FERRAN ANTOLÍN, LAURENT BOUBY, LUCIE MARTIN,
MAURO ROTTOLI AND ANA JESUS

Archaeobotanical Evidence of Plant Food Consumption among Early Farmers (5700-4500 BC) in the Western Mediterranean Region*

▾ **Abstract** Domesticated plants, gathered wild plants and possibly not fully domesticated but cultivated plants (e.g., poppy) were an integral part of the Neolithic diet. Data from 65 sites of the Early Neolithic phase (5800-4500 cal. BC) ranging from the territories of the North Eastern Iberian Peninsula to the Po valley is used to illustrate farmers' choices in crop assemblages and plant gathering activities. We conclude that plant food consumption was very diverse in the Neolithic, involving cultivated cereals, pulses and oil plants, along with varying levels of gathered resources, depending on environmental conditions.

▾ **Keywords** Early Neolithic, Spain, France, Italy, Seeds and fruits, Carpology, Diet, Agriculture, Wild plant gathering, Western Europe

▾ **Résumé** Les plantes domestiquées, les plantes sauvages cueillies et les plantes cultivées qui n'étaient peut-être pas entièrement domestiquées (par exemple, le pavot), faisaient partie intégrante du régime alimentaire du Néolithique. Des données provenant de 65 sites datés du Néolithique ancien (5800-4500 cal. BC) et situés entre le Nord-Est de la péninsule Ibérique et la plaine du Pô sont utilisées pour illustrer les choix des agriculteurs dans les assemblages de cultures et les activités de cueillette de plantes. Nous concluons que la consommation de nourriture végétale était très diversifiée

* We would like to thank the Swiss National Science Foundation for the funding provided in form of a SNF Professorship (PI: F. Antolín, PP00P1_170515.), and two grants (PI: Lucie Martin, PMDP1_139632/153337). We thank Anne de Vareilles for English editing.

Ferran Antolín, Ana Jesus • University of Basel

Ferran Antolín • German Archaeological Institute (DAI)

Laurent Bouby • CNRS-University of Montpellier-IRD-EPHE

Lucie Martin • University of Geneva/EDYTEM University of Savoie Mont-Blanc

Mauro Rottoli • Musei Civici di Como

au Néolithique, impliquant des céréales cultivées, des légumineuses et des plantes oléagineuses ainsi que des niveaux variables de ressources cueillies, en fonction des conditions environnementales.

▾ **Mots clés** Néolithique ancien, Espagne, France, Italie, Semences, Fruits, Carpologie, Alimentation, Agriculture, Cueillette de plantes sauvages, Europe occidentale

There are at least two reasons why the study of plant food consumption among early farmers in the Western Mediterranean is a major topic of interest. One of them is an obvious one: these were among the first farming populations that moved with a set of cultivated crops and tools from a so-called "domestication centre" (area where the wild ancestors of these crops were cultivated over generations until they became domesticated through selection, thus needing human intervention for their reproduction) to a region where plants had presumably never been cultivated before. This opens up many questions regarding the know-how of these groups on farming techniques, their risk-reducing strategies in new environments, their ability or choice to keep or transform the crop spectrum they inherited from other groups or their own ancestors, and the capacity to adopt new plants into their set of cultivated crops. The second reason is less obvious, but still of major importance, and it concerns the perception and way of interaction with the environment of these populations. Most people influenced by Western thought nowadays have a very clear division between wild and domestic or cultural environments. This was not necessarily so in the Neolithic period, where human groups lived in a "wild" environment and the impact of their activities was presumably very local.[1] In some regions and periods, the consumption of wild plants could have been as important as the consumption of domestic resources, depending on the environmental availability of edible resources and on cultural choices. When we deal with plant food consumption among early farmers, we necessarily need to tackle both domestic and wild resources, with a large measure of uncertainty regarding the role of each plant in the diet, as will be explained below. For practical reasons, though, we will deal with these two types of resources from an actualistic point of view and classify them into cultivated and wild edible plants.

The archaeological study of plant food consumption is limited by the chance preservation of organic remains in archaeological sediments. Only rarely are accidentally burnt processed food remains preserved and recovered for analyses. Fortunately, seed and fruit remains are common finds in archaeological sites, mostly found in a charred state and therefore no longer affected by organic decay. They do not represent all plant remains consumed at the site: greens, tubers and wild fruits are often under-represented. However, edible fruits and

1 Tim INGOLD, "Growing Plants and Raising Animals: An Anthropological Perspective on Domestication", in David R. HARRIS (ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia* (London, 1996), pp. 12-24.

grains are frequently processed and/or cooked before consumption, increasing their chances of being preserved and recovered as carbonised remains. Seed and fruit remains are mostly recovered in bulk sediment samples. These must be of sufficient volume (usually 10 litres of sediment at least) and in a sufficiently high number (>50 samples for instance), and originating from the full range of archaeological contexts identified at the site in order for us to be sure that they are representative. Unfortunately, budgetary limitations and lack of tradition, particularly in old studies, have resulted in many sites with only a few judgement samples available, or samples that have not been processed adequately. There are several methods by which to retrieve plant macroremains from sediment samples, the use of flotation being the most common one. An important element is the use of sieves with a minimum mesh size of at least 0.5 mm. Larger mesh sizes do not allow a reliable recovery of important edible seeds, such as those of opium poppy, wild strawberry, or cereal chaff (all those parts of the ear other than grain that become residues during threshing and dehusking). Several publications offer guidelines on the recovery methods for archaeobotanical remains.[2]

Archaeobotanical analyses can therefore define the crop spectrum present in one site, usually with certain biases against seeds/fruits that are rarely processed with fire, and those that are more readily destroyed by fire (such as pulses and oily seeds) (see below). These biases can at best be solved with very intensive sediment sampling and proper recovery methods (as described above), together with good preservation conditions. The most repeatedly processed crops will be better represented in the record because they will have better chances of being recovered; likewise, edible wild plants can also be recovered in sediment samples and subsequently identified, as long as the plant remains were charred. Exceptionally, waterlogged contexts are found (in wells, sites close to natural water sources or lakes, etc.). In such conditions of anoxia, plant remains are usually very well preserved, mostly uncharred, and a much larger plant assemblage can be recovered. Food remains are best preserved in conditions of extreme desiccation, such as in the Egyptian tombs, but no such finds are known in the study region as regards the Neolithic period.

