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# The Archaeobotany and Ethnobotany of Portuguese or White Crowberry (*Corema album* (L.) D. Don)

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**Abstract** Portuguese crowberry (*Corema album* (L.) D. Don) is a shrub considered endemic to the Atlantic coastal dunes of the Iberian Peninsula. For many reasons, among which the most prominent are habitat loss and competition from invasive species, but possibly also due to overexploitation, the survival of several of its populations is now compromised. By promoting the identification of its archaeobotanical remains and gathering information about its past uses, the current need for conservation is emphasized. The plant has been exploited for its berries since at least the Early Neolithic and the species features in a number of historical written sources. Archaeological sites located within its current natural distribution area have yielded relatively abundant archaeobotanical finds. This evidence suggests that its distribution area was much larger in the past and has decreased rapidly in recent decades. Its archaeological importance may be misrepresented due to issues with identification, particularly outside its current distribution area. It is hoped that this paper will contribute to a higher identification rate of archaeobotanical remains of this plant, eventually leading to a more thorough recognition of its past importance and contributing to its present conservation.

**Resumen** La camariña (*Corema album*) es un arbusto considerado auctóctono de las dunas de la costa atlántica de la península Ibérica. Varias de las poblaciones de esta planta están actualmente en peligro de extinción por una serie de razones entre las que destacan la destrucción del hábitat, la sobreexplotación y la desventaja competitiva frente a especies invasoras. Este artículo tiene como objetivo facilitar la identificación de esta planta en el registro arqueológico, y recopilar evidencias de su uso en el pasado y para su conservación presente. Las sociedades humanas han explotado las bayas de esta planta desde, al menos, el Neolítico Inicial. Existen abundantes citas de su hallazgo en yacimientos arqueológicos localizados dentro de su área de distribución actual y en fuentes históricas. Diversas evidencias apuntan a que este área de distribución fue mucho más amplia en el pasado y que se ha visto rápidamente reducida en épocas recientes. La importancia de esta planta ha podido estar infravalorada debido a problemas de identificación, particularmente fuera de su área de distribución actual. Se espera que este artículo contribuya a incrementar las identificaciones arqueobotánicas de esta planta, el reconocimiento de su importancia en el pasado y recoger datos que puedan ser utilizados en la prevención de su extinción.

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## Introduction

*Corema album* (Portuguese crowberry, Ericaceae) is a long-lived evergreen understory shrub which rarely grows more than 1 m in height. Fruiting starts in spring and the fruits ripen in summer but remain on the plants until autumn (Álvarez-Cansino et al. 2013) or even winter (Marques 2007). Female shrubs show a huge variation in fruit crop (from tens to tens of thousands of fruits; Piazzon et al. 2012). The fruits are spherical white or pink-white berries between 5 and 10 mm in diameter (Figure 1, A). Seed size is positively correlated with fruit size and germination occurs after one to four years' dormancy (Larrinaga and Guitián 2016). A wide range of frugivores

