugi Island, Dalmatia) where stable isotope analyses have revealed that the diet of the individual buried in the cave around 7000 cal BC was mainly based on marine proteins and complemented by wild cereals, such as wheat, barley, and oats (Cristiani et al., 2018).

Economies based on marine resources and storable plant resources have been argued to lead to affluence (via conservation and storage), permanent settlements, and, conversely, reduced mobility (cf. Testart, 1982). Archaeological evidence from the central Mediterranean and the Balkans partially confirms such claims (Rainsford et al., 2014; Sampson, 2014; Živaljević, 2017) although direct evidence of the storage of plants foods, such as wild cereals, pulses, nuts, and fruits, is still lacking due to the paucity of Mesolithic records. Nevertheless, comparable consumption of wild cereals and other storable plants during the Mesolithic is well documented in the central Mediterranean and the Balkans (Kotzamani & Livarda, 2018), while evidence of plant storage (namely of nuts) is recorded in different European Mesolithic contexts (for details, see for example, Verjux, 2017).

The high proportions of wild species in Early Neolithic contexts are often explained as a continuation of a partly Mesolithic way of life, i.e. as an adoption of Neolithic innovations by indigenous Mesolithic groups.

But these acculturation theories are often difficult to demonstrate. The problem is that “continuity” claims are mostly based on cave sites which are prone to post-depositional disturbances and therefore to the mixing of materials. In the Mediterranean, since the beginning of the Neolithic and throughout historical times, many caves were used as pens, clearly indicating that the use and function of caves changed over time (Angelucci, Boschian, Fontanals, Pedrotti, & Verges, 2009). The presence of wild mammals and/or marine species in Early Neolithic layers is thus often described as a result of *ab antiquo* disturbances and not as evidence of “continuity.” However, in a few cases, a significant number of non-domestic species is documented in the zooarchaeological assemblages of Early Neolithic open-air sites. In the peri-Adriatic region, that is namely the case for the central Po Plain (Rowley-Conwy, Gourichon, Helmer, & Vigne, 2013), while in the Adriatic, a large quantity of sea shells were found in Coppa Navigata (Apulia) and fish remains associated with bone hooks were identified in Kargadur (Istria) (Komšo, 2006).

According to stable isotope data, the diet of the Neolithic population from the Adriatic was based on terrestrial resources, consisting mainly of domesticated animals (Lelli et al., 2012; Guiry et al., 2017), but some data from the western Adriatic show that the Neolithic farmers who settled near the coast, in both Apulia and Marches, consumed small, but significant amounts of marine proteins (Lelli et al., 2012, p. 386).

Although, given the overall paucity of data, it is almost impossible to approach the problem of the Mesolithic/Neolithic transition from the perspective of plant economies, it seems that locally available, spontaneously growing grains, gathered by Mesolithic groups (such as *Avena* and *Fabaceae*), did not really interest the first farmers. The domestication of oats does not appear until the Bronze Age (Zohary et al., 2012) and pulse crops seem to be rather scarce during the Early Neolithic in both Italy<sup>7</sup> (Fiorentino et al., 2013; Rottoli & Pessina, 2016) and Dalmatia (Reed, 2015; Reed & Colledge, 2016). Since lentils and peas are well preserved in archaeological contexts when charred, could the rarity of these crops reflect cultural choices and therefore a certain break with Mesolithic traditions?

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<sup>7</sup> Scamuso seems to be an exception (Fiorentino et al., 2013, p. 10, Table 3).

### 3.2 Lithics – An Industry Common to the Last Hunter–Gatherers and the First Farmers

In the larger central-Mediterranean context, Castelnovian and Early Neolithic lithic production systems may seem very similar at first glance. They are both oriented towards the production of blades obtained through the use of pressure flaking and/or indirect percussion. Both of these complex debitage techniques<sup>8</sup> are known since the Late Mesolithic and cannot be considered as Neolithic innovations. However, the important difference between Castelnovian and Early Neolithic production systems is primarily observed in the raw material economy.