The total list of plants provided by archaeobotanical analyses will be incomplete, and it is not possible to reconstruct "recipes" from them, since we cannot reconstruct how plants were cooked and prepared and in what amounts. With this in mind, the focus of this article is to collate plant records documented for a large number of sites found in the northwest Mediterranean region and dated to the period between 5800 and 4500 BC, with the goal of comparing them to

---

2 Stefanie JACOMET, Angela KREUZ, Manfred RÖSCH, *Archäobotanik: Aufgaben, Methoden und Ergebnisse Vegetations- und Agrargeschichtlicher Forschung* (Stuttgart, 1999); Ramón BUXÓ, Raquel PIQUÉ, *La Recogida de Muestras en Arqueobotánica: Objetivos y Propuestas Metodologicas. La Géstion de los Recursos Vegetales y la Transformacion del Paleopaisaje en el Mediterraneo Occidental. Encuentro del Grupo de Trabajo de Arqueobotánica de la Península Ibérica Barcelona / Bellaterra, 29, 30 Noviembre y 1 Diciembre 2000* (Barcelona, 2003); Deborah M. PEARSALL, *Paleoethnobotany: A Handbook of Procedures* (Walnut Creek, 2015); Bigna L. STEINER, Ferran ANTOLÍN, Stefanie JACOMET, "Testing of the Consistency of the Sieving (Wash-over) Process of Waterlogged Sediments by Multiple Operators", *Journal of Archaeological Science: Reports*, vol. 2 (2015), pp. 310-20.

current evidence of plant food consumption in the different regions (northeast Iberian Peninsula, southeast France and northern Italy).

The region and sites under analysis

This article focuses on the territories that stretch from the Po valley to the Ebro valley, including the Rhone valley, the Ligurian coast and the region of the Gulf of Lyon. The earliest farming settlements in this area are documented on the Ligurian coast and the Gulf of Lyon around 5800 BC, followed by the remaining regions around 5600 BC. Speaking in terms of pottery traditions, we will deal with the first Impressa culture sites, from which we have only very few plant records (less than 1% of the available data), and mostly focus on the Cardial and Epicardial cultures in the West and the Fiorano, Vhò, Gruppi Friulani and Isolino cultures in the East (Po Valley and Friuli), all within the period from 5600 to 4500 BC. This is a rather broad chronological frame but, in order to include all analysed sites, we must be less restrictive in the temporal range, since the number of radiocarbon dated contexts is still insufficient.

This is a climatically, topographically and ecologically diverse region. The northeastern areas of the Iberian Peninsula are dryer and the local vegetation is nowadays dominated by shrubland, and mixed evergreen/deciduous woodlands are only to be found towards the north. The regions of northern Italy and southeast France (particularly the former) were wetter and potentially more densely wooded during the Neolithic.[3] Our knowledge of the palaeoclimate in the region during the period studied is not very precise, but it is improving as palaeoecological data also increase. There seems to have been a cooling period around 5200 BC but otherwise this was the so-called Climatic Optimum, with wetter conditions than at present; dense deciduous woodlands were widespread outside of the coastal Mediterranean areas, with expansions of silver fir and other conifers in colder phases, while the coastal fringes remained more open with a dominance of evergreen taxa.[4]

We collated data from 65 archaeological sites (table 1, fig. 1), 74 settlement phases (some sites were occupied several times during the analysed period). We

3 Odile PEYRON, Nathalie COMBOURIEU-NEBOUT, David BRAYSHAW et al., "Precipitation Changes in the Mediterranean Basin During the Holocene from Terrestrial and Marine Pollen Records: A Model–Data Comparison", *Climate of the Past*, vol. 13 (2017), pp. 249-65.

4 Jordi REVELLES, Francesc BURJACHS, Antoni PALOMO et al., "Human-Environment Interaction During the Mesolithic- Neolithic Transition in the NE Iberian Peninsula. Vegetation History, Climate Change and Human Impact During the Early-Middle Holocene in the Eastern Pre-Pyrenees", *Quaternary Science Reviews*, vol. 184 (2018), pp. 183-200; Janet BATTENTIER, Didier BINDER, Sebastien GUILLON et al., "The Environment of the Last Hunters-Gatherers and First Agro-Pastoralists in the Western Mediterranean Region, between the Rhone and the Northern Apennines (7th-6th Millennium cal. BC): Attractiveness of the Landscape Units and Settlement Patterns", *Quaternary Science Reviews*, vol. 184 (2018), pp. 167-82; Yannick MIRAS, Ana EJARQUE, Santiago RIERA et al., "Dynamique Holocène de la végétation et occupation des Pyrénées Andorranes depuis le Néolithique Ancien, d'après l'analyse pollinique de la tourbière de Bosc dels Estanyons (2180 m a.s.l., Vall del Madriu, Andorre)", *Comptes Rendus Palevol*, vol. 6 (2007), pp. 291-300; Ana Maria MERCURI, "Genesis and Evolution of the Cultural Landscape in Central Mediterranean: The 'Where, When and How' through the Palynological Approach", *Landscape Ecology*, vol. 29 (2014), pp. 1799-810.

Table 1. Sites, chronological phase (Phase 1: 5800-5000 BC; Phase 2: 5000-4500 BC) and main taxa used for analyses in this article with indications of presence (1), except for pulses (number of taxa shown instead).

OID	SITE	Phase	Naked wheat	Barley	Glume wheats	Oil plants	Pulses (No. taxa)	Hazelnut	*Maloideae*	Acorns
1	C/Reina Amàlia 31-33	2	1	1	1					
2	Can Sadurní	1	1	1	1					1
3	Caserna de Sant Pau	1	1	1	1		2			
4	Codella	2						1		
5	Coro Trasito	1	1	1	1		1	1	1	1
6	Coro Trasito	2	1	1	1	1		1		1
7	Cova de Sant Llorenç	1	1							
8	Cova de Sant Llorenç	2	1	1	1					1
9	Cova del Sardo	1		1				1		
10	Cueva de Chaves	1								
11	Font del Ros	1	1	1	1		1			
12	DOU	2						1		
13	La Draga	1	1	1	1	1	2	1	1	1
14	Los Cascajos	1		1				1		
15	Los Cascajos	2		1	1			1		
16	Plansallosa	2	1	1			1			1
17	Abri Buholoup	1								
18	Abri Roc Troué	2	1	1				1		
19	Aspre del Paradís	2		1	1			1		
20	Balma Margineda	1	1	1			1	1		1
21	Baume Abeurador	1		1				1		
22	Baume Bourbon	2								
23	Baume d'Oulen	1	1	1	1					
24	Cova de l'Esperit	1	1				1	1		
25	Font Juvénal	2	1					1		1
26	Font-aux-Pigeons	2	1	1			2			
27	Fontbregoua	1	1	1	1		1			1
28	Grotte de l'Aigle	1	1		1					
29	Grotte du Gardon	1	1	1	1			1		1
30	Grotte du Tai	1	1	1	1					
31	Grotte Gazel	1								
32	Grotte Gazel	2								

