



Research Article

Raquel Piqué*, Antoni Palomo, Xavier Terradas, Vasiliki Andreaki, Joan Anton Barceló, Igor Bogdanovic, Àngel Bosch Lloret, Patrick Gassman, Oriol López-Bultó, Rafael Rosillo Turra

Models of Neolithisation of Northeastern Iberian Peninsula: New Evidence of Human Occupations During the Sixth Millennium cal BC

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Abstract: The goal of this article is to discuss the significance of the archaeological evidence from the sites of La Draga (Banyoles, Spain) and Coves del Fem (Ulldemolins, Spain), in the context of the neolithisation of Northeastern Iberia. The ^{14}C dates have been analysed using Bayesian statistics. The stratigraphy of Coves del Fem covers the transition between the last hunter–gatherers of the region and the first farmers. The chronological sequence covers approximately 1,300 years, from 6065–5990 cal BC to 4700–4550 cal BC. The site of La Draga was occupied by the first farmers circa 5300–5230 cal BC when a wooden platform was constructed and first used. Subsequent repairs of the wooden piles have been dated as well. Another use of the wooden platform is documented around 5200–5085 cal BC, although until now new construction evidence has not been documented. La Draga site was reoccupied later, when several travertine structures dated in two moments between the years 5100–4900 cal BC and 4950–4700 cal BC were constructed and used. The radiocarbon dates of Coves del Fem and La Draga support the existence of two different models of neolithisation in Northeastern Iberia. In the southern part of the territory, Coves del Fem suggests that the Holocene hunter–gatherer populations remained in the area until the arrival of the first farmers, in a model similar to the one observed at the Ebro basin. On the contrary, the site of La Draga supports the hypothesis of the first farmers colonising a previously unoccupied territory.

Keywords: mesolithic, neolithic, chronology, Iberian Peninsula

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* **Corresponding author: Raquel Piqué**, Departament de Prehistòria, Universitat Autònoma de Barcelona, Barcelona, Spain, e-mail: Raquel.pique@uab.cat

Antoni Palomo: Museu d'Arqueologia de Catalunya, Barcelona, Spain

Xavier Terradas: Archaeology of Social Dynamics, Institució Milà i Fotonals, CSIC, Barcelona, Spain

Vasiliki Andreaki, Joan Anton Barceló, Igor Bogdanovic, Oriol López-Bultó: Departament de Prehistòria, Universitat Autònoma de Barcelona, Barcelona, Spain

Àngel Bosch Lloret: Independent Researcher, Girona, Spain

Patrick Gassman: Laboratoire de dendrochronologie, Gümliigen, Switzerland

Rafael Rosillo Turra: Independent Researcher, Girona, Spain

1 Introduction

The neolithisation of the Northeastern Iberian peninsula is still poorly known due to the scarcity of evidence of occupations corresponding to the late Mesolithic hunter–gatherer and the early Neolithic farmer sites. This situation contrasts with other surrounding regions of the Iberian Peninsula, such as the Ebro Basin (Utrilla & Montes, 2009) and the Eastern Iberia (Bernabeu & Badal, 1990; Bernabeu, Aura, & Badal, 1993; Bernabeu, Barton, Pardo, & Berginc, 2015), where a model of early farmers' colonisation and acculturation of the last hunter–gatherers has been proposed. Although the new research carried out in the Cueva de la Cocina shows that the possible acculturation is due to the existence of taphonomic problems (Pardo-Gordó *et al.*, 2018).

According to the archaeological evidence and radiocarbon dates, the number of sites corresponding to the last Holocene hunter–gatherers, known as Mesolithic geometric, increased during the seventh millennium cal BC in the Medium and Ebro valley (Utrilla & Domingo, 2014; Utrilla, Montes, Mazo, Martínez Bea, & Domingo, 2009; Vaquero & Garcia-Argüelles, 2009). However, in the Northeastern Iberia, there is a lack of Mesolithic geometric sites which coincides with a gap of radiocarbon dates. Effectively, the information of the last hunter–gatherer populations that inhabited Northeastern Iberia during the seventh millennium cal BC is scarce. So far, only the sites of Cova del Vidre (Bosch, 2001), Font del Ros (Martínez-Moreno, Mora, & Casanova, 2006; Pallarès, Bordas, & Mora, 1997), Bauma del Serrat del Pont (Alcalde & Saña, 2017), and Can Sadurní have provided dates that could be included in this hiatus. The first site, Cova del Vidre, has a layer with geometric Mesolithic evidence, whilst the other two sites are characterised by the presence of the so-called notch and denticulate lithic industry. However, these deposits are separated for more than 500 years from the first Neolithic populations, as the first evidence of Neolithic societies in the area appears in the middle of the sixth millennium cal BC (Morales & Oms, 2012; Morales, Fontanals, Oms, & Verges, 2010; Oms *et al.*, 2016; Oms, Terradas, Morell, & Gibaja, 2018; Vaquero & Garcia-Argüelles, 2009). This hiatus of data has been interpreted, both due to problems in the stratigraphic sequences and as a consequence of change in the behaviour of hunter–gatherer populations. This hiatus has also been documented in several parts of the western Mediterranean region and has been interpreted as the result of depopulation of the region, linked to the climatic cold event that occurred circa 6250 cal BC (8.2 year cal BP) (Alley & Ágúsdóttir, 2005; Alley *et al.*, 1997; López de Pablo & Jochim, 2010; Weninger *et al.*, 2006). In this sense, it has been argued that the absence of population could be due to the migration to neighbouring areas, such as the lowlands of Aragon, where, as it has already been mentioned, a higher density of Mesolithic occupations is documented.

Due to the lack of ^{14}C dates corresponding to the first half of the sixth millennium cal BC and the availability of very few corresponding to the second half of the seventh millennium cal BC, it has been proposed that a period of non-occupation preceded the arrival of the first farming communities at the northeastern part of the Iberian Peninsula. As a result, the first farmers arrived at a sparsely populated territory carrying with them all the Neolithic package and technological knowledge. The earliest evidence of farming societies at the Northeastern Iberia are located in coastal sites such as Guixeres de Vilobí (6655 ± 45 BP, 5644–5491 cal BC) (Oms, Esteve, Mestres, Martín, & Martins, 2014) or Cavet (6590 ± 60 BP, 5630–5470 cal BC) (Fontanals, Euba, Oms, & Morales, 2008). The Neolithic deposits of the region are usually located in areas without the evidence of previous occupation of the last hunter–gatherer societies. Thereafter, during the second half of the sixth millennium cal BC and especially during the fifth millennium cal BC, the use of the territory was intensified. The dynamics of Neolithic occupation expand following the natural corridors of the Mediterranean coast and adjacent plains as well as the Llobregat river valley.

