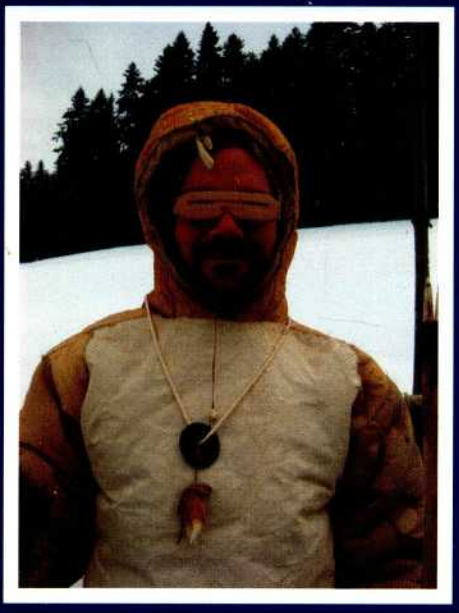
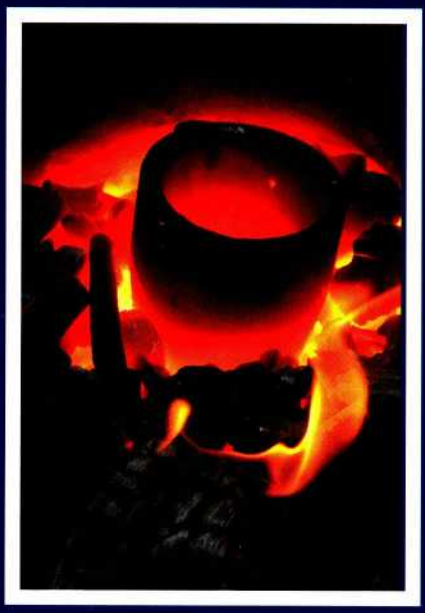
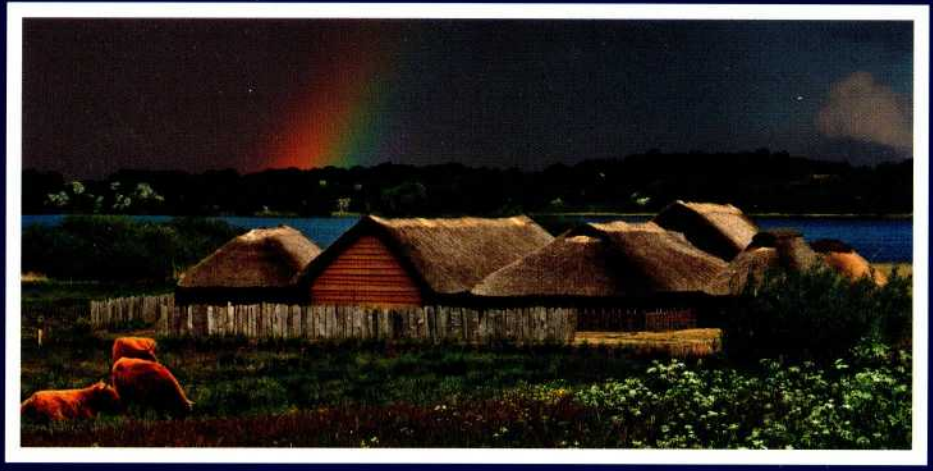
# EXPERIMENTELLE ARCHÄOLOGIE

## in Europa

BILANZ 2012







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EXPERIMENTELLE ARCHÄOLOGIE IN EUROPA
BILANZ 2012
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Herausgegeben von Gunter Schöbel
und der Europäischen Vereinigung zur
Förderung der Experimentellen
Archäologie / European Association for
the advancement of archaeology by
experiment e.V.

in Zusammenarbeit mit dem
Pfahlbaumuseum Unteruhldingen,
Strandpromenade 6,
88690 Unteruhldingen-Mühlhofen,
Deutschland