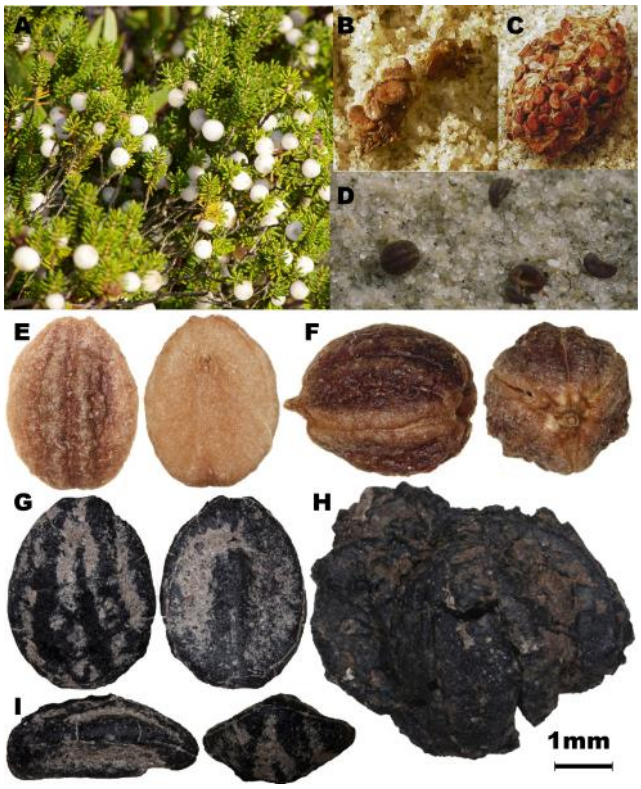


**Figure 1** *Corema album*: A) berries (by Júlio Reis); B, C) bird (blackbird, B, and seagull, C) pellets with seeds (by María Calviño Cancela); D) ant-predated seeds (by María Calviño Cancela); E) dorsal and ventral view of a fresh seed; F) defleshed fruit with three seeds; G) dorsal and ventral view of archaeological charred seed from S. Pedro de Canaferrim (López-Dóriga 2015-2016); H) archaeological charred crushed fruit from Lapiás das Lameiras (López-Dóriga 2015-2016); and I) lateral and transversal view of archaeological charred seed from S. Pedro de Canaferrim.

(lizards, deer, rabbits, and hares, foxes, boars, badgers, blackbirds, and seagulls) are important agents for the dispersal of the seeds (Figure 1, B-C), either through defecation or regurgitation (Calviño-Cancela and Martín-Herrero 2009). Rodents and passerines are also important seed predators (Figure 1, D; Piazzon et al. 2012). Each fruit has three (exceptionally four or two) elongated seeds, ± 500 μm in length, with a thick woody endocarp. The seeds have six dorsal vittae, a roughly elliptical section, and a convex ventral side in which the hilum and an orifice are located (Figure 1, E-I; Aedo and Castroviejo 2012; Bugalhão and Queiroz 2005; Pérez-Jordà et al. 2017; Queiroz and Mateus 2011; Villar 1993)[1]. Wood, leaf, and stem anatomy are described by Carlquist (1989) and Queiroz and van der Burgh (1989), and pollen grain morphology by Kim et al. (1988) and Mateus (1989). The uniformity of Ericaceae pollen grains and wood may prevent precise taxonomic determinations of both where poor preservation of seeds and fruit occurs.

The Portuguese crowberry is endemic to the Southern European Atlantic coast; it is vulnerable or at risk of disappearance due to habitat loss, competition from invasive species, and possibly overexploitation (Clavijo et al. 2002; Gil López 2011; Sánchez García 2000). The genus *Corema* is distributed on both sides of the Atlantic Ocean, showing a typical amphi-Atlantic distribution pattern (León-González et al. 2013). Its habitat is coastal, ranging from sea level up to 50 masl. It is frequently associated with stone pine (*Pinus pinea*) and juniper (*Juniperus phoenicea*) formations, and other plants such as lentisc (*Pistacia lentiscus*), heather (*Calluna vulgaris*), rockrose (*Cistus crispus, Halimium* sp.), and gorse (*Ulex* sp.). It is drought-adapted and thrives in a broad range of habitats (Álvarez-Cansino et al. 2013), from bare stabilized sand dunes to cliff systems. Its current distribution (Figure 2) is mostly limited to the Azores archipelago and the Iberian Peninsula, from the North of Galicia to Gibraltar in the south, where several place names derive from the common name of the plant (Fernández de la Cigoña 1988; Gil López 2011). Due to its endangered status, many are concerned with understanding trends in the distribution and reproduction of the population (e.g., Álvarez-Cansino et al. 2013; Fernández de la Cigoña 1988). Several pieces of evidence could hint to a much wider distribution in the past: a Pleistocene find in Britain (Parfitt et al. 2005), the success of the introduction in a wider area of possibly naturalized populations in Western France (Bock 2016; Lainz 1971; Villar 1993), an isolated relict population in the Mediterranean coast of the Iberian peninsula (Aguilella and Laguna 2009), some potentially native populations, now possibly extinct, in the North of Africa (Euro+Med Plantbase 2016), and the current distribution of *Empetrum nigrum,* a very closely related taxon. Within this current distribution, only two populations of Portuguese crowberry remain with male and female individuals in all age ranges, while the other populations are isolated and composed of old individuals and are thus condemned to extinction unless conservation measures are taken (Aguilella and Laguna 2009).