The goal of this article is to discuss the significance of the archaeological evidence retrieved from the sites of La Draga (Banyoles, NE Spain) and Coves del Fem (Ulldemolins, NE Spain), in the context of the early Neolithic period in the region. The site of La Draga is, apparently, a clear example of the colonisation of a previously unoccupied territory. On the other hand, the recently excavated site of Coves del Fem has provided evidence of an occupational sequence that covers all of the sixth millennium cal BC, suggesting that the area was one of the last hunter–gatherer shelter and one of the earliest Neolithic occupation in the region. These two sites suggest that the neolithisation model had different dynamics between the northern and the southern parts of the region. Moreover, the low signal of early farmers' occupation in the region according to the recent dendrochronological results from the site of La Draga is discussed.

2 Materials: Archaeological Setting

2.1 Coves del Fem Site

The site of Coves del Fem (Ulldemolins) is located at the Natural park of Serra del Montsant in southern Catalonia (Figure 1). The Montsant is a part of the prelitoral ranges with a higher altitude of 1,115 m. The site is actually a rock shelter 10 m above the current level of the Montsant river (Figure 2). Currently, the documented cavity surface covers approximately 300 m² covered with sediment that potentially preserves archaeological layers. The first fieldwork at the site has revealed a complex, of almost 135 cm deep stratigraphic package, which covers the transitional period from the last hunter–gatherer occupations to the first evidence of early Neolithic occupation in the area (Bogdanovic, Palomo, Piqué, Rosillo, & Terradas, 2017; Palomo et al., 2018, 2020).

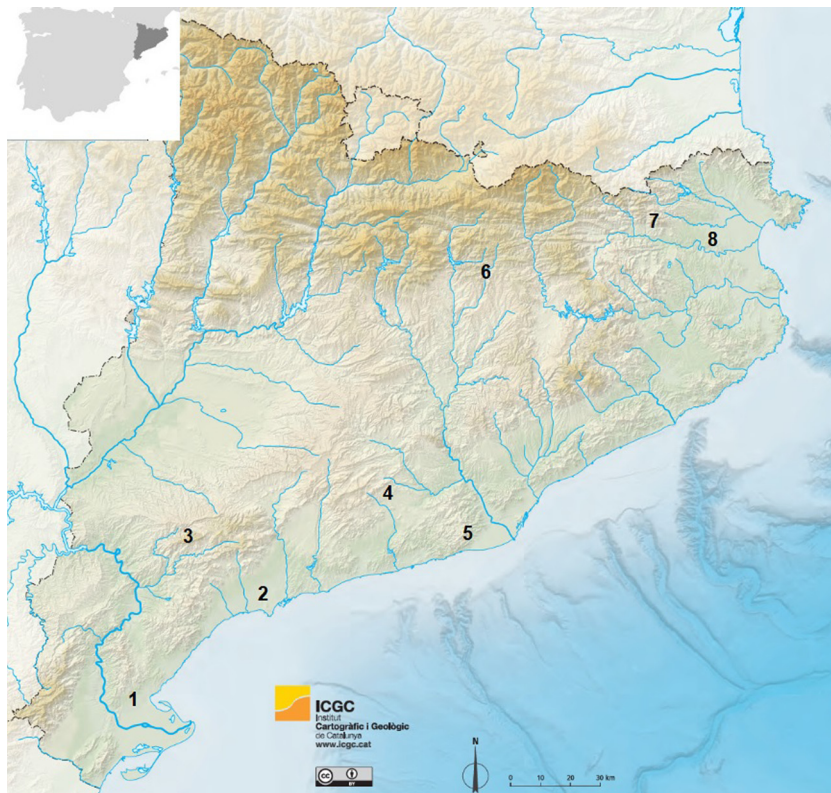


Figure 1: Locations of the sites cited in the text: (1) Cova del Vidre, (2) El Cavet, (3) Coves del Fem, (4) Guixeres de Vilobí, (5) Cova de Can Sadurní, (6) Font del Ros, (7) Bauma del Serrat del Pont, and (8) La Draga.

The Montsant range is a rich archaeological region and several sites have provided occupation evidence dated at the end of Paleolithic and the Epipaleolithic periods, as it is the case of Abric del Filador, Hort de la Boquera, or Abric del Colls (Garcia-Argüelles, Nadal, & Fullola, 2005, 2014b; Garcia-Argüelles i Andreu et al., 2014a). However, the stratigraphical sequences of the region rarely document archaeological layers dated at the sixth millennium cal BC. As a result, the transition to the Early Neolithic period remains unclear.

The excavated surface from the upper layers covers 9 m², whilst from layer 1,008 to the layer 1,014, the excavated surface covers only 5 m² due to the presence of a large block of stone. The five upper layers documented at Coves del Fem (UE 1008, 1009, 1011, 1012, and 1013) can be attributed to the end of the early



Figure 2: General view of Coves del Fem.

Neolithic period according to the pottery style (Figure 3a), defined as epicardial (Bosch, 1994: 57). The pottery is characterised by globular shapes with plastic decoration, incisions, and channelling. Moreover, several structures have been documented in these epicardial layers: postholes, fireplaces, and pits. Some of the structures were excavated until the underlying soil perturbing the early Neolithic cardial and Mesolithic layers. Carbonised archaeobotanical remains are abundant, including among them are the remains of basketry, charcoal, fruits, and seeds. Wooden remains have also been preserved desiccated, showing woodworking traces. Lithic technology in the epicardial layers is characterised by blade production, always unipolar. The technique of knapping is characterised by indirect percussion and heat treatment on core preforms is often applied. The cores have platforms of percussion with denticulate overhangs. These layers have also provided the evidence of cereal cultivation as well as domesticated caprine.

Layers 1010 and 1014 have provided cardial ware ceramics, while the pots are a combination of impressions and dragged technique (Figure 3b). Combustion features and negative structures have also been identified during the excavation. At the cardial layer, the size of the unipolar blade production remains is shorter than the ones found in the epicardial levels. It is also necessary to emphasise the presence of geometrics of triangular form or segments among the retouched pieces of both Neolithic layers.