# EXPERIMENTELLE ARCHÄOLOGIE IN EUROPA

## BILANZ 2012



Unteruhldingen 2012

Gedruckt mit Mitteln der Europäischen Vereinigung zur Förderung der Experimentellen Archäologie / European Association for the advancement of archaeology by experiment e.V.

| | |
|---|---|
| Redaktion: | Ulrike Weller, Thomas Lessig-Weller, Erica Hanning, Brigitte Strugalla-Voltz |
| Textverarbeitung und Layout: | Ulrike Weller, Claudia Merthen Thomas Lessig-Weller |
| Bildbearbeitung: | Ulrike Weller |
| Umschlaggestaltung: | Thomas Lessig-Weller, Ulrike Weller |

Umschlagbilder: Markus Klek, Frank Trommer, Ute Drews

Bibliographische Information der Deutschen Bibliothek

Die Deutsche Bibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliographie, detaillierte bibliographische Daten sind im Internet abrufbar unter: http:\\dnb.dbb.de

ISBN 978-3-9813625-7-2


Gedruckt bei: Beltz Bad Langensalza GmbH, 99941 Bad Langensalza, Deutschland

# INHALT

## Rekonstruierende Archäologie

## Vermittlung und Theorie



## Kurzberichte



## Jahresbericht

Experimentelle Archäologie in Europa - Bilanz 2012, S. 56-65
Kategorie: Experiment und Versuch

# Woodworking technology and functional experimentation in the Neolithic site of La Draga (Banyoles, Spain)

Oriol López, Raquel Piqué, Antoni Palomo

***Zusammenfassung*** *– „La Draga" ist ein vom Wasser eingeschlossenes Gebiet in Banyoles (im Nordosten der iberischen Halbinsel). Die anaeroben Gegebenheiten bieten eine unglaubliche Art der Konservierung von organischen sowie hölzernen Überresten. Die ältesten Siedlungen in diesem Gebiet sind von 5.300-5.130 v. Chr. (frühes Neolithikum).*
*Wir haben ein experimentelles Programm entwickelt, dass durch den Nachbau und die Konstruktion der hölzernen Artefakte sowie die Benutzung dieser Gegenstände Aufschluss über ihren genauen Gebrauch und Nutzen liefern soll. Wir benutzen dieses Programm ebenso um die unterschiedliche morphologische Beschaffenheit sowie die Gebrauchsspuren der Gegenstände besser zu erkennen und die Artefakte besser zuordnen zu können.*
*Mit diesem experimentellen Programm war es uns somit möglich, die verschiedenen Schritte des Arbeitsablaufes der Holzwerkzeuge zu verstehen und die verschiedenen Gebrauchsspuren im Abgleich mit den nachgebildeten Werkzeugen an den Gegenständen zu charakterisieren.*

## Introduction (La Draga)

The site of La Draga is located in the north-east of Iberia, on the eastern shore of the "Estany de Banyoles" (Banyoles Lake), a small lake 50 km from the Mediterranean coast and 40 km south of the Pyrenees (*Fig. 1*). It was discered in 1990 and has been excavated from 1990 to 2005, and again from 2010 to 2012, under the direction of the Museu Arqueològic Comarcal de Banyoles (MACB) and the Centre d'Arqueologia Subaquàtica de Catalunya (CASC). Recently, the research team has been enlarged with the participation of the Consejo Superior de Investigaciones Científicas (CSIC), the Universitat Autònoma de Barcelona (UAB) and the Museu Arqueològic de Catalunya (MAC).
The lake is a karst landform and is fed by underground waters. Originally it was drained on its eastern side by a small river. This river, as it exited the lake, must have created an area of marshes on the northern shore, which is the location of La Draga archaeological site. During the Neolithic occupation this shore would have been in the form of a peninsula which stretched out into the lake, with a gentle continuous slope, from east to west and from north to south. According to the surveys which have been carried out, it is believed that the settlement