OID	SITE	Phase	Naked wheat	Barley	Glume wheats	Oil plants	Pulses (No. taxa)	Hazelnut	*Maloideae*	Acorns
33	Grotte Saint Marcel	1								
34	La Gillière 1 et 2	2	1	1	1	1	1	1	1	
35	La Grand Rivoire	1						1		
36	La Planta	2	1					1		
37	La Resclauza	2	1	1						
38	Le Valladas	2	1	1	1		1			
39	Les Coudomines	2								
40	Mas de Vignoles X	2		1	1					
41	Mas Neuf	2	1	1						
42	Peiro Signado	1	1		1					
43	Pendimoun	1	1	1	1		1			1
44	Périphérique Nord-Lyon	2	1	1	1					
45	Pont de Roque Haute	1	1		1					
46	Roc de Dourgne	1								
47	Roc de Dourgne	2	1							
48	Tourbillon	2	1	1	1	1		1		
49	Albinea	1		1						
50	Caverna delle Arene Candide	1	1	1	1		1			
51	Bazzarola	1	1	1	1		2	1	1	1
52	Bazzarola	2		1	1			1	1	1
53	Bazzarola	2	1	1	1		1	1	1	1
54	Cecima	2		1						
55	Chiozza di Scandiano	1		1						
56	Fagnigola	1	1	1	1			1		
57	Fiorano	1						1		
58	Isolino di Varese	1						1		
59	Isolino di Varese	2	1	1	1	1		1	1	1
60	Isorella	2	1		1			1		
61	Lugo di Grezzana	1		1	1			1	1	1
62	Lugo di Romagna	1	1	1	1		2	1	1	1
63	Ostiano-Dugali Altri	1		1				1		
64	Pavia di Udine	2	1	1	1		3	1		
65	Piancada	1		1	1		3	1	1	1
66	Pizzo di Bodio	1		1	1			1		

OID	SITE	Phase	Naked wheat	Barley	Glume wheats	Oil plants	Pulses (No. taxa)	Hazelnut	*Maloideae*	Acorns
67	Ponte Ghiara	2		1	1	1	2	1	1	1
68	Rivaltella- Ca Romensini	1	1	1	1	1		1		1
69	Rivaltella- Ca Romensini	2	1	1	1			1	1	
70	Sammardenchia	2	1	1	1	1	6	1	1	1
71	Savignano	1		1						
72	Valer	1		1	1			1		
73	Vela di Trento	1		1	1			1		
74	Vho di Piadena	1	1	1	1			1		

estimate that the study includes more than 1000 sediment samples and 700,000 plant macroremains. Fully quantified data are not available for all sites, which limits site by site comparisons of the relative importance of crops and gathered wild edible plants. Our work includes and expands on previous regional synthesis,[5] and we present the first archaeobotanical comparison between the three regions. The classical botanical nomenclature for cereals has been adopted.[6]

The aim of this article is therefore to see whether there are regional differences that can tell us something about choices in plant food consumption among early farmers. For the representation of the data we have used ArcGis and have relied on the simple recording of presence of taxa at a site level to identify regions where specific resources were used more frequently.[7] We are aware that the absence of taxa is only relevant for intensively sampled sites with good preservation conditions, but it is the only possible way to homogenize the data at the moment.

---

5 Mauro ROTTOLI, Elisabetta CASTGILIONI, "Prehistory of Plant Growing and Collecting in Northern Italy, Based on Seed Remains from the Early Neolithic to the Chalcolithic (C. 5600-2100 cal. BC)", *Vegetation History and Archaeoabotany*, vol. 18 (2009), pp. 91-103; Ferran ANTOLÍN, Vanessa NAVARRETE, Maria SAÑA et al., "Herders in the Mountains and Farmers in the Plains? A Comparative Evaluation of the Archaeobiological Record from Neolithic Sites in the Eastern Iberian Pyrenees and the Southern Lower Lands", *Quaternary International*, vol. 484 (2018), pp. 75-93; Laurent BOUBY, Frédérique DURAND, Oriane ROUSSELET et al., "Early Farming Economy in Mediterranean France: Fruit and Seed Remains from the Early to Late Neolithic Levels of the Site of Taï (Ca 5300-3500 cal. BC)", *Vegetation History and Archaeobotany*, vol. 28 (2018), pp. 17-34; Lucie MARTIN, *Premiers paysans des Alpes: Alimentation végétale et agriculture au Néolithique* (Rennes, 2014).

6 Daniel ZOHARY, Maria HOPF, Ehud WEISS, *Domestication of Plants in the Old World* (4th ed., Oxford, 2012).

7 ESRI, *Arcgis 10.0*, ed. Environmental System Research Institute, Inc. (California, 2010, https://www.esri.com).

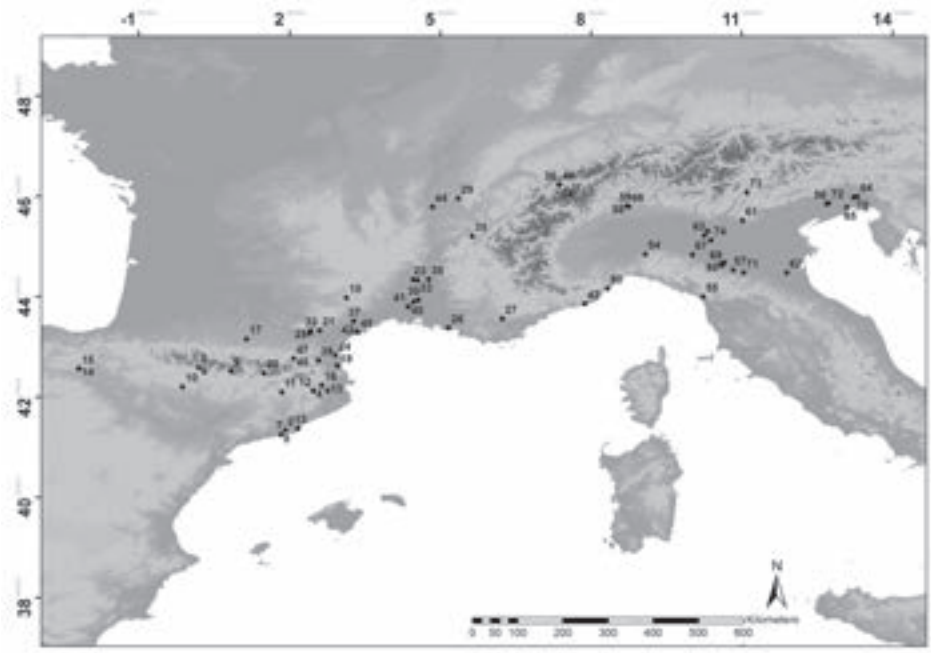

Figure 1. Sites (settlement phases) included in this study. 1: C/Reina Amàlia 31-33; 2: Can Sadurní; 3: Caserna de Sant Pau; 4: Codella; 5 & 6: Coro Trasito; 7 & 8: Cova de Sant Llorenç; 9: Cova del Sardo; 10: Cueva de Chaves; 11: Font del Ros; 12: La Dou; 13: La Draga; 14 & 15: Los Cascajos; 16: Plansallosa; 17: Abri Buholoup; 18: Abri Roc Troué; 19: Aspre del Paradís; 20: Balma Margineda; 21: Baume Abeurador; 22: Baume Bourbon; 23: Baume d'Oulen; 24: Cova de l'Esperit; 25: Font Juvénal; 26: Font-aux-Pigeons; 27: Fontbregoua; 28: Grotte de l'Aigle; 29: Grotte du Gardon; 30: Grotte du Tai; 31 & 32: Grotte Gazel; 33: Grotte Saint Marcel; 34: La Gillière 1 et 2; 35: La Grande Rivoire; 36: La Planta; 37: La Resclauza; 38: Le Valladas; 39: Les Coudomines ; 40: Mas de Vignoles X; 41: Mas Neuf; 42: Peiro Signado; 43: Pendimoun; 44: Périphérique Nord-Lyon; 45: Pont de Roque Haute; 46 & 47: Roc de Dourgne; 48: Tourbillon; 49: Albinea; 50: Arene Candide; 51-53: Bazzarola; 54: Cecima; 55 : Chiozza di Scandiano; 56: Fagnigola; 57: Fiorano; 58 & 59: Isolino di Varese; 60: Isorella: 61: Lugo di Grezzana; 62: Lugo di Romagna; 63: Ostiano-Dugali Altri; 64: Pavia di Udine; 65: Piancada; 66: Pizzo di Bodio; 67: Ponte Ghiara; 68: Rivaltella-Ca Romensini; 69: Rivaltella-Ca Romensini; 70: Sammardenchia; 71: Savignano; 72: Valer; 73: Vela di Trento; 74: Vho di Piadena. © European Digital Elevation Model (EU-DEM), version 1.1. European Environment Agency (EEA). CLMS (Copernicus Land Monitoring Service) 2016.