Finally, the lower layers UE 106, 107, 108, and 109 of the stratigraphic sequence established in a survey carried out during 2015 (pending unification and renaming with the new sequence established on more recent excavations) can be attributed to Mesolithic occupations. These layers have not been properly excavated and only a test pit was dug in order to obtain samples for radiocarbon dating. Nevertheless, it was possible to document a combustion structure used repeatedly *in situ*. The archaeological material consists of abundant charcoal, ash and, to a lesser extent, faunal remains and lithic industry. The combustion structure has allowed a very good conservation of the carbonised archaeobotanical remains, among which it is remarkable the presence of an entire cone pine. The lithic remains are scarce and for the moment no geometric elements have been found; however, it has been documented a core for the production of bladelets by hard percussion and other core for the production of flakes (Figure 3c).

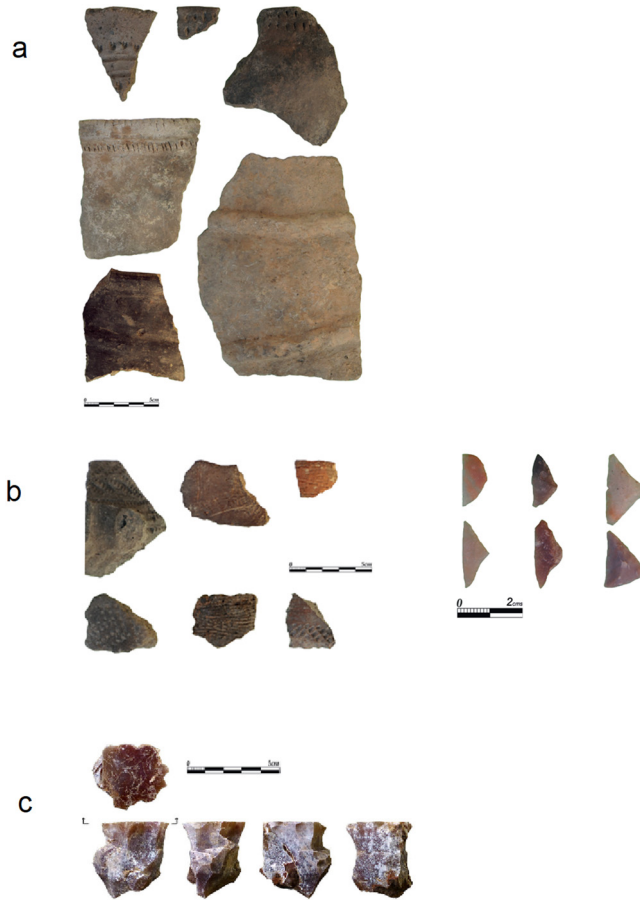


Figure 3: Materials from Coves del Fem: (a) pottery from epicardial layers, (b) pottery and lithics from cardial layers, and (c) lithic from the Mesolithic layer.

2.2 La Draga Site

The site of La Draga is located in the central part of the eastern shore of Banyoles lake (Girona, NE Iberia) at an altitude of 170 m (Figure 1). Nowadays, the archaeological site is partially underwater, but the most extensively excavated area is towards the inland. The site has an estimated extension of approximately 15,000 m² and has been systematically excavated since 1991. The fieldwork has been focused on three different sectors: sectors A and B–D in the shore of the lake and sector C underwater (Figure 4). One thousand square meters have been excavated so far providing an extraordinary archaeological record.

This open-air site corresponds to a lake dwelling of one of the first farming groups that settled in the northeast of the Iberian Peninsula (Andreaki et al., 2020; Bosch, Chinchilla, & Tarrús, 2000, 2006, 2011; Palomo et al., 2014). The pottery style documented at the site corresponds to the cardial culture or impressed ware culture. Systematic surveys carried out in the area and archaeological data gathered at regional level until now confirm the scarce evidence of occupations prior to the Neolithic settlement in the region. The closest Mesolithic site, in this case, is the Bauma del Serrat del Pont, previously mentioned, some 25 km away (Alcalde & Saña, 2017).

According to the superposition of the structures built with travertine slabs over a layer of timber logs (Figure 5), at least two phases of occupation have been proposed for the site, both corresponding to cardial ware culture (Palomo et al., 2014). However, these stratigraphic layers have been clearly documented in sectors B–D and C of the site, where waterlogged conditions have preserved the organic materials, whereas in the area of the site located further inland and at a higher height (Sector A), the stratigraphy shows a more



Figure 4: General view of La Draga site and excavated sectors. The labels indicate the different sectors excavated: Sector A corresponds to the driest part of the site. Sectors B–D are waterlogged and sector C is underwater.

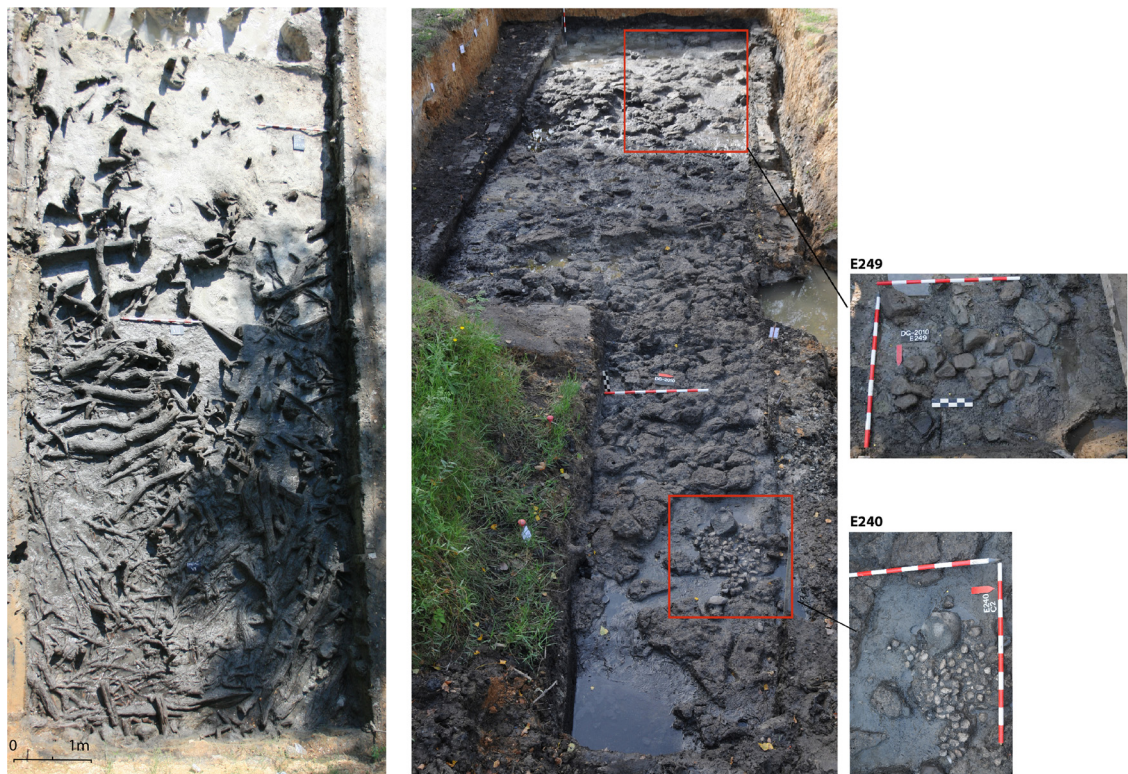


Figure 5: View of sector D. Left: wood and piles corresponding to the oldest phases of occupation (platform and post-platform). Right: travertine pavement that overlaps the wooden collapse and structures E249 and E240.