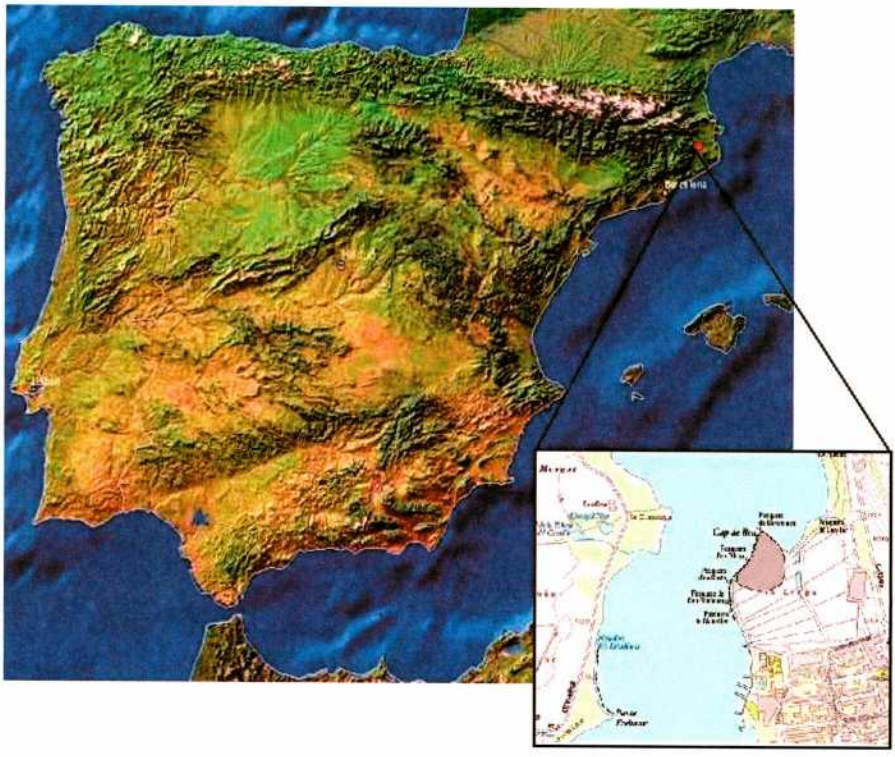

*Fig. 1: Situation of La Draga and Banyoles in the Iberian Peninsula.*

occupied an area of about 8000 m$^2$.

The archaeological excavations carried out to date have documented a habitation level situated immediately above the lacustrine chalk, which corresponds to an occupation by a Neolithic population linked to the Cardial Culture (Bosch, Chinchilla, Torrus 2006; Bosch, Chinchilla, Torrus 2011) (*Fig. 2*). Numerous radiocarbon dates have been obtained from samples of wood, bone and charcoal, whose results place the oldest occupation between 5.300 and 5.000 cal BC. Equally, based on the dendrochronological analysis of wooden posts, we may consider that the occupation perhaps went through different phases, during a period of approximately 80 or 100 years.

Above this habitation layer are the remains of a more recent, and possibly less important, occupation, dating to the beginning of fifth millennium cal BC. At the moment this second occupation, in contrast with the first, seems to have been located further from the shore and higher above the lake. In areas closer to the lake this level appears to be very diffuse. In these areas, some of the structures dug in the ground affected the earlier archaeological level.

The location of the site does not seem to have been chosen at random and corresponds to a pattern that is repeated in early Neolithic occupations in the western Mediterranean. They are wetland locations, on the shores of lakes, lagoons or marshes, yet close to agricultural land. This pattern has been clearly documented in Italy (La Marmota) (Fugazzola,

*Fig. 2: Capture of the last excavation season.*

D'Eugenio, Pessina 1993), southern France (Leucate) (Guilaine, Freises, Montjardin 1984), by lakes in the Alps and the Jura, and inland in the Iberian Peninsula (Rojo et al. 2008).

The fact that the site is now partially covered by the waters of the lake has favoured the extraordinary state of conservation of organic remains made from plant matter, which range from the wooden posts in the buildings to the smallest objects made or gathered by the occupants. We can highlight dozens of wooden utensils, of types that are repeated in different modules and sizes (Bosch, Chinchilla, Torrus 2006). Of all these, the most important are agricultural tools (pointed sticks and sickles), building tools (adzes, wedges), hunting instruments (bows, arrows, spears) and domestic utensils (wooden bowls, baskets made from aquatic plants, mixers, combs, spindles, spoons and spatulas).