The edible berries of the Portuguese crowberry have been highly appreciated and exploited in contemporary times (Gil López 2011). It is thus possible that over-exploitation may have contributed to its endangered status. Current archaeobotanical research is expanding the record on the importance of this plant in human culture, dating back as far as the Early Neolithic (sixth millennium cal BCE). Still, its archaeobotanical importance is likely imperfectly understood due to misidentification resulting from a lack of awareness of its potential presence in the archaeological record. The purpose of this paper is to gather data about the past uses of this plant as well as its archaeological distribution, in order to demonstrate its longstanding importance in human subsistence, and to facilitate further identifications in the archaeological record that may aid in understanding its past distribution and the extent of the human impact leading to its current status. The use of environmental archaeological data, including both zooarchaeological and archaeobotanical evidence, can contribute essential information for biodiversity conservation (e.g. Wolverton and Lyman 2012), as has been already shown for the case of ancient crops (e.g. Padulosi et al. 1996).

## Material and Methods

In this paper, all published records of archaeological finds of *C. album* have been compiled (Table 1, Figure 2), including sites with both charred and waterlogged preservation of plant remains. In addition, some previously unpublished references have been cited. The archaeological contexts and archaeobotanical assemblages are summarily described with the purpose of discussing the taphonomic processes involved. All finds described were recovered at archaeological sites where specific techniques for the retrieval of plant remains were employed, specifically sediment processing with small meshes (minimum 0.3 or 0.25 mm), either by flotation (López-Dóriga 2015-2016), wet-sieving (Bugalhão and Queiroz 2005), or wash-over (Carruthers 2014). Ethnobotanical references on past uses have been compiled with the aim of understanding the extent of the human interactions with this plant, since the scope of these uses may have been greatly reduced in recent times as a result of its endangered status and limited distribution. These references have been mostly obtained through historical metasearch engines, both for scientific and vernacular nomenclature, including a wide range of variations and synonyms (Table 2).

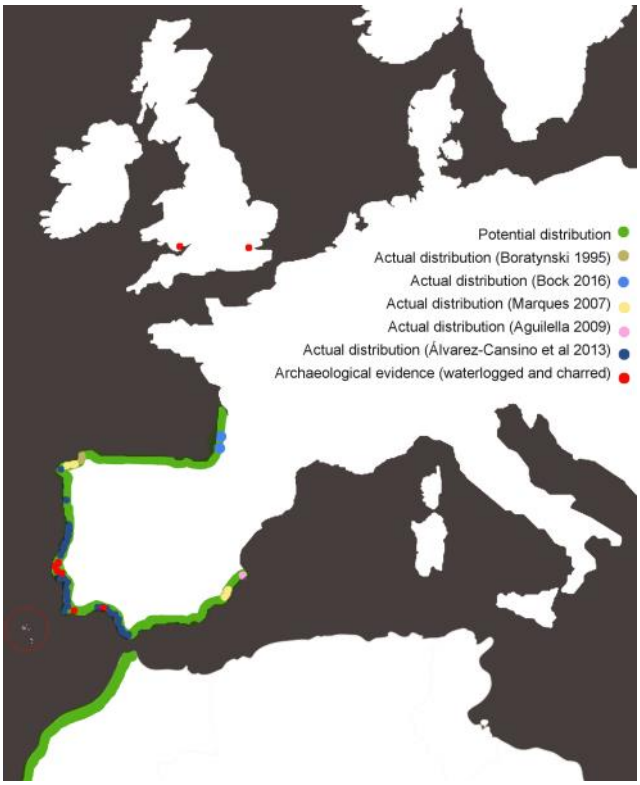


**Figure 2** Current and potential distributions of *Corema album* with plotted archaeological records. Note: The potential distribution is a minimum estimate based on the current distribution areas recorded in most references (Aedo and Castroviejo 2012; Álvarez-Cansino et al. 2013; Boratyński and de la Puente 1995; Marques 2007), including relict (Aguilella et al. 2009) or successfully introduced and naturalized (Bock 2016) populations outside the frequently cited range.