Although the use of exogenous raw materials has not been documented in the Mesolithic context of the Southern Italy<sup>9</sup> nor in the Adriatic<sup>10</sup> the existence of pre-Neolithic long-distance distribution networks is evidenced in the central Mediterranean, where Melian obsidian circulated in the Aegean since the Final Palaeolithic (Perlès, 2001). However, during the Mesolithic, unlike the Neolithic, the exploitation of these exogenous raw materials did not differ from the exploitation of local rocks, as both were used in the same way and for the same purposes (for expedient flake production) and were characterised by simple technical investment (see Perlès, 2001, 2009).

Thus, following the model established by C. Perlès for Greece, we think that the distinctive element between Castelnovian and Impressed Ware lithic production systems is the absence of a complex raw material economy in the former.

The Early Neolithic knapped stone assemblages from the Adriatic show clear regional differences in the organisation of lithic production systems and two main zones can be distinguished: the south-central and eastern Adriatic (roughly Dalmatia and Apulia) and north-central and western Adriatic (Istria, Karst, Venetian-Friulian Plain, eastern Po Plain, Marches, and Abruzzi). Therefore, in addition to the obvious differences in ceramic styles, lithic production also indicates that the Neolithic process in the Adriatic cannot be considered as a single phenomenon.

Artefacts made from Gargano cherts are recorded at many Early Neolithic sites in southern Italy (namely Apulia) and Dalmatia (Figure 5), attesting to the existence of prehistoric networks involving mining and distribution in Apulia since the very beginning of the Neolithic, from ca. 6000 cal BC onwards.

After initial reduction (decortication and trimming), which was probably carried out inside or near the mines (Tarantini, Eramo, Monno, & Muntoni, 2016), preformed cores and finished products (blank or retouched blades) were distributed further across land and sea. At the current stage of research, the exact extent of this network is still difficult to define, but it does not seem to spread very far north of Gargano since it is absent in the *Impressa medio-adriatica* of central Italy (M. Serradimigni and D. Moscone pers. comm.).

In both Apulia and Dalmatia, blade morphometry (with widths often >14 mm) implies that the blanks made on Gargano cherts were usually produced by more complex pressure flaking methods (cf. Pelegrin, 2012) indicating a break with Castelnovian traditions (Guilbeau, 2011, p. 97; Kačar, 2019a, 2019b). Some of these blades reach impressive sizes, with widths exceeding 20 mm (see Kačar & Philibert, 2021). Such large and regular blades were probably obtained by a lever pressure technique, suggesting a high level of technological investment, which involves special equipment, but above all special skills and knowledge acquired by long apprenticeships, and thus a certain degree of socioeconomic specialisation (Perlès, 2001, p. 208–209). The lever pressure technique has already been recorded in southern Italy<sup>11</sup> and in Greece and

<sup>8</sup> Yet, not all the modes of the pressure technique are attested during the Mesolithic (see *infra*).

<sup>9</sup> The idea that Liparian obsidian circulated in southern Italy during the Mesolithic, backed by a few obsidian finds in pre-Neolithic layers of some Ligurian and Sicilian cave sites, is rejected today as the contexts are deemed to be unreliable (cf. Pessina & Tiné, 2008, Lo Vetro & Martini, 2016).

<sup>10</sup> However, in this sense we must note that the presence of Gargano cherts in a Late Mesolithic-Castelnovian context (chronocultural phase 5) was recently reported in Žukovica Cave on Korčula Island (Vukosavljević & Perhoč, 2020). The macroscopic examination of raw materials gave rise to the cautious hypothesis that the Gargano cherts represent half of all identifiable raw materials, implying pre-Neolithic connections between the two Adriatic shores and the pre-Neolithic complex raw material economy. However, future research is needed in order to confirm the south Italian origin of the cherts and/or to rule out possible post-depositional disturbances.

<sup>11</sup> Namely in Ripa Tetta (Guilbeau, 2011, p. 93).

undoubtedly represents a Neolithic innovation transmitted from the East (Guilbeau, 2011; Collina, 2015; Guilbeau & Perlès, 2019). Early Neolithic lithic toolkits also point to a break with the Castelnovian and namely as far as trapezes are concerned. Indeed, these tools come in various shapes and sizes and were not made by the microburin technique (Kačar, 2019a, p. 364).