In the area nearest the shore of the lake, in the Cardial level, the archaeological excavation has recovered hundreds of posts that supported large huts, sunk in the ground to depths of over 2 metres. Next to these, small posts or stakes correspond to complementary structures. The archaeological layer has accumulated all the wood from the collapse of the huts, including several boards, fragments of ropes made from plant matter and rolls of lianas used to hold together the different building elements (posts, beams and boards). Additionally, fragments of oak bark have been found and these may have been part of the roofs or the floors of the huts.

At the base of the stratigraphy, we believe that the large huts that surrounded the lakeshore stood a little above the original ground level (the lacustrine chalk). This building method would have avoided flooding if the level of the lake rose. It is not surprising, therefore, that no hearths are found in this area (any there might have been inside the huts would have disintegrated at the time of the collapse of the huts). However, we should note that accumulations of charcoal and cobblestones affected by heat have been found, and these are the result of the hearths inside the huts being cleaned out while the huts were in use.

In contrast, in the area furthest from the lake, as it is at a higher altitude, the present-day phreatic level lies below the archaeological level. Therefore, the only plant remains that have been preserved are the posts located 40 cm below this archaeological level. Since it was a much

drier area it was possible to build dozens of hearths directly on the ground, in hollows that are full of charcoal and quartz and sandstone cobbles. Some structures built directly on the ground, like the two hut pavements made with travertine flagstones, were aimed at insulating the hut floor from the damp.

Due to the good preservation of organic material it has been possible to analyse thousands of samples of plant remains that, together with fauna remains, provide exceptional information about the subsistence of the first farming communities. The population of La Draga primarily practised agriculture and animal-husbandry, whilst hunting and the gathering of wild plants was a secondary activity. Cereals like wheat and barley would have made up the main agricultural base, always accompanied by pulses such as peas and broad beans (Buxo, Rovira, Saüch 2000; Antolin, Buxo 2011).

The excellent state of conservation of the organic matter allows us to study aspects of reaping techniques that cannot be inferred solely from the analysis of lithic artefacts, which are all that are normally preserved at most archaeological sites. Nevertheless wood material should be preserved in order to stop the degradation process once out of the archaeological level. In the case of La Draga the wooden implements were lyophilized (freeze-dried) and stored in a controlled ambient (Aguer 2006).

All this makes La Draga a privileged place to carry out subsistence, technological or even experimental studies in order to understand these first Neolithic populations in the western Mediterranean in greater depth. The excellent state of conservation of the organic matter allows the study of different aspects of woodworking techniques that cannot be inferred solely from the analysis of lithic artefacts.

The aim of the experimental process is to understand the way those wooden tools were made, how and why were they used, and also difference between the different types of traces (tool-marks and use wear).

In order to reach those objectives an experimental program was developed based on replicating the technological process of production of those wooden artefacts, and contrasting its functional hypothesis. This paper focuses on the agricultural tools (pointed sticks and sickles), as well as the adzes, which are the most abundant type of tools at the site.

## Study of the technological process of the agricultural tools of La Draga

### Raw materials

The determination of the raw materials is the first step in the study of the wooden artefacts. The aim is to determine both the taxon and the anatomical part of the tree or bush used, in order to establish regularities and recurrences in which certain properties of the material were taken advantage of (flexibility, strength, resistance,...), as well as how much effort was invested in order to obtain the support. In the experimental program is very important to work with the same raw materials as the ones that are found at the archaeological site. In this way it is possible to more fully understand the elaboration process and to contrast the efficiency of those materials for certain uses. The observation of those features in the archaeological material have made it

possible to consider hypothesis about the process of obtaining these raw materials that have been used as a base for the development of the experimental program.
The raw material used in La Draga is diverse; at least 17 taxa were used to manufacture the wooden objects (Bosch, Chinchilla, Torrus 2006).