Plant foods found in the Early Neolithic in the Western Mediterranean

Cultivated crops in the Early Neolithic period (5800-4500 cal. BC)

Early farmers cultivated a considerable diversity of cereals, pulses and oil plants. For various reasons, the full diversity of crops known for the period is not found in all sites and not all crops are equally well represented in the record. Among the sites with at least 50 plant macroremains found, the majority have three or more different cereal taxa documented.

Figure 2. Ears of (from left to right) *Triticum monococcum*, *T. dicoccum*, *T. timopheevii*, *T. durum*, *Hordeum vulgare* var. *nudum* and *Hordeum vulgare*. Photo courtesy of Raül Soteras, AgriChange Project, University of Basel.

Among the cereals, different wheat taxa and different types of barley are known (fig. 2). Identification of cereal species/subspecies in the archaeological records is constrained by the charring process, and we therefore also need to assume that we cannot grasp the full diversity of prehistoric landraces with traditional methods.[8] Barley is present in almost all investigated sites (around 70%). In most cases, we do not know if it is hulled barley (either the six-rowed type: *Hordeum vulgare* var. *vulgare*; or the two-rowed type: *Hordeum distichon*, although it is generally considered to be six-rowed) or naked barley (*Hordeum vulgare* var. *nudum*). In some instances, it was possible to identify two-rowed

8 For further insight into the problematic, see for instance: Stefanie JACOMET, *Bestimmung Von Getreidefunden Aus Archäologischen Ausgrabungen. Identification of Cereal Remains from Archaeological Sites* (Basel, 2006).

barley due to the exceptional conditions of preservation, such as at the lakeshore settlement of La Draga, in Banyoles (Spain).[9] The main difference (in terms of tasks involved after harvesting) between hulled and naked barley concerns the ease of processing. Hulled barley is normally dehusked if consumed by humans. Naked barley is well represented in the western half of the study region, but this may be due to the fact that barley is rarely identified to a variety level in the publications available for sites in northern Italy.

Among wheats, different patterns can be observed. Glume wheats were widespread through the region, but they are much better represented in northern Italy and at certain sites in the west where they are usually found with naked wheat. Instead, naked wheat is only occasionally present in the northern Italian sites (fig. 3). Emmer (*Triticum dicoccum*) and einkorn (*Triticum monococcum*) are the most commonly found. Occasionally, the so-called "new" glume wheat (presumably a species close to today's *Triticum timopheevii*, but not yet proven) has also been identified, mostly in the Friuli area (the easternmost part of northern Italy), but also in the western part of the study region, where the role of this taxon seems to not have been of much relevance during the Neolithic period.[10] Among the naked wheats it is difficult to distinguish between taxa unless well-preserved chaff remains (mostly rachis segments) can be recovered. In such cases, tetraploid naked wheat (*Triticum durum/turgidum*) seems to be dominant, with potential occasional presence of hexaploid-looking rachis remains (*T. aestivum*). That would be the case of the site at La Draga.[11]

Agriculture was not only based on cereals, despite the fact that they are dominant in the archaeobotanical record. Oil plants and pulses are also documented in the investigated sites (fig. 4), particularly in those where up-to-date recovery methods were applied (fig. 5). Seeds from oil plants are rarely recovered in a charred state because they rarely survive heat exposure.[12] Nevertheless, flax (*Linum usitatissimum*) seeds have been identified in sites in northern Italy and the northeast Iberian Peninsula. Opium poppy (*Papaver somniferum*) seeds have been found in the three regions studied and they are particularly abundant in sites with waterlogged deposits, such as La Draga and Isolino Virginia.[13]

---

9 Ferran ANTOLÍN, Ramón BUXÓ, Stefanie JACOMET et al., "An Integrated Perspective on Farming in the Early Neolithic Lakeshore Site of La Draga (Banyoles, Spain)", *Environmental Archaeology*, vol. 19 (2014), pp. 241-55.

10 Ferran ANTOLÍN, Stefanie JACOMET, Ramón BUXÓ, "The Hard Knock Life. Archaeobotanical Data on Farming Practices During the Neolithic (5400-2300 cal. BC) in the Ne of the Iberian Peninsula", *Journal of Archaeological Science*, vol. 61 (2015), pp. 90-104.

11 Ferran ANTOLÍN, *Local, Intensive and Diverse? Early Farmers and Plant Economy in the North-East of the Iberian Peninsula (5500-2300 cal. BC)* (Groningen, 2016).

12 Stefanie JACOMET, Christoph BROMBACHER, Martin DICK, *Archäobotanik Am Zürichsee. Ackerbau, Sammelwirtschaft Und Umwelt Von Neolithischen Und Bronzezeitlichen Seeufersiedlungen Im Raum Zürich. Ergebnisse Von Untersuchungen Pflanzlicher Makroreste Der Jahre 1979-1988* (Zürich, 1989); Tanja MÄRKLE, Manfred RÖSCH, "Experiments on the Effects of Carbonization on Some Cultivated Plant Seeds", *Vegetation History and Archaeoabotany*, vol. 17 (2008), pp. 257-63.