North-central regions of the Adriatic (Istria, eastern Po Plain, Venetian-Friulian Plain, Marches, and Abruzzi) were excluded from the Gargano distribution networks (Figure 5). Here, the on-site lithic knapping of locally available cherts (often pebbles) is oriented towards the production of blades and bladelets (with a preference for the latter as the average width is  $\leq 12$  mm) by means of pressure flaking, indirect percussion, and direct percussion (Komšo, Andreasen, & Forenbaher, 2008; Radi & Petrinelli, 2017; Kačar, 2019a, 2020; Moscone, 2019; Santaniello, Delladio, Ferrazzi, Grimaldi, & Pedrotti, 2020). When pressure flaking was employed, the blade(let) morphology suggests that they were produced by simpler pressure-flaking techniques, i.e. with a short crutch used in a sitting position (“mode 3,” see Pelegrin, 2012, pp. 467–479). In Istria, local cherts were used to obtain bladelets and bladelet-like flakes (35 by 10.6 mm on average) and production can be characterised as technologically simple and expedient. The small sample of blade(let)s renders the identification of production techniques difficult, but according to non-systematic experiments carried out in Jalès (Ardèche), indirect percussion (with a small punch?) seems to have been the main detachment technique.

With regard to toolkits, geometric trapezes made by the microburin technique, which evokes Castelnovian traditions, are quite well represented in all north Adriatic assemblages (see different papers in Visentini & Podrug, 2014; Radi & Petrinelli, 2017). Besides this common feature, there are some regional specificities: for example, side-notched burins (bullino di Ripabianca) are known in the Early Neolithic of the Marches and in the Po Plain (Stamini, Biagi, & Mazzucco, 2018), but absent in Istria. In the latter, one tool type was especially sought after: bladelet-like flakes and bladelets were often retouched by abrupt or semi-abrupt removals representing perforators and becs. In the coastal site of Kargadur, which was interpreted as a fisherman campsite (Komšo, 2006), this tool type is the most frequent (Figure 4). Given the site context, it is tempting to attribute these artefacts to fishing-oriented activities, but this presumption requires confirmation by microwear analyses.

It is important to emphasise that the Neolithic lithic production systems reflect cultural rather than technical logics (cf. Perlès, 2009). For example, in Dalmatia, the almost exclusive use of exogenous (Gargano) cherts cannot be solely explained by the absence of good-quality raw materials since cherts suitable for pressure flaking (at least for average-sized blades) are found in the region (e.g. on Korčula Island, see Perhoč, 2009, p. 48, Figure 2). Therefore, this choice illustrates cultural preferences (Forenbaher & Perhoč, 2017, pp. 205–206; Forenbaher, 2019) rather than technical constraints. Likewise, although the Early Neolithic Istrian knappers privileged technologically simple expedient production, non-systematic experiments in Jalès have shown that local cherts (Vižula outcrops) are suitable for the production of larger blades by both indirect percussion and pressure flaking (Kačar, 2019a, p. 139).

### 3.3 An Arrhythmic Neolithisation – Where From?

The available data show that the Neolithisation of the Adriatic, from the Strait of Otranto to the eastern fringes of the Po Plain was a complex, multilinear, and arrhythmic process that took almost 1,000 years to establish. And while the heterogeneity of the Adriatic Early Neolithic has long been evident due to obvious differences in ceramic production (Impressed Ware of south-central Adriatic vs different cultural styles of northern Adriatic), as well as within Italian Impressed Ware (*Impressa arcaica*, *Guadone*, and *Impressa medio-adriatica* facies), recent research, however, has shown that important differences may also be observed within eastern Adriatic Impressed ware. Although the same style of pottery was found in the south-central region (Dalmatia) and in the northern area (Istria), lithic production, settlement patterns, and subsistence strategies differ, clearly suggesting distinct Neolithisation scenarios for these two regions (Kačar, 2019a, 2020).