Nomenclature follows the *Flora Iberica* (Castroviejo 1986-2012) for wild plants and traditional archaeobotanical literature for domesticated cereal taxa.

## Archaeobotanical Evidence

Remains of Portuguese crowberry have been found in the archaeological record in different forms (both macro and microremains) and preserved by different processes (waterlogging and charring), from a range of sites dating from the Palaeolithic to the Modern period in Western Europe (Table 1).

### *Non-Woody Plant Macroremains*

The earliest record of crowberry is fossil plant macroremains, found where the plant is no longer

**Table 1** Summary of the occurrences of *Corema album* plant macroremains in the archaeobotanical record.

| Site | Location | Chronology | Type of evidence | Type of preservation | Type of deposit | Sampling | Quantity (seed total / fruit total) | References |
|---|---|---|---|---|---|---|---|---|
| Pakefield-Kessingland | United Kingdom | Pleistocene | Macroremain (seeds) | Fossil | Channel | ? | ? | Parfitt et al. 2005 |
| São Pedro de Canaferrim | Sintra, Portugal | Early Neolithic (*ca*. 5400 cal BCE) | Macroremain (seeds) | Carbonized | Pit with domestic refuse | 95% sediment | 6/1 | López-Dóriga 2015-2016 |
| Lapiás das Lameiras | Sintra, Portugal | Early Neolithic (*ca*. 5200 cal BCE) | Macroremain (seeds) | Carbonized | Pit with domestic refuse | 95% sediment | 9/0 | López-Dóriga 2015-2016 |
| Zambujal | Torres Vedras, Portugal | Chalcolithic | Macroremain (wood) | Carbonized | ? | Unknown % | — | Hopf 1981 |
| Alcalar | Portimã, Portugal | Chalcolithic | Macroremain (seeds) | Carbonized | Domestic refuse | 79 samples | 4/10 | Stika and Heiss 2014 |
| Calle Concepción | Huelva, Spain | Phoenician ($9^{th}$-$8^{th}$ centuries cal BCE) | Macroremain (seeds) | Waterlogged | Domestic refuse & natural accumulation? | 11 samples (unknown %) | 145/0 | Pérez-Jordà et al. 2017 |
| Alto da Vigia | Lisbon, Portugal | Andalusian (older than $12^{th}$ century CE) | Macroremain (seeds) | Carbonized | Pits with domestic refuse | 10 samples (unknown %) + 17 samples of a total of 87 l. (100%) | 13(*)/0 | Jesus et al. 2017 |
| Núcleo Arqueológico da Rua dos Correeiros | Lisbon, Portugal | Andalusian ($5^{th}$-$9^{th}$ centuries CE) | Macroremain (seeds) | Waterlogged | Cesspit | 250 $cm^3$ (~7%) | 4/0 | Bugalhão and Queiroz 2005 |

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| Site | Location | Chronology | Type of evidence | Type of preservation | Type of deposit | Sampling | Quantity (seed total / fruit total) | References |
|---|---|---|---|---|---|---|---|---|
| Casa dos Bicos | Lisbon, Portugal | Medieval | Macroremain (seeds) | Waterlogged | Cess and domestic refuse | 5 samples of 100-200 g. (unknown %) | ? | Queiroz and Mateus 2011 |
| Newport Medieval Ship (ship 467) | Newport, United Kingdom | Late Medieval (fifteenth century CE - 1468) | Macroremain (seeds) | Waterlogged | Ship cargo/ dunnage | 31 samples analyzed of 0.15-7.6 l. (unknown %) | 11(*)/0 | Carruthers 2014 |
| Praça do Municípi-o | Lisbon, Portugal | Modern (16th century CE) | Macroremain (seeds) | Waterlogged | Gully with domestic refuse | ~5% | ? | Mateus, Queiroz and van Leeuwaarden 2003 |

(*) Alto da Vigia: as this is currently under study, absolute numbers are not yet available; Newport Medieval Ship: the number of Corema album seeds may be an underestimation since a total of 109 samples were assessed but only 31 were analyzed and quantified. The original reference for Praca Município is not accessible and the secondary reference does not mention the quantity.

