

## Identification by histology of wooden implements from two coastal prehistoric sites in the Casma Valley, Peru

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### Abstract

A sample of wooden implements that come from two pre-Hispanic sites in the Casma Valley (Bahía Seca and Huaynuná), among which fire starters stand out, were manufactured from wood, which histological analyses of the vascular anatomy indicated the use of *Prosopis* sp. wood “algarrobo”, using thick and thin secondary branches. These findings indicate that the generation of fire in pre-Hispanic times was carried out using technological knowledge and the use of wood, in this case using a species that has the characteristic of having resinous wood, favorable for the generation and obtaining of fire, a technology that would have extended over the period of 3,000 years in the prehistory of the Peruvian coast.

**Keywords:** Fire starters, wood, carob, Bahía Seca, Huaynuná

### Resumen

Una muestra de implementos de madera que provienen de dos sitios prehispánicos del valle de Casma (Bahía Seca y Huaynuná), dentro de los que destacan iniciadores de fuego fueron fabricados a partir de madera, que los análisis histológicos de la anatomía vascular indicaron el uso de madera de *Prosopis* sp. “algarrobo”, utilizando ramas secundarias gruesas y delgadas. Estos hallazgos indican que la generación del fuego en tiempos prehispánicos se realizó utilizando conocimientos tecnológicos, y que del uso de las maderas, en este caso el de utilizar una especie que tiene como característica tener madera resinosa, favorable para la generación y obtención de fuego, fue una tecnología que se habría extendido a lo largo de 3.000 años en la prehistoria de la costa peruana.

**Palabras clave:** Iniciadores de fuego, madera, algarrobo, Bahía Seca, Huaynuná

## Introduction

Archaeological sites on the Peruvian coast reveal various well-preserved archaeobotanical remains, especially wooden remains. Some wooden statues or idols have been studied from the perspective of the anatomy of their wood, to identify the tree from which it was made, as in the case of the Pachacamac idol, which is known to have been made from wood of "carob" *Prosopis* sp. (Sepúlveda et al, 2020). Another important idol, such as the one discovered in Huaca Cao Viejo, at the El Brujo archaeological complex, indicates that the species of tree from which its wood was used for its manufacture was *Pouteria lucuma* "lúcumo" (Franco and Gálvez, 2003).

As part of the 2018 season excavations of the Utzh An walled complex, of Chan Chan archaeological complex, 20 wooden sculpted statuettes were discovered, which were located within elaborate niches. Histological analyzes of the wood of the idols indicated the use of wood from *Prosopis pallida* "carob" and *Acacia* sp. "hawthorn" (Rosales et al, 2019).

In past decades, wooden implements, such as evidence of utensils, instruments, construction elements, objects that pre-Hispanic settlers used in their daily lives, did not present any interest and were described as "wooden artifacts", however a French specialist, Fanny Moutarde, began this type of studies on the north coast as part of her doctoral research, and her studies in wood and charcoal have made it possible to reconstruct the paleo-environment, the plant economy and the ritual world of these populations (Moutarde, 2007).

The objectives were to carry out the histological study of the wood and therefore identify the tree species that were used as raw material for the manufacture of these implements and also to know how the timber vegetation was used according to its features, for obtaining and efficiency of the implement manufactured in these sites and during their occupation in the Casma Valley.

### *Bahía Seca and Huaynuná*

Excavations carried out by Thomas Pozorski and Shelia Pozorski during the 1980s in various sites in the Casma Valley have allowed valuable wooden implements to be recovered from Bahía Seca and Huaynuná.

The Bahía Seca site, with an area of two hectares, is located on the shore of a fossil bay about 5 km north of the Casma River. This site was excavated during June and July 1989. This site has two main occupations, one during the Late Preceramic Period (2.500-2.000 years BC) and the other during the Early Period (2.000-1.000 years BC) (Pozorski and Pozorski, 1992: 848, 859).

During the Late Pre-ceramic Period the site was a small fishing village. During the Initial Period, the site was used as a small administrative center for the political entity of Sechín Alto to control the distribution of marine resources (Pozorski and Pozorski, 1991: 352-353, 1996: 345-347, 1998: 93). The main evidence for this interpretation

is the presence of a medium-sized stone mound containing a square box, an architectural unit associated with activities at almost all of the Initial Period sites in the Casma Valley (Pozorski and Pozorski, 2011). Near the end of the Initial Period the site had another occupation by people who used Las Haldas-type ceramics, decorated with scoring areas.