complex deposition of sediments. Due to the wedged deposits associated with the two occupational phases and the degradation of the timber logs' level, the two phases are not clearly separated in Sector A. In addition, the spatial distribution of the structures shows totally different dynamics.

The distribution of the travertine pavement and structures corresponding to the last moment of occupation are different in this sector. Several negative constructions, of irregular forms and of reduced or extensive dimensions, have been identified. These structures are filled with large quantities of diverse archaeological materials such as charred seeds, animal bones, fragments of ceramics, quartz, flint and bone tools, pieces of ornaments, and grinding instruments. Because of the kind of materials they contain, the pits have been interpreted as landfills for food waste and remains of manufactured objects that were once considered useless.

Combustion features are abundant in sector A where about 40 of them have been identified and they present different morphologies. The combustion features identified are arranged with travertine slabs, sandstones, or burnt pebbles, all in varying quantities, and charcoal, which are the remains of the firewood used.

The particular conditions of conservation at La Draga have allowed the recovery of evidence of some technical productions barely documented on Neolithic sites of the western Mediterranean. Agriculture and livestock, as well as artisanal productions, involved a diversification of tasks and required specific tools and equipment.

Regarding craft productions, the site has provided direct evidence of the use of plant fibres for the production of ropes and basketry and indirect evidence of textile production with vegetal fibres, as well as abundant evidence of tools made of wood (Figure 6) (López-Bultó & Piqué, 2018; López-Bultó et al., 2020; Palomo et al., 2011, 2013; Piqué et al., 2015, 2018). The remains of artefacts made with bone materials, shells, and minerals of different nature, provide a complete picture of the diversity of production processes



Figure 6: Wooden tools and cordage from La Draga.

(Berihuete, Girbal, Piqué, Palomo, & Terradas, 2018; De Diego *et al.*, 2018; Palomo, Piqué, & Terradas, 2017; Terradas *et al.*, 2017).

The diversity and quality of remains suggest that these early farmers had well-developed agriculture and husbandry (Antolín, 2016; Saña, 2011). They arrived with all their technological knowledge and created a new settlement of big dimensions.

3 Methods

The ^{14}C dates obtained from short live samples from La Draga and Coves del Fem are analysed in the frame of the early Neolithic dates of the northeast of the Iberian Peninsula. The radiocarbon ages provided by laboratory reports have been calibrated using the OxCal program (Bronk Ramsey, 2009) using the IntCal13 (Reimer *et al.*, 2013) curve with the half-life variable of the sample introduced. They were later analysed using Bayesian statistics. Bayesian models were implemented in order to identify the discontinuities in the chronological sequence. In the case of Coves del Fem, a total amount of six radiocarbon dates have been analysed with Chronomodel 1.5.0 software (Palomo *et al.*, 2020). The data were introduced in stratigraphic order, since the overlapping of strata date is clear and the results of the calibration form a chronological distribution that corresponds to the stratigraphic arrangement.

In the case of La Draga, in addition to the ^{14}C dates, the dendrochronological analysis of the piles and horizontal woods was integrated, in order to obtain a better picture of the duration and dynamics of the settlement (Andreaki *et al.*, 2020). Fourteen of these wooden piles were selected for the ^{14}C AMS method in order to date the moment of construction and the duration of the occupation. A total amount of 40 radiocarbon dates have been analysed with Chronomodel 2.0 software according to the stratigraphic order and sedimentary description of the archaeological deposits.

4 Results

4.1 Coves del Fem Chronology

The site of Coves del Fem has provided nine radiocarbon dates on short live samples (seeds, pine cone, animal bone, and charcoal) (Table 1). The sequence obtained covers approximately 1,300 years, from 6065–5988 to 4699–4545 cal BC. The analysis of the radiocarbon dates shows three sets of consecutive intervals, which in turn can be interpreted as widely contemporary (Figure 7).

The three lower stratigraphic units sampled are dated in 6065–5556 cal BC and correspond to the Mesolithic hunter–gatherer occupations. The radiocarbon dates of the early Neolithic cardial period come from three stratigraphic units and place this occupation between 5623 and 5221 cal BC. The last period of occupation is dated in the interval 4941–4545 cal BC and corresponds to the epicardial layers, the final phase of the early Neolithic period.

The chronological proximity between the Mesolithic stratigraphical layers and the strata attributed to the early Neolithic is noteworthy. On the other hand, there is a discontinuity within the early Neolithic period between the layers characterised as “cardial” and the ones characterised as “epicardial.”

4.2 La Draga Dendrochronology

The excavations carried out to date at the site of La Draga have made it possible to recover more than a thousand wooden piles from all the excavated sectors. The dendrochronological analysis of the piles is still

Table 1: Radiocarbon dates from La Draga and Coves del Fem. The dates were calibrated using the OxCal v4.4 programme and the IntCal20 calibration curve (<https://c14.arch.ox.ac.uk/oxcal/OxCal.html>)