13 Giuseppina D. BANCHIERI, Mauro ROTTOLI, "Isolino Virginia: Una Nuova Data per la Storia del Papavero da Oppio (*Papaver somniferum* subsp. *somniferum*)", *Sibrium (Centro di studi preistorici e archaeologici di Varese)*, vol. 25 (2009), pp. 31-49; Ferran ANTOLÍN, *Local, Intensive and Diverse? …*

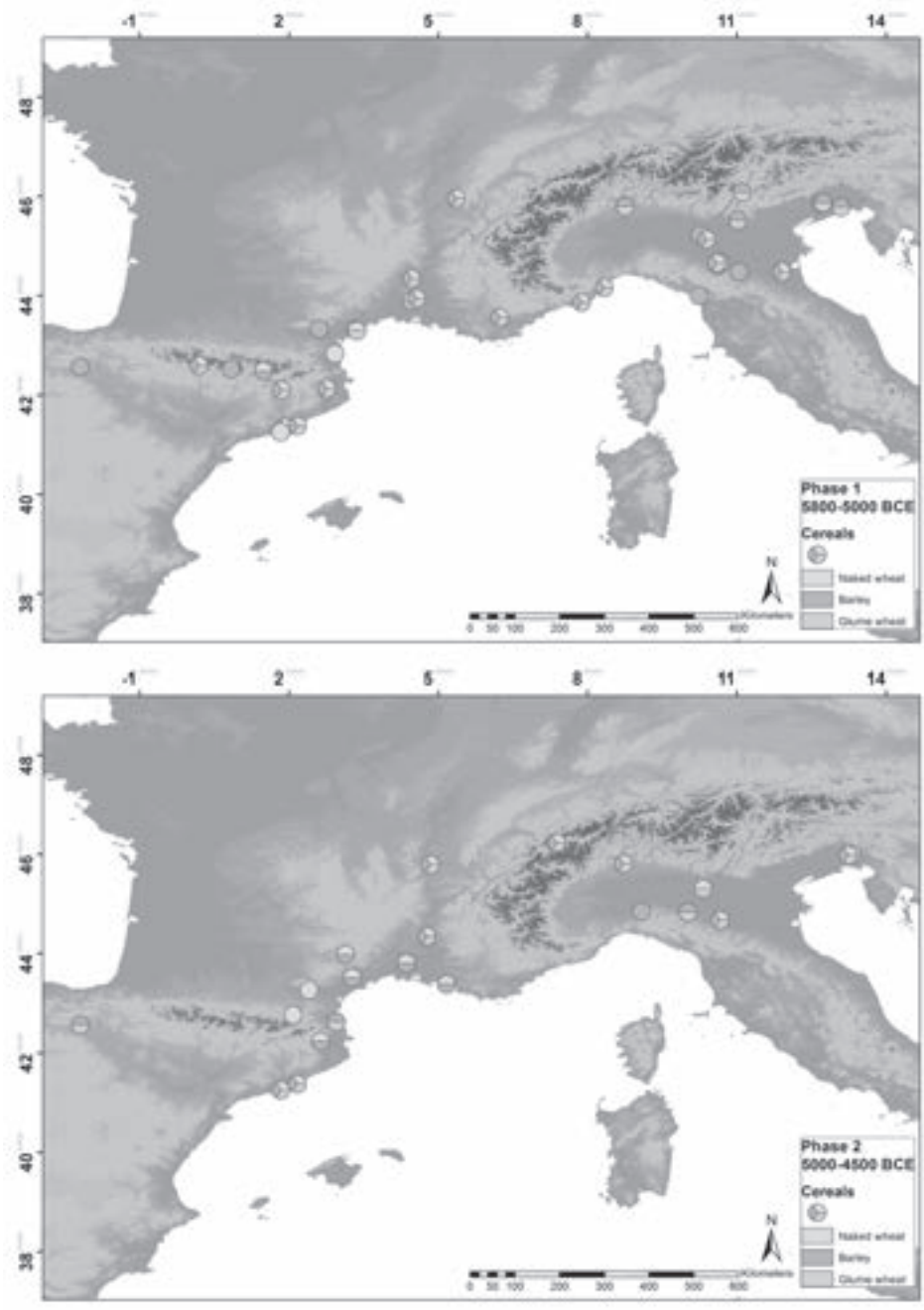

Figure 3. Presence of naked wheat, glume wheat and barley in the analysed sites represented in pie charts (the charts do not reflect relative proportions of absolute counts). © European Digital Elevation Model (EU-DEM), version 1.1. European Environment Agency (EEA). CLMS (Copernicus Land Monitoring Service) 2016.

Figure 4. From left to right, capsules of *Papaver somniferum*, *Linum usitatissimum*, pods and seeds of *Lens culinaris* and pods and seeds of *Vicia faba* var. *minor*. Photo courtesy of Raül Soteras, AgriChange Project, University of Basel.

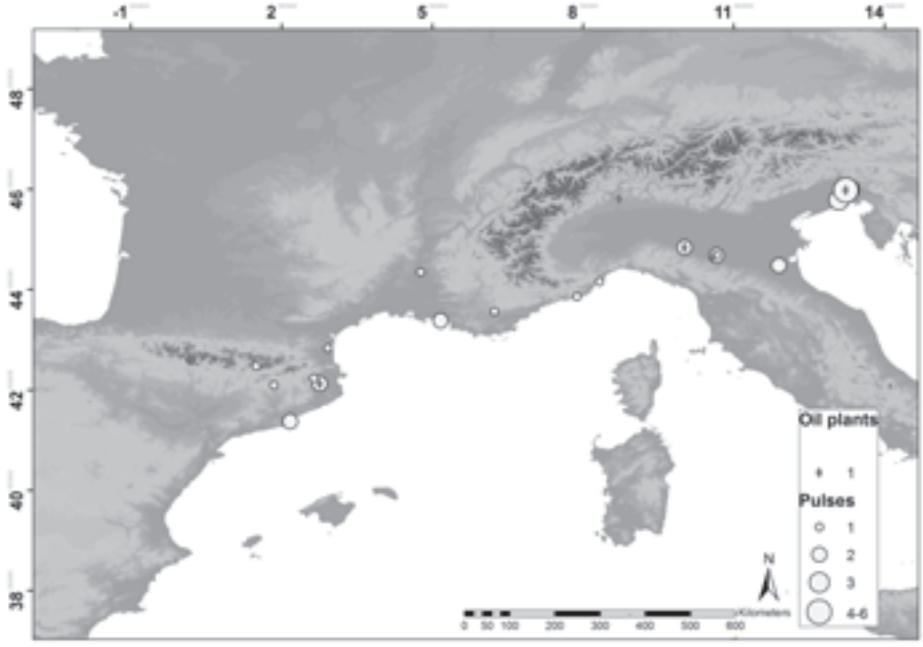

Figure 5. Presence of oil plants and pulses (number of taxa indicated by the size of the circles) in the sites analysed in this article. © European Digital Elevation Model (EU-DEM), version 1.1. European Environment Agency (EEA). CLMS (Copernicus Land Monitoring Service) 2016.

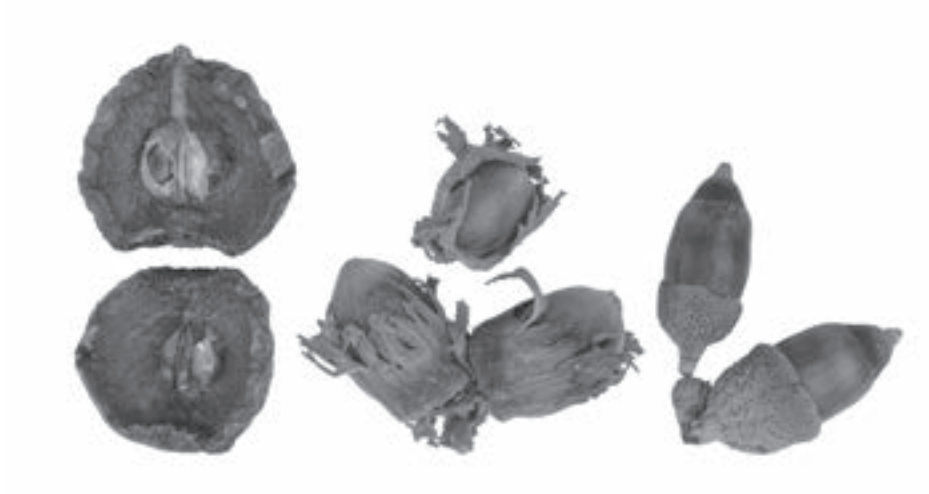

Figure 6. Fruits of *Malus sylvestris* (two dried fruit halves), *Corylus avellana* and *Quercus ilex*. Photo courtesy of Raül Soteras, AgriChange Project, University of Basel.