**Table 2** Common synonyms of scientific and vernacular names for *Corema album*.

| Scientific | Vernacular | | | | |
|---|---|---|---|---|---|
| | **English** | **Castilian** | **Galician** | **Portuguese** | **French** |
| *Corema album* | Portuguese crowberry | camarina | marmaeira | camarinha | Corèma blanc |
| *Corema alba* | Portugal crakeberry | camarine | camarineira | camarinheira | genièvre doux |
| *Empetrum album* | White crowberry | comarina | caramineira | | camarine à fruits blancs |
| *Empetrum lusitanicum* | White-berried heath | camarillera | camariñeira | | camarigne blanche |
| *Empetrum erectum* | | camariña | caramiñeira | | camarine blanche |
| *Erica erecta baccias candidis* | | caramiña | | | Grande bruyere à baies blanches |
| *Erica baccifera lusitanica* | | camariñera | | | |
| *Euleucum album* | | | | | |

present, in interglacial deposits in the British Isles (Parfitt et al. 2005). Charred plant macroremains determined as *C. album* have been found at the Early Neolithic sites of São Pedro de Canaferrim and Lapiás das Lameiras in Sintra, Portugal (López-Dóriga 2015-2016). Abundant detached seeds, a crushed fruit (a crust of three seeds attached to a fleshy thin mesocarp), and a possible whole crowberry fruit were found at these sites. The remains were misidentified as *Crataegus* sp. in a preliminary presentation of results (López-Dóriga 2015-2016). The assemblages from which this taxon was recovered were rich in remains from domesticates, particularly naked wheat (*Triticum aestivum/T. durum/T. turgidum*) and naked barley (*Hordeum vulgare* var. *nudum*), and both emmer (*Triticum dicoccum*) and einkorn (*Triticum monococcum*) were present in small quantities. A range of legumes, including wild (*Medicago* sp./*Melilotus* sp./*Trifolium* sp., *Vicia* cf. *cracca*) and possibly domesticated species such as garden pea and broad bean (*Pisum sativum, Vicia faba*), were also identified. Remains of other fruits in the assemblages belonged to dwarf palm (*Chamaerops humilis*), black nightshade (*Solanum nigrum*), and possibly deadly nightshade (cf. *Atropa belladonna*). Seeds of wild plants included oat grass (*Avena* sp.), crucifers (*Brassica* sp./*Sinapis* sp.), goosefoot (*Chenopodium* sp.), and mallows (Malvaceae). The assemblages were recovered from the fills of a series of pits in which the by-products of domestic activities had been discarded. Radiocarbon dates on some of the cereal crop remains have provided a chronology of occupation in the second half of the sixth millennium cal BCE (*ca.* 5400 for Lapiás das Lameiras and *ca.* 5200 for São Pedro de Canaferrim).

Several charred fruit and seeds of *C. album* have also been identified at the Chalcolithic settlement of Alcalar in Southern Iberia (Portimão, Portugal; Stika and Heiss 2014). Full publication of these results is in preparation (Stika, in prep.). More than one hundred waterlogged seeds of *C. album* have been identified at Calle Concepción, Huelva, Spain (Pérez-Jordà et al. 2017). This Phoenician site dates to the transition from the ninth to the eight century cal BCE, with the majority of the plant remains being preserved by waterlogging, and only minimal examples of charred preservation. The earliest evidence of arboriculture in the Iberian Peninsula has been firmly attested in the area of Huelva in the assemblages from Concepción and Núñez Méndez. The two sites comprise long-cultivated, or intensively managed, fruit tree species such as grape (*Vitis vinifera*), olive (*Olea europaea*), and fig (*Ficus carica*), as well as new exotic species such as almond (*Prunus dulcis*), pomegranate (*Punica granatum*), and melon (*Cucumis melo*). The cultivated fruit taxa