Site	Sample	Material	Sector/ square	Year BP	Standard deviation	68% interval	68% interval	95% interval	95% interval	UE/phase	Chronomodel
Coves del Fem	Beta 42864	Bone	E21	5970	30	-4899	-4797	-4945	-4730	2103	Phase 3
Coves del Fem	Beta 42865	Charcoal	G13	6631	30	-5619	-5531	-5625	-5483	103	Phase 2
Coves del Fem	Beta 42866	Bone	G13	6633	30	-5620	-5531	-5625	-5483	106	Phase 1
Coves del Fem	Beta 42867	Cone of pine	G13	6635	30	-5620	-5534	-5626	-5483	109	Phase 1
Coves del Fem	Beta 42868	Charcoal	G13	6630	30	-5619	-5531	-5624	-5483	102	Phase 2
Coves del Fem	SUERC- 50640	Seed	G12-G13	5772	27	-4681	-4555	-4703	-4545	2	Phase 3
Coves del Fem	SUERC-50641	Seed	G12-G13	5840	27	-4780	-4623	-4790	-4612	3	Phase 3
Coves del Fem	SUERC- 50642	Charcoal	F14	6634	29	-5620	-5533	-5626	-5483	10	Phase 1
Coves del Fem	SUERC-53025	Bone	H13-G13	6632	32	-5620	-5531	-5625	-5482	104	Phase 2
La Draga	Beta 0000	Fauna	B	6184	27	-5174	-5072	-5216	-5038	BII	Post-platform
La Draga	Beta 278255	Fauna	C	6270	40	-5307	-5213	-5323	-5071	CII	Post-platform
La Draga	Beta 278256	Fauna	C	6170	40	-5208	-5054	-5217	-4997	CII	Post-platform
La Draga	Beta 298438	Fauna	D	6010	40	-4951	-4839	-5002	-4793	DIII	Travertine 2
La Draga	Beta 315049	Cereal	D	6130	40	-5207	-4996	-5210	-4952	DVII	Post-platform
La Draga	Beta 315050	Cereal	D	6180	40	-5208	-5061	-5286	-5003	DIV	Travertine 1
La Draga	Beta 315051	Cereal	D	6210	40	-5216	-5066	-5302	-5041	DIIa	Travertine 1
La Draga	Beta 315052	Cereal	D	6270	30	-5303	-5215	-5318	-5084	DVIII	Platform
La Draga	Beta 422869	Fauna	A	5990	30	-4935	-4805	-4987	-4791	E258	Travertine 2
La Draga	Beta 422871	Fauna	A	6100	30	-5200	-4952	-5208	-4907	E260	Travertine 1
La Draga	Beta 422872	Fauna	A	6050	30	-4997	-4905	-5036	-4846	E261 base	Travertine 1
La Draga	Beta 425194	Wooden post	A	6200	30	-5212	-5072	-5292	-5046	Construction	Platform
La Draga	Beta 425195	Wooden post	A	6280	30	-5305	-5216	-5324	-5132	Repair	Platform
La Draga	Beta 425196	Wooden post	A	6320	30	-5322	-5220	-5363	-5216	Repair	Platform
La Draga	Beta 425198	Fauna	A	5920	30	-4836	-4727	-4888	-4716	E261	Travertine 2
La Draga	Beta 428247	Fauna	A	6060	30	-5006	-4905	-5198	-4847	E258 base	Travertine 1

(Continued)

Table 1: (Continued)

Site	Sample	Material	Sector/ square	Year BP	Standard deviation	68% interval	68% interval	95% interval	95% interval	UE/phase	Chronomodel
La Draga	Beta 438952	Cereal	A	6140	30	-5206	-5005	-5210	-4997	Hearths A	Travertine 1
La Draga	Beta 453513	Wooden post	A	6401	38	-5470	-5321	-5475	-5310	Construction	Platform
La Draga	Beta 481571	Wooden post	A	6270	30	-5303	-5215	-5318	-5084	Construction	Platform
La Draga	Beta 481572	Wooden post	A	6320	30	-5322	-5220	-5363	-5216	Repair	Platform
La Draga	Beta 481573	Fauna	A	5980	30	-4904	-4800	-4984	-4784	E263	Travertine 2
La Draga	Beta 505895	Peat	C	5060	30	-3945	-3800	-3955	-3783	C3b	Posterior Occupation 2
La Draga	Beta 505896	Peat	C	5360	30	-4320	-4070	-4328	-4054	C5b	Posterior Occupation 1
La Draga	Beta 505910	Wooden post	A	6210	30	-5215	-5072	-5297	-5050	Repair	Platform
La Draga	Echo 2448.1.1	Cereal	B	6090	90	-5207	-4850	-5292	-4791	BlI	Post-platform
La Draga	ETH 88872	Cereal	D	6116	26	-5203	-4995	-5208	-4945	DVII	Post-platform
La Draga	ETH 88873	Cereal	D	6131	26	-5205	-5000	-5210	-4991	DVII	Post-platform
La Draga	ETH 88874	Cereal	D	6152	26	-5208	-5037	-5209	-5010	DVII	Post-platform
La Draga	HD 15451	Cereal	A	6060	40	-5023	-4854	-5203	-4841	Hearths A	Travertine 1
La Draga	OxA 20232	Cereal	B	6121	33	-5206	-4991	-5209	-4946	BlI	Post-platform
La Draga	OxA 20233	Cereal	A	6179	33	-5178	-5065	-5216	-5011	All	Post-platform
La Draga	OxA 20234	Cereal	A	6127	33	-5206	-4996	-5209	-4953	Hearths A	Travertine 1
La Draga	OxA 20235	Cereal	A	6143	33	-5207	-5006	-5210	-4996	Hearths A	Travertine 1
La Draga	OxA 20231	Cereal	B	6163	31	-5208	-5048	-5212	-5011	BlI	Post-platform
La Draga	Ua 62941	Wooden post	B	6308	39	-5318	-5218	-5368	-5212	Construction	Platform
La Draga	Ua 62942	Wooden post	D	6285	39	-5307	-5217	-5363	-5083	Construction	Platform
La Draga	UBAR 1247	Wooden post	B	6295	45	-5312	-5217	-5372	-5079	Repair	Platform
La Draga	UBAR 1248	Wooden post	B	6240	35	-5302	-5081	-5306	-5066	Repair	Platform
La Draga	UBAR 1293	Wooden post	B	6220	45	-5291	-5071	-5306	-5044	Construction	Platform
La Draga	UBAR 1308	Wooden post	B	6270	45	-5309	-5211	-5332	-5064	Construction	Platform