Nevertheless, it is not clear if they belong to the cultivated or the wild form, and studies are currently ongoing.[14]

Pulses are rare finds and the only sites with a diversity beyond two taxa are in the Friuli region, in the easternmost part of northern Italy: Piancada, Pavia di Udine and Sammardenchia. Pea (*Pisum sativum*) is the most widespread taxon, while other pulses are sparsely documented. Faba beans (*Vicia faba*), for instance, have not been recorded in SE France, where lentils (*Lens culinaris*) are also rare, particularly in comparison to northern Italy. Common vetch (*Vicia sativa*) and bitter vetch (*Vicia ervilia*) are only recorded in northern Italy during these earlier moments of the Neolithic.

Edible wild plants documented in the Early Neolithic

Edible wild plants, mostly fruits of trees and shrubs, are often present in Neolithic sites with crop remains (fig. 6). Hazelnut (*Corylus avellana*) is the taxon that is documented in most sites (c. 50%). It has a clear distribution connected to its availability in the landscape, since it was not commonly growing in the lowlands close to the sea. In these areas, other taxa such as acorns (*Quercus* sp.) or mastic tree (*Pistacia lentiscus*) were more often recorded (fig. 7). Maloideae are clearly more abundant in northern Italy and in mountainous areas of the western part of the analysed region (fig. 7). Small seeded wild fruits are also found, such as bramble (*Rubus fruticosus*), raspberry (*Rubus idaeus*) or wild strawberry (*Fragaria*

14 Aurélie SALAVERT, Lucie MARTIN, Ferran ANTOLÍN et al., "The Opium Poppy in Europe: Exploring Its Origin and Dispersal During the Neolithic", *Antiquity*, vol. 92 (2018); Aurélie SALAVERT, "Le Pavot (*Papaver Somniferum*) à la fin du 6e millénaire av. J.-C. en Europe Occidentale", *Anthropobotanica*, vol. 1 (2010), pp. 3-16.

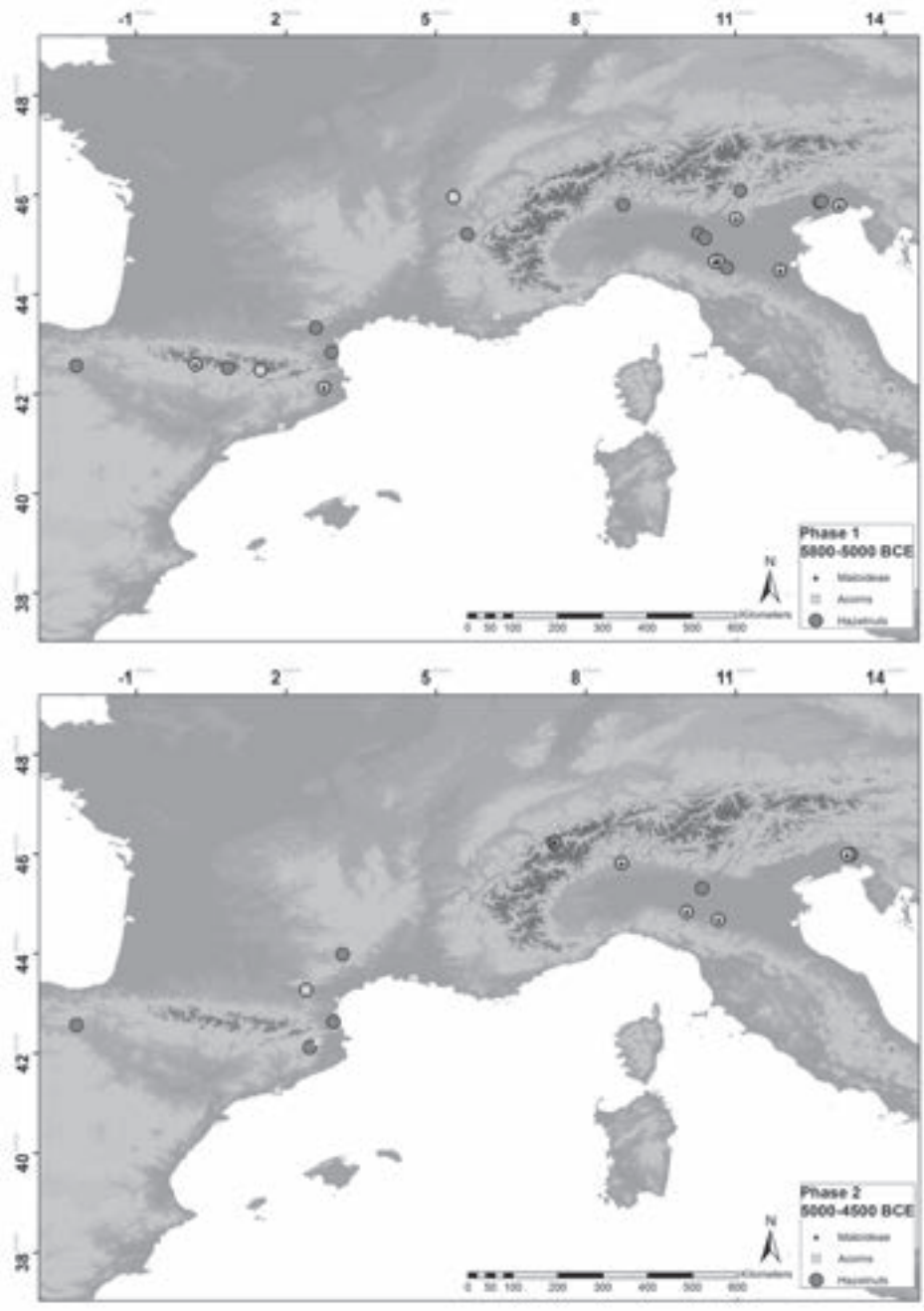

Figure 7. Presence of important wild edible fruits in the archaeobotanical record of the sites analysed in this article. © European Digital Elevation Model (EU-DEM), version 1.1. European Environment Agency (EEA). CLMS (Copernicus Land Monitoring Service) 2016.

vesca). Most of these fruits are better represented in sites with waterlogged preservation conditions such as La Draga or Isolino Virginia.[15]

Discussion

Differences between regions

The archaeobotanical data available for the different regions are at the moment difficult to compare due to the different methodologies in sampling, sediment processing and quantification techniques applied. Nevertheless, the use of presence/absence data has enabled us to overcome most of these biases and to detect some of the major trends in each region. Thus, naked wheat is more abundant in the southern sites that are found to the west of the study region, while glume wheats (including the so-called "new glume wheat") are more often found in northern Italy. Here also pulses are better represented, as well as certain gathered plants such as crab apple. This might be due to a combination of wetter climate and different types of soils that are encountered in northern Italy (see section 2). It might also have to do with farmers' choices and cultural influences. After all, crops may be adopted or grown for multiple reasons, including the prestige or status associated with them or the labour and technology required for their production and consumption.[16] It is important to notice that the easternmost part of northern Italy could have been subject to greater influence from the Balkans than the rest of the study region.[17]

Cereal-based meals?