After 2.000 years, the site was briefly reoccupied approximately 1.000 years AD. by people of the Casma culture. Three wooden implements that we studied and identified their wood belong to the late reoccupation of the Bahía Seca site.

The second site from which the remaining wooden implements come is Huaynuná, with a total area of 11.5 hectares, located on the shore of the Pacific Ocean about 13 km north of the Casma Valley. This site was excavated in 1986 and 1989. The main occupation was during the Late Preceramic Period with minor reoccupations during the Initial Period, the Early Horizon (1.000-200 years BC) and the Late Intermediate Period (1.000-1.470 years AD) (Pozorski and Pozorski, 1990:17).

Associated with the pre-ceramic occupation of the site is a stone building with an area of 20 m by 20 m, built on a slope to a maximum elevation of 8 meters (Pozorski and Pozorski, 1990: 24; 1992: 849-850). This building has four terraces divided in the middle by a stone staircase. It is possible that this building was used for religious ceremonies or other public activities. When the building was abandoned near the end of the Late Preceramic Period, the site's occupants covered the building with garbage containing mollusks and especially barnacles (parrot beak). Two of the five wooden implements studied are from Huaynuná and come from this not very deep garbage deposition.

The other three artifacts examined belong to the Early Horizon occupation, which consists mainly of a midden that partially covers a stone building measuring about 12 m by 4 m. The three artifacts were found about 20-40 cm below the modern surface within this midden.

## **Materials and methods**

### **Samples**

Wooden implements from the Bahía Seca site There are three wooden implements for this site, and they have the following name:

C22A1-2=126 (fire-making implement, Fig. 1), C22A1-2=491 (excavating implement, figure 2) and C22A1-2=591 (worked wood, figure 3). These three wooden implements come from the depositions of superficial sediments (20-90 cm below the modern surface), affected by rainwater, that covered the mound containing the fourth square. The other artifacts and ceramics associated with the surface deposition indicate that these sediments belong to the Late Intermediate Period and the Casma culture about 1.000 years AD.



**Figure 1.** Fire-making implement, code C22A1-2=126 (Photo: Thomas and Shelia Pozorski)



**Figure 2.** Implements for digging, code C22A1-2=491 (Photo: Thomas and Shelia Pozorski)



**Figure 3.** Worked wood implement, code C22A1-2=591 (Photo: Thomas and Shelia Pozorski)

### Wooden implements from the Huaynuná site

From the Huaynuná site, there are five wooden implements, and they have the following denomination: C3B1-7=980 (digging stick, Fig. 4) and C3B1-7=1146 (digging stick, Fig. 5). These two wooden implements come from the surface deposition on top of the building with four terraces. The other artifacts associated with this deposition and the absence of ceramics indicate that these wooden artifacts belong to the Late Preceramic Period.



**Figure 4.** Wooden digging implement, code C3B1-7=980 (Photo: Thomas and Shelia Pozorski)



**Figure 5.** Wooden digging implement, code C3B1-7=1146 (Photo: Thomas and Shelia Pozorski)

The remaining three elements are: C3B1-29=33 (fire-making implement, Fig. 6), C3B1-29=39 (fire-making implement, Fig. 7) and C3B1-29=156 (fire-making implement, figure 8). These three wooden implements come from the garbage that partially covers a stone building. The artifacts were discovered about 20-40 cm below the modern surface. The other artifacts and pottery associated with this trash belong to the Early Horizon and, by association, the wooden implements as well.



**Figure 6.** Fire-making implement, code C3B1-29=33 (Photo: Thomas and Shelia Pozorski)



**Figure 7.** Implements for making fire, code C3B1-29=39 (Photo: Thomas and Shelia Pozorski)



**Figure 8.** Fire-making implement, code C3B1-29=156 (Photo: Thomas and Shelia Pozorski)

### *Treatment and taxonomic identification*

The wood samples of the studied implements were obtained from the parts that had old breaks. The wood samples were sectioned transversely and longitudinally to aid in the taxonomic identification of the wood from the cellular tissues. The vascular anatomy of wood is based on the observation and characterization of different cell types (fibers, parenchyma, vessels, etc.) in the secondary xylem of the wood. These

may include size, quantity, arrangement, opening types, and cell wall properties, among other elements. The observations were made in two planes or anatomical sections: transverse and longitudinal-tangential, to allow each element to be examined in its entirety, since some characteristics can only be seen in specific planes (Esau, 1995). Taxa can be differentiated based on the specific combination of several criteria or traits displayed by specific elements of the cellular tissue. This allow the identification down to the species level, for taxa that feature peculiar and distinctive elements.