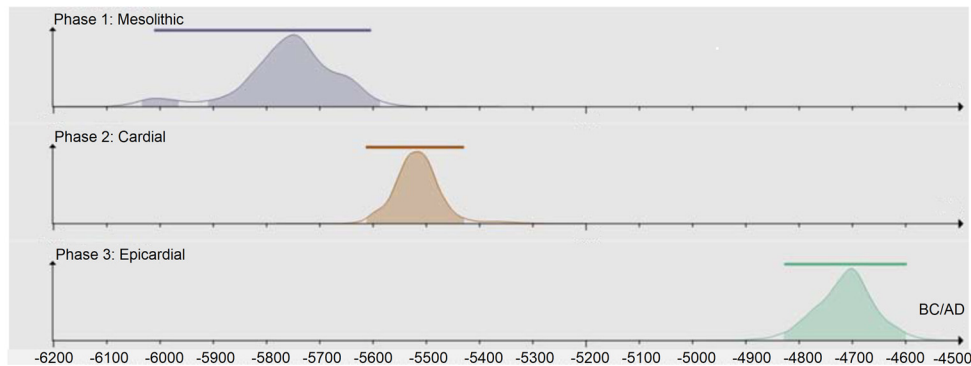
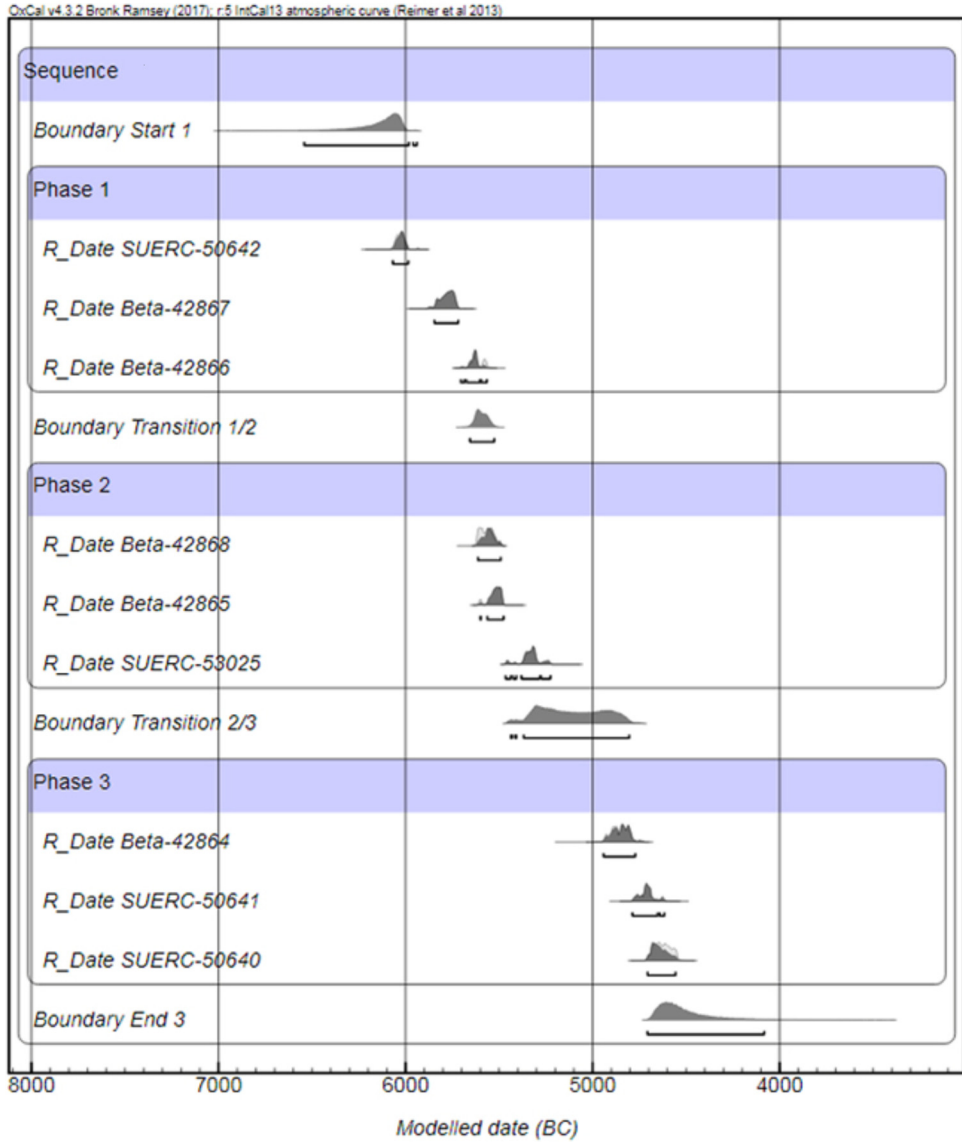


Figure 7: Model of phases of Coves del Fem (Chronomodel 1.5.0) (Bogdanovic et al., 2017).

in progress. That is the reason why the preliminary results of the research are presented in this article. At the moment, 111 of the piles and horizontal timber logs have been cross-dated, providing a floating dendrochronological sequence that covers an interval of 265 years. The dendrochronological sequence could

not be correlated with any other because there is currently no fixed dendrochronological sequence that continues from the Neolithic period up to the present for the northeastern part of the Iberian Peninsula.

The preservation of the last growth ring (*cambium*) in the 61 piles used to build the wooden platforms during the oldest phase of occupation in La Draga has allowed determining that most of them were cut in the same year and season. The dated piles come from the various sectors of the site, which is why the hypothesis is raised that the wooden platform or platforms on which the dwellings were built were distributed throughout the excavated area and that they were built at the same moment. First of all, the analysis of the global diagram shows that all sectors (A, B–D, and C) are occupied at the same cut-off year, the year 237 of the floating chronology (Figure 8). That is, the settlers of La Draga constructed their dwellings at the same time. This evidence is quite unusual at the moment. In Switzerland (and throughout the Alpine Arch) sites dating to the early Neolithic period, settlements are generally smaller and their rate of growth is relatively slow and taken out by neighbourhood. Similar processes are documented for more recent settlements like Cortaillod-Est – dating of the Final Bronze (Arnold, 1986; Gassmann, 1984).

The last phase of cut includes 26 samples that correspond to reinforcement and repairs of the structures (platforms and/or dwellings). These samples come from all the excavated sectors. All of them were cut between the years 241 and 265, which suggests a minimum duration of 28 years for the settlement's life.

The ^{14}C AMS dates of 14 of these piles allow us to correlate the chronology of the site construction and the phases identified during the excavation according to stratigraphy and the radiocarbon chronology. In all cases, the last ring of the pile has been dated, which has made possible to determine with greater precision the date of construction of the wooden platform. In one of the piles, the ^{14}C dating does not agree with the dendrochronological results, which is due to a problem of contamination by microorganisms. It, therefore, has been discarded from the Bayesian model.

In the diagram, the dated samples correspond to both the construction of the platform and the subsequent repairs (Figure 8). The six oaks from the initial construction in the year 237 come from four oak stands of different ages. Oak stiffeners made from 241 to 265 come from at least two oak stands.