We have observed that cereals are the most common plant macroremains in the study region. Should we assume that cereal-based foods were the daily basis of the diet? At the current state of research this statement is difficult to affirm, since, as mentioned above, there are multiple biases affecting our record. Unfortunately we cannot calculate the daily amount of cereals consumed per person. Cereal food products are sometimes also very time-consuming to produce, as proven

15 Ferran ANTOLÍN, Stefanie JACOMET, "Wild Fruit Use among Early Farmers in the Neolithic (5400-2300 cal. BC) in the North-East of the Iberian Peninsula: An Intensive Practice?", *Vegetation History and Archaeobotany*, vol. 24 (2015), pp. 19-33.

16 Alexandre CHEVALIER, Elena MARINOVA, Leonor PEÑA-CHOCARRO, "Plants and People: Choices and Diversity through Time", in Patricia C. ANDERSON, Leonor PEÑA-CHOCARRO, Andreas G. HEISS (eds), *Early Agricultural Remnants and Technical Heritage (Earth)* (Oxford, 2014), p. 501; Dorian Q. FULLER, Leilani LUCAS, "Adapting Crops, Landscapes, and Food Choices: Patterns in the Dispersal of Domesticated Plants across Eurasia", in Michael D. PETRAGLIA, Nicole BOIVIN, Rémy CRASSARD (eds), *Dispersal and Species Movement: From Prehistory to the Present* (Cambridge, 2017), pp. 304-31.

17 Kelly REED, Mauro ROTTOLI, "L'agricoltura in Friuli e Dalmazia nel Neolitico – Neolithic Agriculture in Friuli and Dalmatia", in Paola VISENTINI, Emil PODRUG (eds), *Adriatico Senza Confini: Via die comunicazione e crocevia di popoli nel 6000 A.C.* (Udine, 2014), pp. 155-65.

by some experiments on grinding and dehusking.[18] But there are certainly a number of cooking methods that do not require such intensive work, such as stews or soups (table 2). Some of the modes of preparation are also linked to the storage of the food products as well. Thus both bulgur (parboiled, broken and dried grain) and trachanas (broken grain cooked in sour milk and left to dry in small lumps) allow for the prolonged storage of grain and are usually prepared in bulk.[19] Potential bulgur finds were reported from the site at La Draga in the form of amalgamated grain fragments, probably of durum wheat.[20] Flour and semolina are rare in archaeobotanical assemblages, and we basically need to rely on use-wear traces and residue analyses of grinding stones to prove a regular production of transformed cereal food products. Recent research on hearths at the Natufian site of Shubayqa in Jordan, and refuse deposits from the Neolithic tell-site of Çatalhöyük in Turkey have resulted in the identification of flat bread production from different cereals (sometimes including other "ingredients" such as pulses).[21] On the other hand, bread ovens are almost lacking from our study area. Fermented beverages are equally a possibility that has been proposed for the early domestication of cereals in Southwest Asia and cannot be excluded for our study region. Nevertheless, it has not been proven for these very early dates.[22]

The differences observed between the regions would have had a considerable impact on the tasks carried out in areas such as northern Italy, where dehusking must have been a very common and time-consuming activity to obtain edible grains. The choice of free-threshing cereals in the western part of the analysed region might have facilitated some of these tasks, making it easier and faster to obtain clean grain and flour, which, compared to emmer, could have been more suitable for bread making. In any case, prehistoric bread need not have looked

---

18 Delwen SAMUEL, "Experimental Grinding and Ancient Egyptian Flour Production", in Salima IKRAM, Aidan DODSON (eds), *Beyond the Horizon: Studies in Egyptian Art, Archaeology and History in Honour of Barry J. Kemp (Cairo, 2009)* (Cairo, 2009), pp. 456-77; Natàlia ALONSO, Ferran ANTOLÍN, Daniel LÓPEZ et al., "The Effect of Dehusking on Cereals: Experimentation for Archaeobotanical Comparison", in Patricia C. ANDERSON, Carole CHEVAL, Aline DURAND (eds), *Regards croisés sur les outils liés au travail des végétaux (An Interdisciplinary Focus on Plant-Working Tools). Actes des XXXIII^e Rencontres Internationales d'archéologie et d'histoire d'Antibes, 23-25 Octobre 2012* (Antibes, 2013), pp. 155-68; Jutta MEURERS-BALKE, Jens LÜNING, "Some Aspects and Experiments Concerning the Processing of Glume Wheats", in Patricia C. ANDERSON (ed.), *Préhistoire de l'agriculture. Nouvelles approches expérimentales et ethnographiques* (Paris, 1992), pp. 341-62.

19 Soultana Maria VALAMOTI, "Ground Cereal Food Preparations from Greece: The Prehistory and Modern Survival of Traditional Mediterranean 'Fast Foods'", *Archaeological and Anthropological Sciences*, vol. 3 (2011), pp. 19-39.

20 Ferran ANTOLÍN, *Local, Intensive and Diverse? ...*

21 Amaia ARRANZ-OTAEGUI, Lara GONZÁLEZ-CARRETERO, Monica N. RAMSEY et al., "Archaeobotanical Evidence Reveals the Origins of Bread 14,400 Years Ago in Northeastern Jordan", *Proceedings of the National Academy of Sciences*, vol. 115 (2018), pp. 7925-30; Lara GONZÁLEZ-CARRETERO, Michèle WOLLSTONECROFT, Dorian Q. FULLER, "A Methodological Approach to the Study of Archaeological Cereal Meals: A Case Study at Çatalhöyük East (Turkey)", *Vegetation History and Archaeobotany*, vol. 26 (2017), pp. 415-32.

22 Brian HAYDEN, Neil CANUEL, Jennifer SHANSE, "What Was Brewing in the Natufian? An Archaeological Assessment of Brewing Technology in the Epipaleolithic", *Journal of archaeological method and theory*, vol. 20 (2013), pp. 102-50.

Table 2. Main types of cereal food products, processes involved (order in which they are conducted expressed in numbers) and cereal taxa that are most commonly used for each type of product.[23] In the past, the uses of cereals may have been more varied.