The artefacts' fabrication

Once the raw materials have been studied, the next step in the analysis of the artefacts is to establish the fabrication hypothesis of those artefacts. The hypothesis can be formed from observing the different tool marks that can be seen on the artefacts' surface and that have been produced during the different steps of the elaboration process. Even though the tool marks can be hidden because of other tool marks or use-wear, enough information can be obtained about the different actions that have produced it.
During visual inspection of the archaeological tools from La Draga it was possible to identify different kinds of tool marks. Depending the size and shape of those marks, it was possible to distinguish between the ones produced during the splitting process, the use of the adze, or even the surface regularization process by polishing.
The aim of this experimentation was to verify the hypothesis about the different processes that produced those tool marks. In order to do these two different artefacts from La Draga site were reconstructed: a double pointed stick, and an adze. For this experimentation the kind of tools that can be found on the archaeological site were used, such as wooden wedges of boxwood (Buxus

*Fig. 3: Fabrication of an adze: snapping the trunk.*

sempervirens), a wooden hammer and an adze with an oak handle and a hornfels blade. These tools were specifically made for the experimental work. Below are the details of the protocol followed during the construction of the adze handle and the pointed stick.

Adze handle

First of all the pine branch must be split longitudinally (*Fig. 3*). This was done using silex chips, wooden wedges and a wooden hammer. Once the piece of wood was split to an adequate size, the excess wood was eliminated with the hornfels adze blade. The tool marks from this part of the process could not be observed in the archaeological adze handles due to the perfect polished finished that can be found on the surface of those tools. So, afterwards, this adze replica was polished with a piece of sandstone (Palomo et al. 2011).

Double pointed stick

The case of the pointed sticks is slightly different, because of the large variety of this tool that are found at the site:

*Fig. 4: Fabrication of a pointed stick: rough-hew.*

examples with one pointed end and the other with a bevelled edge, only one pointed end, two bevelled edges, and so on. Even a wide range of sizes and the raw materials can also be found. It was decided to replicate the elaboration process of one of the pointed sticks which had one pointed end and the other one bevelled. Moreover in these kinds of tools, a notch with unknown function can be found in the central part of the "body".

For this reproduction boxwood (Buxus sempervirens) was used, because it is the only species that was used for the double-pointed sticks. The same tools that were used for the adze handle were also here: flint chips, boxwood wedges and hammer and an adze.

The branch was again split longitudinally. But in this case this process was repeated at least three more times in order to obtain the adequate size. Afterwards the surplus of wood was eliminated with an adze until the pieced reached the desired size and shape (*Fig. 4*). Following the archaeological example, the ends were then polished (PALOMO ET AL. 2011).

The experimental work allowed the verification of the elaboration process hypothesis that was made from the observation of the archaeological tools, and at the same time provided new data about the initial steps of the splitting of the wood (which are not so obvious in the tool mark). Likewise the amount of time invested in the creation of the tool could also be studied. Additionally the waste produced by this work could also be characterized, which could then be used to distinguish between tools and working waste.

The artefacts' function

Another of the factors that was to be studied was the function of the archaeological wooden tools. As stated, before their function was inferred from ethnographic and archaeological parallels. However, the wood suffers a certain kind of wear, due to the use, the so-called use-wear. That's why experimentation is fundamental in order to understand the different actions that have produced certain use-wear, and therefore the function of those wooden artefacts. The aim of using an experimental approach was to compare and contrast the most likely hypotheses.

The pointed sticks of La Draga are one of the artefact types that needed to be checked. At first glance, based on ethnographic parallels, it was thought that they were digging sticks, related with the agricultural task of removing the soil before sowing. Based on this hypothesis the reconstructed pointed sticks were used for this task: removing soil. This process not only had the aim to ascertain the efficiency of those tools in this specific activity, but also to obtain a good record of the use-wear that this "removing the soil" left on the active parts of the tool.