According to the annual ring growth, between three and five oak forests were exploited. The age of the forest and the anatomical features of the annual rings suggest that this forest was managed before the occupation of La Draga, probably by a population invisible until now in the archaeological record of the region.

4.3 La Draga Radiocarbon Dating

The 40 ^{14}C AMS dates (Table 1 and Figure 9) were documented throughout the excavated sectors A, B, D and C. The dates come from faunal remains, seeds, and 14 of them from horizontal piles and timber logs (Andreaki *et al.*, 2020). Except for an aberrant date around 3700 cal BC, the other dates correspond to the early Neolithic period. This way, a first Bayesian model was built in order to estimate the probability of the different documented stratigraphic events, which are summarised in Figure 10.

The best estimation suggests a 68% confidence interval between 5301 and 5229 cal BC for the moment of construction of the platform and for the first use of the wooden pile dwellings. The temporal distance between the cutting moment of the logs and successive moments of repair of the original platform can be determined, dendrochronologically, in around 29–30 years. It is less than the calibrated error estimated using radiocarbon dates. At least one date on a cereal seed is located in this interval and can be related directly to the repair of the wooden piles. According to the model, the moment of construction associated with wooden pile dwellings, their repair, and use (*Platform*) could be placed in the confidence interval at 68% interval of 5292–5216 cal BC.

The subsequent use of the platforms (*Post-platform*) corresponds to at least four stratigraphically contemporary events documented in sectors A, B–D, and C and dated at 68% interval of 5213–5085 cal BC.

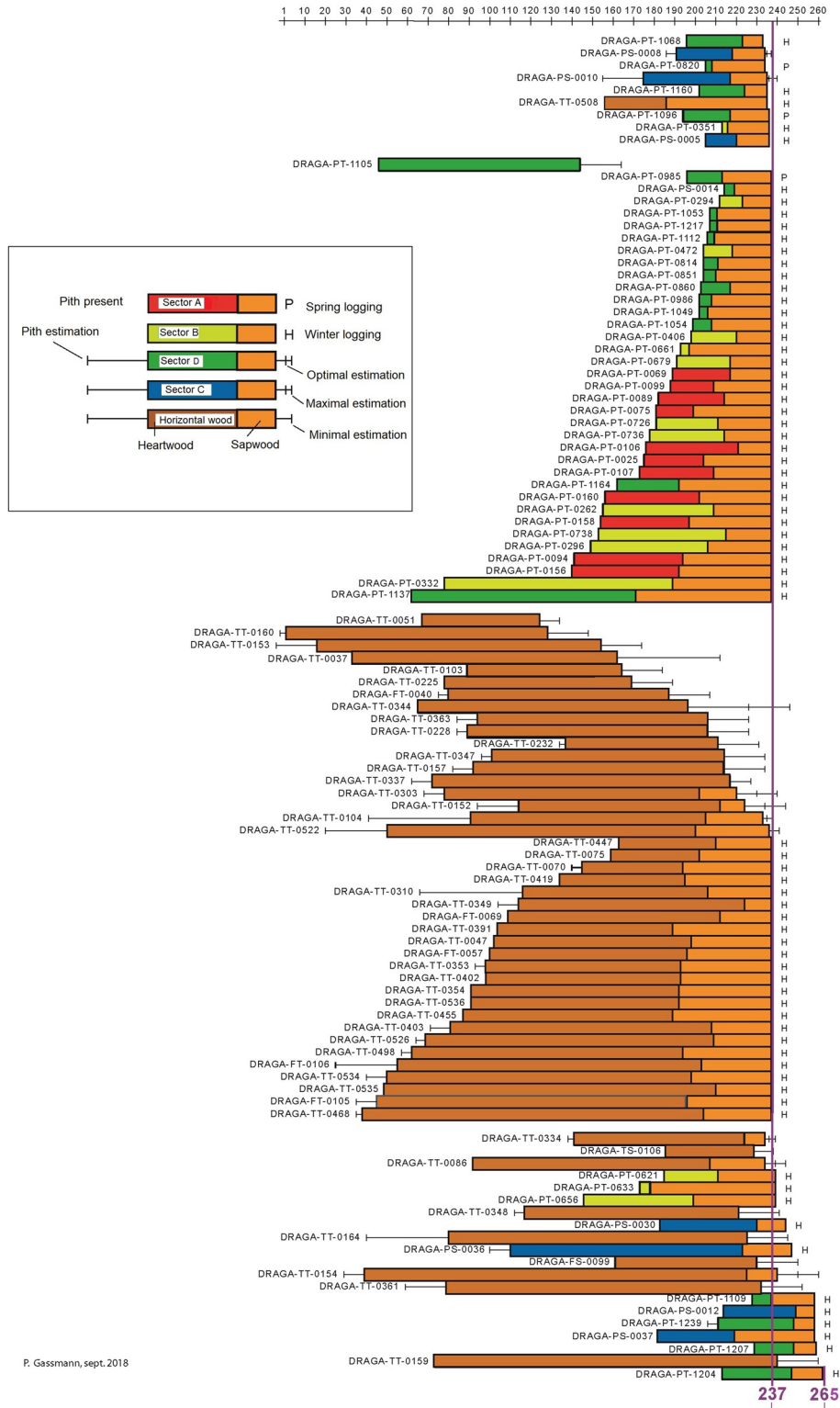


Figure 8: Results of the dendrochronological analysis of the piles and horizontal wood from La Draga.

After the construction and use of the wooden platforms during the first occupations, a reoccupation of the site has been documented, characterised by its stratigraphic association with anthropic accumulations of building blocks of limestone tuff –travertine – and not with wooden structures. The new occupation,

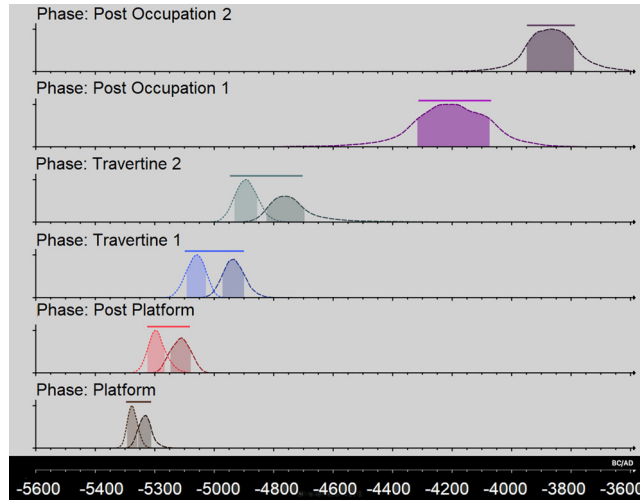


Figure 10: Distribution of probability densities (68% confidence interval) of the respective occupations in the site of La Draga (Andreaki et al., 2020).