	Grinding	Soaking	Drying	Pounding/grinding	Sieving	Cooking, baking, roasting	Bread wheat	Hard wheat	Barley	Emmer	Einkorn
Frikke: unripe grain	•		•	•		1					
Roasted grains	•					1					
Broken grain	•			•	•	•					
Dough/Groats		2		1		3					
Bulgur	4		2	3	5	1					
Trachanas	1	2	4	5		3					
Flour	2	•		1	3	•					
Semolina	2			1	3	•					
Bread	2	4		1	3	5					
Knödel	2	3		1		4					

like the bread we are used to now and it could have been produced from multiple combinations of cereals and other seeds.

Oil plants and pulses

It is currently not possible to propose a clear role for oil plants and pulses in the study region. Although one may assume that pulses were consumed by most early farming groups, we cannot be sure about the role of oil plants. One of the advantages of oil plants is that they are very calorie-rich, but they can also be used for multiple purposes, and not just for human consumption. If consumed by humans, oil plants could have been consumed as seeds or transformed into oil, but the processing of oil plants has not been detected in the archaeological record of the study region so far. Currently, the main limitation is their scarce

23 Adapted from Ferran ANTOLÍN, Natàlia ALONSO, Marian BERIHUETE et al., "Grütze, Bulgur, Mehl Und Griess. Bericht zum internationalen Arbeitstreffen "Archäobotanische Identifikation von Getreidespeisen" (Basel, 2. und 3. Juli 2015), mit einem praktischen Leitfaden zu ihrer integrativen Untersuchung", *Jahrbuch Archäologie Schweiz*, vol. 99 (2016), pp. 143-51; Andreas G. HEISS, "Bread", in Karen BESCHERER METHENY, Mary Carolyn BEAUDRY (eds), *Archaeology of Food: An Encyclopedia* (Lanham/Boulder/London/New York, 2015), pp. 70-75.

documentation, particularly in old investigations. It is possible that the spread of pulses was a bit slower than the spread of cereals and that some of them became more widespread in the fifth millennium BC. This could be due to multiple causes, such as cultural choice or difficulties involved in the cultivation of pulses, as well as climatic factors. What is particularly remarkable is the cultivation of opium poppy, which might be one of the few plants that was not domesticated in Southwest Asia and was probably cultivated for the first time in the western Mediterranean region. It is difficult to prove what this plant was used for, but it is remarkable to detect how early farmers maintained a continuous interaction with wild plants and incorporated interesting plants into their crop assemblage.

Wild plants in the diet of early farmers

Wild plants have traditionally been treated as a sort of non-essential addition to the diet of farming populations. There is little ethnographic research on wild fruit preparation, storage and consumption in comparison to the existing corpus dedicated to cultivated plants (mainly cereals). Activities around fruit processing and cooking have been poorly investigated, although there has been recent research devoted to aspects such as food preparation using acorns.[24] In general, large seeded fruits, such as hazelnuts and crab apples have more often drawn the attention of researchers, while the use of under-represented resources such as roots, tubers, herbaceous plants and small-seeded plants has been more difficult to investigate.[25] This, along with a relatively poor recording of their presence in archaeological sites, makes it difficult to establish the role of wild plants in human diets during the Early Neolithic.

In any case, our results have shown that they were widespread in the study region, although their use might also be conditioned by their availability in the environment. Thus, crab apple is more frequent in northern Italy and sites in the Pyrenees, than in sites in the lowlands elsewhere. It is unlikely that populations in these areas did not consume crab apples by choice. It is more likely to be due to its reduced availability in drier environments. A similar case can be made for hazelnuts. On the other hand, acorns are more widespread because several species of oaks grew in the study area and would have been available in different

---

24 Domenico PIGNONE, Gaetano LAGHETTI, "On Sweet Acorn (Quercus Spp.) Cake Tradition in Italian Cultural and Ethnic Islands", *Genetic Resources and Crop Evolution*, vol. 57 (2010), pp. 1261-66.

25 Sarah MASON, "Acornutopia? Determining the Role of Acorns in Past Human Subsistence", in John WILKINS, David HARVEY, Mike DOBSON (eds), *Food in Antiquity* (Exeter, 1995), pp. 12-24; Aldona BIENIEK, Maria LITYNSKA-ZAJAC, "New Finds of *Malus Sylvestris* Mill. (Wild Appple) from Neolithic Sites in Poland", *Vegetation History and Archaeobotany*, vol. 10 (2001), pp. 105-106; Marian BERIHUETE, Ferran ANTOLÍN, "A les Avellanes, Foc i Flames: Tafonomia i Quantificació de Closques d'Avellana recuperades en Contextos arqueològics. Revisió del Registre documentat a la Península Ibèrica", *Cypsela*, vol. 19 (2012), pp. 281-94; Daniela HOLST, "Hazelnut Economy of Early Holocene Hunter-Gatherers: A Case Study from Mesolithic Duvensee, Northern Germany", *Journal of Archaeological Science*, vol. 37 (2010), pp. 2871-80; Inés L. LÓPEZ-DÓRIGA, "An Experimental Approach to the Taphonomic Study of Charred Hazelnut Remains in Archaeological Deposits", *Archaeological and Anthropological Sciences*, vol. 7 (2015), pp. 39-45.

climatic ranges. The use of fire to process these fruits was common for these three major taxa. Roasting acorns and hazelnuts could have been practised to enhance their flavours and for better preservation, while crab apples could have been roasted also for storage purposes. Apple halves are relatively frequent finds in the archaeological record and early experiments have proven that charred apple halves found in many sites are the result of an accident during drying.[26] Small-seeded wild plants could have also been important in the diet of early Neolithic populations. Bramble, raspberry, as well as mastic tree and wild grapes are present at several sites, and sometimes in considerable numbers. In order to calibrate the role of wild plants in the diet, more systematic archaeobotanical research is necessary. We need to sample all kinds of sites in order to understand the role of wild plant resources: permanent vs. seasonal occupations, sites in the highlands and in the lowlands, on the coast and inland. Furthermore, an intensification of research of waterlogged deposits would be highly informative, given the higher chances of finding fruits and wild plants preserved in anoxic conditions than charred.

Conclusions

The synthesis of data presented in this article has allowed us to detect differences in the main crops and gathered plants within the northwestern Mediterranean region. These differences are probably a response to multiple factors including soil types, climate and the cultural heritage of the groups as well as choices made by farmers. The common aspect of these groups is that plant food consumption was based on the cultivation of several cereals, pulses and oil plants, combined with the gathering of numerous wild plants. Among the differences, we can highlight the higher frequency of naked wheat in the western part of the study area, while glume wheats, some pulses and also crab apple were more often recorded in northern Italy. Full quantification of macroremains by site with suitable sampling and recovery methods would be necessary to perform further detailed analyses that might help us to pursue some of the questions left unanswered by this article. As a final remark, we had to work with a sizeable chronological framework due to the absence of good radiocarbon dating sampling programmes for many of the sites included in this study. Only with increased systematic dating of short-lived samples will it be possible to undertake more detailed analyses on the evolution of plant food consumption during the Neolithic and how it interplayed with factors such as climatic variability.

26 Hans HELBAEK, "Preserved Apples and Panicum in the Prehistoric Site at Nörre Sandegaard in Bornholm", *Acta Archaeologica*, vol. 23 (1952), pp. 107-15.