At the same time, the idea of cultural unity between south Italian and Dalmatian Impressed Ware was reinforced by recent research conducted on Dalmatian lithic assemblages (Forenbaher & Perhoč, 2017;

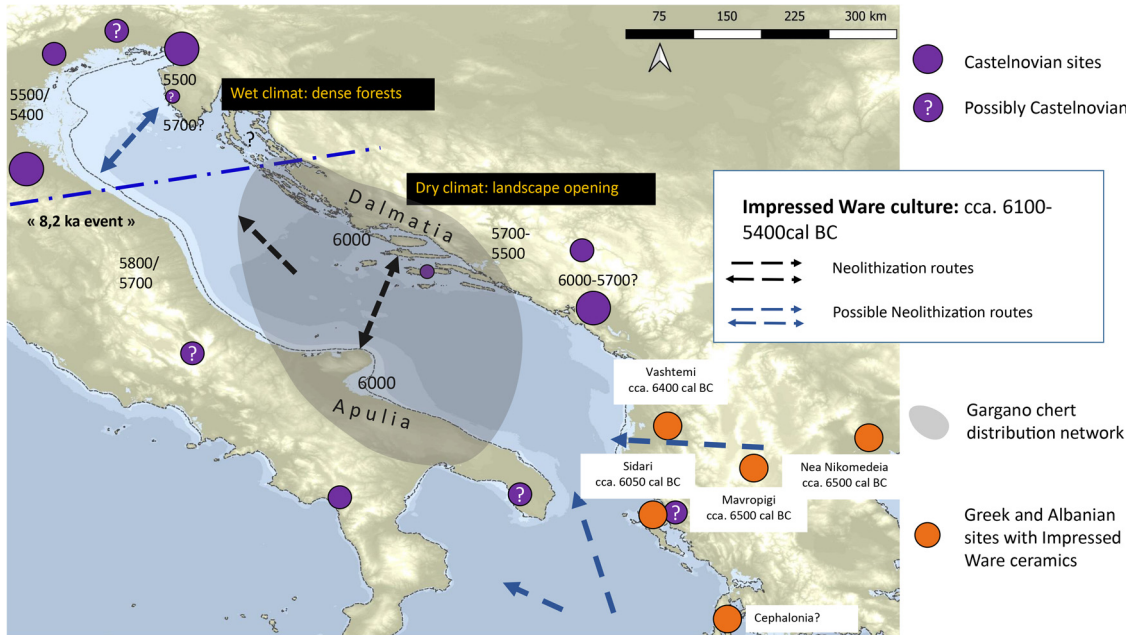


0 ——— 3 cm

**Figure 4:** Kargadur (Istria). Above: position of the site (credits: D. Komšo and Archaeological Museum of Istria). Below: bladelet-like flakes and bladelets retouched by abrupt or semi-abrupt removals representing perforators and becs.

Mazzucco et al., 2018; Podrug et al., 2018; Forenbaher, 2019; Kačar, 2019a, 2019b). The almost exclusive reliance on Gargano cherts in the Dalmatian Early Neolithic from the very beginning of the Neolithic reopened the question of possible Apulian influences in the Neolithisation of the eastern Adriatic and therefore of the west–east direction of colonisation (Forenbaher & Perhoč, 2017; Forenbaher, 2019).

In this regard, it is worth mentioning that in Apulia, this sophisticated and “wholly Neolithic” lithic production occurs alongside less elaborate on-site blade production using locally accessible raw materials (Guilbeau, 2011, p. 88; Collina, 2015). Thus, according to the current state of research, for southern Italian Impressed Ware, unlike the Dalmatian, local cherts were nevertheless used in blade production. In some



**Figure 5:** Proposed model for the Neolithisation of the Adriatic: the Gargano chert distribution network (shaded surface) corresponds to the epicentre of the Impressed Ware culture (Apulia, Eastern Calabria, Northern Basilicata, and Dalmatia), while the regions outside the distribution area represent the margins of the Impressed Ware culture (Istria and possibly Kvarner). The northern extension of the Gargano network is possibly linked to the border between the Italo-Dalmatian Impressed Ware and the Impresa medio-adriatica. The numbers (6000, 5800/5700 etc.) correspond to the cal BC dates.