5 Fems and La Draga in the Frame of the Early Neolithic of Northeast of Iberia

La Draga and Coves del Fem, the two presented sites in this article, offer some interesting data for the understanding of the models of the Neolithisation process in the region. They present clear differences with respect to this process.

In the case of Coves del Fem, the Neolithic occupation reaches chronologically very close to the Mesolithic occupation as it happens in other sites located at the basin of the Ebro river. The site presents a complete chronostratigraphic sequence covering this transitional period, including some occupations attributable to the 6000–5500 cal BC period. In this case, however, the little excavated area neither allows the technological and cultural affiliation of the Mesolithic layers to be absolutely precise, nor helps to determine a possible relationship with the geometric settlements of the Ebro valley, dating close to the Neolithic period. In Northeastern Iberia, the late Mesolithic evidence documented so far (Can Sadurní, Bauma del Serrat del Pont, and Font del Ros) was characterised by notches and denticulate lithic assemblages; however, all these sites are located at the northern part of the territory, in the prelitoral ranges and the Pre-Pyrenees (Figure 1). The only exception is Cova del Vidre, the only site with geometrics that is placed at the low Ebro Basin. It is noteworthy that Coves del Fem is also placed in the Ebro Basin.

The same rock shelter was occupied later by a population with a very distinct technology. The cardial pottery is well represented, which suggests the arrival of the farmers at the area very early around 5623–5221 cal BC. However, despite the introduction of Neolithic elements, there is a continuity in the exploitation of faunal resources, as the same wild taxa occur throughout the sequence: *Cervus elaphus*, *Oryctolagus cuniculus*, and *Capra pyrenaica* (pers. communication M. Saña). The place where the site is located is not very appropriate for agriculture, as the rock shelter is located in a narrow canyon of the Montsant river. So far, scarce evidence of cultivation has been documented at the oldest Neolithic layers, although the archaeobotanical remains are still under study. The state of the current research does not allow yet determine the relationship between these early farmers and the last hunter–gatherer population. Later, Coves del Fem was recurrently occupied by farmers who dug silos and pits and built combustion structures probably related to the heat treatment of siliceous rocks, in order to improve their properties for knapping. The abundance of siliceous rocks in the area probably was one of the main attraction for the reoccupation of the shelter.

In the case of La Draga, the construction of a settlement of considerable dimensions by a Neolithic population occurred in a place without previous Mesolithic occupation. Evidence of the Mesolithic

population is also absent in the closest area. Not far from La Draga is placed the site of La Bauma del Serrat del Pont (Alcalde & Saña, 2017) where the cardial layers, dated 5480–5380 cal BC, lay directly over the Mesolithic layers, dated 6300–6060 cal BC, which confirms the chronological distance of more than 500 hundred years between both occupations.

The lack of previous archaeological evidence suggests, in this case, the colonisation of a previously unoccupied territory. This colonisation implied such a massive felling of trees, both to construct dwellings and to enable cultivation fields, which had a significant impact on the environment (López-Bultó, 2019; Revelles *et al.*, 2014, 2015). Although the dendrochronological analysis has provided evidence of another interesting fact: the felled trees correspond to different forests, one of which was already cut 200 years before and the other one about 40 years before the construction of the platform. These data are very interesting because they show that a significant amount of human activity took place in the surroundings of La Draga before the first documented occupation at the site. It is very possible that this mass felling of the forest corresponds to the activity of Neolithic populations of which we have no other data. That is, the first Neolithic population settled at the lake surroundings before the dates that the archaeological evidence suggests. The evidence of forest management prior to the first occupation of La Draga supports the hypothesis of an early neolithisation in the region, also suggested by the chronology of the early Neolithic layer of the abovementioned site of La Bauma del Serrat del Pont (5480–5380 cal BC).

The earliest occupation of La Draga was performed by people carrying all the Neolithic kit. They completely depended on the cultivation of cereals and livestock breeding, whose remains are abundant in the site (Antolín, 2016; Saña, 2011). Moreover, they had a deep knowledge of local resources, both biotic and abiotic, that allowed them to remain in the same place for such a long period of time as well as to reoccupy the same place several times after a short interval of time.

To sum up, La Draga and Coves del Fem are examples of clearly different processes of Neolithisation between the northern and the southern parts of the Northeastern Iberia, on one side, regarding the relationship between the last hunter–gatherers and the arrival of the first farmers and on the other, the pattern of settlement or the economic strategies. Coves del Fem can be related to the sites of the Ebro Basin with respect to the close chronological distance between the last hunter–gatherers and the first farmers, and the pattern of settlement was characterised by the reoccupation of rock shelters. Unfortunately, due to the current state of the research, we are not able to characterise with more precision the technological tradition of these hunter–gatherer groups. The case of La Draga, on the other hand, confirms that the Neolithisation in the northern part was characterised by the arrival of people who colonised a previously unoccupied or scarcely occupied region. The first occupants, carrying cardial pottery, settled shortly after their first arrival at the Mediterranean littoral region and as a result, introduced the Neolithic way of life and its material culture to all the Pyrenean and pre-Pyrenean lands.

Nevertheless, the data allow us to reflect on the limitations of interpreting complex processes such as those of a regional occupation, at the time. We only have indirect data of the presence of a Neolithic population, more numerous and with a greater capacity to modify the environment than hunter–gatherer societies, surely much less numerous and also less intrusive. Of course, we cannot conclude that the absence of data from a Mesolithic population means an absolute population gap.

6 Conclusion

The radiocarbon dates of Coves del Fem and La Draga support the existence of two different models of neolithisation in Northeastern Iberia. In the southern part of the territory, the site of Coves del Fem suggests that the Holocene hunter–gatherers remained in the area until the arrival of the first farmers, in a model similar to that observed in the Ebro Basin. The early farmer occupation lays over the Mesolithic layers and the radiocarbon dates suggest that both occupations are close in time.

On the contrary, the site of La Draga supports the hypothesis that the first farmers colonised a previously unoccupied territory carrying already with them all the Neolithic kit. There is a gap of more than 500

hundred years between the late Mesolithic layers dated in the area and the first farmer evidence. However, according to the dendrochronological results, the first farmers probably arrived at the lake surroundings before the date suggested by the current radiocarbon dates, and shortly after their first arrival to the Mediterranean littoral.

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