For a make most precise identification, we had access to modern and ancient comparative samples of tree species native to the northern and central coast. Wood samples are usually prepared by obtaining a thin section of the used wood fragment for visualization under a reflected light stereomicroscope.

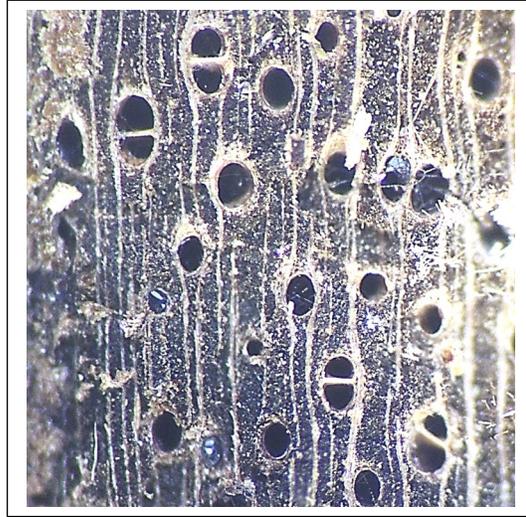
Once the best section that showed the desired characteristics for identification was obtained, a microphotographic record was made with a CANON EOS Rebel T3i 18 Megapixel camera, and then the images were analyzed on a computer screen, with images of the vascular anatomy. from the comparative woods of native trees and the database <https://insidewood.lib.ncsu.edu>

## Results and discussion

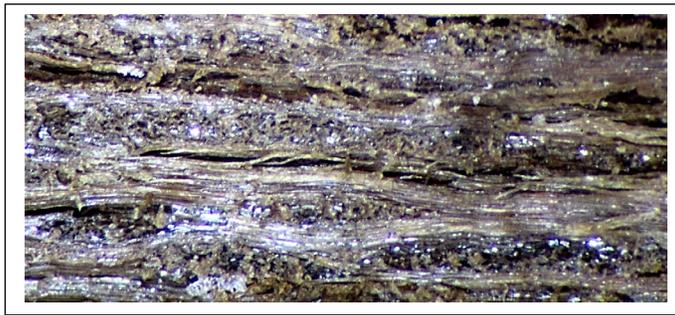
The wood samples from the Huaynuná and Bahía Seca implements are composed of heteroxylar log wood, with diffuse porosity, hard and resinous, such as the wood of *Prosopis sp.* "carob tree" identified in seven implements, and one wooden implement, also of diffuse porosity, without the presence of resin, with muciparous substances, easy to carve, which due to its anatomical-vascular characteristics corresponded to *Pouteria lucuma* "lúcumo" (Table 1).

Table 1. Wooden implements, taxonomic identification and origin according to sites

Sitios	Código	Descripción	Identificación taxonómica	Nombre común
Bahía Seca	C22A1-2=126	Implemento para hacer fuego	<i>Prosopis sp.</i>	"algarrobo"
	C22A1-2=491	Implemento para excavar	<i>Prosopis sp.</i>	"algarrobo"
	C22A1-2=591	Madera trabajada	<i>Prosopis sp.</i>	"algarrobo"
Huaynuná	C3B1-7=980	Implemento para excavar	<i>Pouteria lucuma</i>	"lúcumo"
	C3B1-7=1146	Implemento para excavar	<i>Prosopis sp.</i>	"algarrobo"
	C3B1-29=33	Implemento para hacer fuego	<i>Prosopis sp.</i>	"algarrobo"
	C3B1-29=39	Implemento para hacer fuego	<i>Prosopis sp.</i>	"algarrobo"
	C3B1-29=156	Implemento para hacer fuego	<i>Prosopis sp.</i>	"algarrobo"



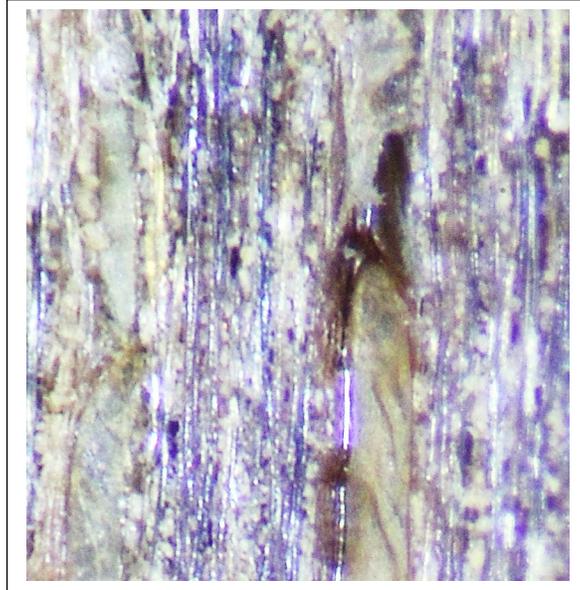
**Figure 9.** Cross section of the wooden implements identified as *Prosopis* sp. "carob tree"