cases, these locally accessible cherts are also of Gargano origin, yet it seems that they were collected from secondary deposits, and thus their extraction did not require complex procurement strategies, i.e. mining activities. Nevertheless, according to C. Collina (2015), the lithic industries of some south Italian Impressed ware sites, such as Scamuso and Favella, retain some Mesolithic traits since bladelet operational schemes are similar to Castelnovian schemes. For example, in both Favella and Scamuso, debitage is oriented towards the production of bladelets, with pebbles being used in Favella. If we add to this the relative importance of marine resources in the Apulian Early Neolithic (Cassano, Cazzella, Manfredini, & Moscoloni, 1987; Lelli et al., 2012, p. 386), the arguments for such a scenario are even more frequent.<sup>12</sup>

However, although claims for the west–east direction of Neolithisation sound plausible, we should bear in mind that reliable recent radiocarbon dates show no temporal anteriority of Italian sites and that many data are probably inaccessible, mainly due to the Holocene sea level rise. The rise in sea level is a real problem for interpretation and the discovery of submerged sites may profoundly modify our understanding and proposed models. Besides, data concerning the earliest Neolithic in Albania and western Greece are noticeably lacking and we still do not know when Impressed Ware reached the Albanian and Greek coastal plains or how these first Neolithic manifestations are structured.

According to current fragmented data, these first settlers may have arrived from the Aegean either following the coasts of the Ionian Sea or from the hinterland, via northern Greece and Epirus. However, given the absence of Impressed Ware pottery in the Peloponnese and western Greece<sup>13</sup> and its early presence in Macedonia and in south-eastern Albania (from ca. 6500–6400 cal BC), the second hypothesis sounds more plausible (Figure 5).

<sup>12</sup> And also pulse crops in Scamuso? (see *supra*, p. 8)

<sup>13</sup> Since the presence of Impressed Ware pottery on the island of Leukade is still questionable (Benvenuti & Metallinou, 2002, p. 18; Berger et al., 2014, p. 229).

## 4 Conclusion

Due to the limited quantity of currently available material, and the fact that many data have been lost due to the marine transgression, all conclusions must be treated with caution, i.e. they should only be interpreted as hypotheses for further examination.

The (re)interpretation of available data, together with new evidence collected during our own studies, suggests that the transition to farming was relatively rapid in the south-central part of the Adriatic basin (Dalmatia and Apulia), as a result of the colonisation of an open landscape (seemingly linked to the “8.2 ka event” and the onset of a drier climate) (Figure 5). These newcomers settled mostly in the fertile plains of the Dalmatian and Apulian hinterland, basing their subsistence almost exclusively on agriculture and livestock, while lithic blade production made from exogenous cherts from Gargano (southern Italy) attests to important social aspects and complex management strategies (such as mining activities, more complex modes of pressure flaking, and specialised distribution networks).

However, in the north of the Adriatic basin (Istria, Karst, Po Plain, and Marches), the Neolithic emerged somewhat later, possibly as a result of some form of “acculturation.” Although available data are still scarce, some evidence suggests that the last Mesolithic groups played an active role in the Neolithisation process in these areas. The presence of Castelnuovian sites is evidenced there and Castelnuovian traditions are identified in the lithic production of Neolithic sites dated to the Impressed Ware period: the use of local cherts, lamellar production by indirect percussion, and “simpler” forms of pressure flaking. Fishing also remains an important food resource.

In the extreme south of the Adriatic, on the border with the Ionian Sea, as well as in the hinterland and in continental parts of present-day Montenegro, Albania, and north-western Greece, Neolithisation is still poorly documented as a result of evident post-depositional disturbances in the main “transitional” sites (such as Sidari, Crvena Stijena, and Odmuť). However, “acculturation” is possible since the region was occupied by Castelnuovian groups. Taken together with southern Apulia, and due to its geographical position, this area is a key region for understanding the diffusion process of both the Castelnuovian and the Neolithic.

According to available data, we propose that Neolithic settlers, originating probably from Greece, established their colonies in Dalmatia and Apulia around 6000 cal BC, from where they sporadically organised expeditions to the north and entered in contact with Castelnuovian groups. It took almost a millennium for the Adriatic region to be neolithised and the last hunters–gatherers were finally assimilated into the Neolithic around the end of the sixth millennium BC.

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