*Fig. 5: Use of a pointed stick to turn over the soil.*

Experimental work of removing the soil

This work was carried out on a 5x5 meter plot. The factors that were recorded include the time of use, and kind of work which was done. The main activity was driving the end of the stick into the soil and levering it up so it can be oxygenated (*Fig. 5*). One of the bi-pointed sticks was hafted as a pick as well, using the aforementioned central nick. Both the use of the pointed sticks as a digging stick as well as a pick (*Fig. 6*) turned out to be pretty effective. Although with the pick the work was faster, at the same time the impact at the end was also abrupt, meaning that this tool suffered much more abrasion that the other. This experimental process of using the pointed sticks has been also useful in order to obtain the required reference collection of use-wear, which can later be used in comparative studies of the archaeological tools.

The study of the tool marks and use-wear on the experimental tools

The technological, as well as the functional study of the archaeological wooden tools can't be performed without

*Fig. 6: Pointed stick as a pick.*

the use wear analysis. The objects of this analysis are the marks and traces that can be found on the tool's surface, which were produced during fabrication or use. This method has been considered as one of the most objective approaches to certain work processes so far. In this sense the use-wear and tool-marks analysis contribute very valid knowledge to the study of the production and reproduction social relations (CLEMENTE 1997).

On the surface of the tools two kinds of marks and scratches can be found: the technological ones made during the elaboration process (tool-marks), and the functional caused by the erosion use (use-wear). It is by the observation of the first type that we can infer what kind of tool was used to work the wood and in what way. And studying the second type of mark (use-wear) establishes what material these archaeological tools were used in and in which way.

In addition to these types of marks, ones produced by pre- and post depositional processes must also be taken into account (CLEMENTE 1997). If those are not well recognized, they will hide or even destroy the use-wear and tool marks. Furthermore, in order that this study can be developed, it is necessary to previously obtain an experimental reference collection of marks and

*Fig. 7: Tool-mark: adze mark.*

*Fig. 8: Use-wear: use starches.*

scratches. Experimentation in use wear studies is the only way in which the investigator can establish a comparative database so the hypothesis can be tested (GIBAJA 1993).

In agreement with those approaches the marks and scratches produced during the experimental processes were recorded. These different features were characterized so that they can be used in the future to identify similar marks on archaeological remains. These include:

- Tool marks such as splitting, adze marks, scratches and sanding marks (*Fig. 7*).
- Use-wear such as fractures, flattened areas, use polish, abrasion and also scratches (*Fig. 8-9*).

Problems in wood traceology analysis

Wood has different qualities than other raw materials in which the use wear

*Fig. 9: Use-wear: fracture.*

approach has traditionally been applied. That's why this methodology had to be adjusted for the peculiarities of wood. The wooden elements from a waterlogged site like La Draga are as much valuable as they are weak, meaning that they must undergo a certain amount of restoration (AGUER 2006). However, during this restoration process of the archaeological material, some of the marks and scratches are distorted and became unrecognisable. So the traceology has to be executed before restoration. Manipulation of the fragile archaeological material before its restoration has to be carried out very carefully. In order to solve this issue, work with 3D scanner and digital reconstruction (*Fig. 10*) has begun, but before that silicone and resin clays were used.

Conclusions

1) The experimental process has been used to test hypotheses about the production process of La Draga tools. It has been possible to establish the

*Fig. 10: 3D model of a pointed stick.*

different steps of the wood working process, as well as register the waste created during this process.

2) It was also possible to characterize the tool marks and use-wear from the experimental tools, even when the marks left from the first activities were erased or masked by the superposition of later ones.

3) The experimental approach proves that the technology and use study of the archaeological wooden tools can be done by the examination of the morphological features, as well as the marks and scratches from the tools surface.

4) The problems that the archaeological wood presents for its study can be solved with 3D scanning, or even with clay impressions. Both methods provide a copy of the artefact with enough quality so use wear analysis can be applied.

5) Additionally it is worth emphasizing that all of these experimental processes can be supplemented with other new proposal to the pedagogical project of the Neolithic Park from La Draga.

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ISBN 978-3-9813625-7-2