**Figure 10.** Longitudinal section of the wooden implements identified as *Prosopis* sp. "carob tree"



**Figure 11.** Cross section of the wooden implement identified as *Pouteria lucuma* "lúcumo"



**Figure 12.** Longitudinal section of the wooden implement identified as *Pouteria lucuma* “lúcumo”

Regarding the histological characteristics of the identified wooden implements, the wood of *Prosopis sp.* “carob” in cross section (Fig. 9), has 21 visible vessels, no tyloses and the axial parenchyma is vasicentric and presents traits of wood from juvenile trees. They feature simple perforation plates and the fossae between the vessels are alternate, from oval to angular, they present frequent geniculate vessels, and in longitudinal section, they show very evident irregular deviations (Fig. 10).

According to the described characteristics of the vascular anatomy of these woods, they are from the Leguminosae family (Fabaceae), and with a high probability of *Prosopis sp.* and possibly *Prosopis pallida*, which is the endemic species that grows in the forests of the northern and central coast of Peru.

The digging implement that comes from Huaynuná was manufactured from *Pouteria lucuma* “lúcumo”, a wood of diffuse porosity, with large vessels of uniform distribution, surrounded by developed fibers, with medullary rays, diffuse axial parenchyma in aggregates ( Fig. 11), with simple perforated plates, shape of alternating polygonal wells (Fig. 12). These features correspond to the Sapotaceae family and being the “lúcumo” a fruit tree with wood that is easy to carve, the identification has no doubts.

### *Fire Starters*

In this study, four implements stand out for making fire using the friction method. One of them is a “stick” made from a secondary “carob” branch, which is polished

and has traces of use at the ends (Fig. 1), and comes from the Bahía Seca site, associated with artifacts and ceramics from the Casma culture, about 1.000 years AD.

The other three implements for making fire come from Huaynuná, The first one (Fig. 6) is a portion of a secondary, thicker branch, which has five holes where the stick described above would fit (Fig. 1), where due to friction by the oscillating movements made with the hands cause the fire to start. This implement did not show signs of burns but did show signs of use. The second sample is made up of three implements, one (top of Fig. 7) is a fire starter in the process of being manufactured, because the bark of the secondary branch has not yet been removed and only a hole has been manufactured to make the friction. The other implements of this sample are two sticks similar to the Bahía Seca sample, also made from secondary branches, with the ends used (middle and bottom of Fig. 7).

The third implement is a starter that has four holes made in a wider wooden base, This one shows traces of fire inside the holes and it is partially incomplete (Fig. 8). These wooden implements come from an accumulation of trash with other artifacts and pottery of the Early Horizon (1.400 years BC to 100 years BC).

In the Andean world there are two documented ways of making fire, One is from the highlands, where three plants were used: branches of *Polylepis* “queñoa”, woody bushes of *Parastrephia spp.* “tola” and *Azorella compacta* “yareta”, a resinous plant, this plant being the main fuel in the Andes and has been identified through geoarcheological studies (Meinekat et al, 2023).

The resin is a complex mixture of chemical compounds that include terpenes, flavonoids, alkaloids, phenolic compounds, among others, which are highly flammable, For this reason the “carob” tree is the ideal wood for making fire starters, because the resin contained in wood is an ideal ally for the origin of fire.

On the pre-Hispanic coast, there must be various remains of fire starters made of wood, but unfortunately, they have not been studied and reported, except for the case of a fire starter evidenced in the excavations in Uripe, which was analyzed by Dr. Abundio Sagastegui (Botanical) and identified as carob. According to Rosales and Figueroa (1982), the starter and its rubbing stick were found on top of a Chimú pot, in a domestic kitchen context. This implies that the use of these artifacts to make fire would have a long history on the Peruvian coast, approximately 3.000 years.

The other wooden implements would have had a digging function; however, they may have had other various uses. The recurrent identification of the use of the wood of the “carob” *Prosopis sp.* possibly *Prosopis pallida*, which has also been identified at the coal level, which confirms its usefulness as fuel. These trees were surely covering the adjacent landscape of Bahía Seca and Huaynuná, and their record is very extensive throughout the prehistory of the Peruvian coast.

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