dominate both assemblages but other domesticated taxa, such as cereals (barley, wheat, and broomcorn millet [*Panicum miliaceum*]), legumes (lentil [*Lens culinaris*], pea, and broad bean) and oil plants (flax [*Linum usitatissimum*], poppy [*Papaver somniferum*]) are also present. *C. album* is presented amongst the list of wild edible fruits recovered at the site, which could have been intentionally exploited as well as have accumulated naturally, along with dwarf palm, stone pine, and pine (*Pinus halepensis/pinaster*), oak (*Quercus* sp.), blackberry (*Rubus ulmifolius*), myrtle (*Myrtus communis*), and lentisc. A long list of other wild plants, ruderals, and weeds were also identified.

Núcleo Arqueológico da Rua dos Correeiros (Lisbon, Portugal) is a site that evidences occupation from the fifth to the nineteenth centuries CE. A few waterlogged seeds of *C. album* were recovered in a small sediment sample taken from the bottom layer of a Roman tank reused as a cesspit during the Andalusian period (Bugalhão and Queiroz 2005). Although the type of preservation of organic remains on site is not specified, the nature of the assemblage, including insect remains and the density of fruit remains in the soil, suggests anoxic conditions such as waterlogging. Other plant macroremains in the assemblage are dominated by fruit remains, including fig, black mulberry (*Morus nigra)*, grape, plum (*Prunus domestica*), raspberry (*Rubus idaeus*), strawberry (*Fragaria vesca*), melon (*Cucumis melo*), and cucumber (*Cucumis sativus*); also present are fiber or oil plants such as flax, flavorings, such as wild celery (*Apium graveolens*), and other wild plants, such as goosefoot, common chickweed (*Stellaria media*), heath (*Erica* sp.), and grasses (including *Poa annua*).

Several carbonized seeds of *C. album* have also been identified in samples obtained from pits at the Andalusian site Alto da Vigia, Praia das Maçãs, Sintra, Portugal (Jesus et al. 2017). This multiperiod site, with occupation evidence from a Roman sanctuary to a sixteenth century CE tower, preserved the remains of an Andalusian *ribat* (hospice) occupation until the twelfth century CE. Although the Andalusian evidence is truncated due to the reuse of the construction stone for the postmedieval tower, copious deposits pointing to the preparation and consumption of shellfish in hearths were identified, in addition to four pits with charred plant remains. Three of the pits exhibit the typical pear or bell-shape associated with storage functions, and were poor in plant remains (n=<20); the fourth pit was rectangular in plan and was exceptionally rich in plant remains (more than 50,000 in 4 small samples). The study was ongoing at the time of publication, so no absolute numbers were available for the features, but remains belonging to more than 15 taxa had been identified, including grains of cereals such as wheat, barley, and broomcorn millet, as well as possible weeds such as catchfly (*Silene* sp.), cornsalad (*Valerianella* sp.), and heath leaves.

Casa dos Bicos (Lisbon) is an urban site containing medieval deposits of possible mixed faecal and domestic rubbish origin, in which waterlogged seeds and pollen grains from Portuguese crowberry were found (Queiroz and Mateus 2011), together with many other taxa including fruits and nuts, flavourings and other wild and cultivated plants, and fish remains. Other plant remains in the deposit include fruits and nuts such as stone pine, walnut (*Juglans regia*), acorn, almonds, plums or cherries (*Prunus* spp.), olive, fig, strawberry, black mulberry, grape, raspberry, and blackberry. In addition, seeds from aromatic herbs, such as parsley (*Petroselinum segetum*), wild celery, coriander (*Coriandrum sativum*), rosemary (*Rosmarinus officinalis*), lavender (*Lavandula pedunculata*), thyme (*Thymus* sp.), mint (*Mentha pulegium*), myrtle, cowbane (*Cicuta virosa*), and black mustard (*Brassica nigra*) have been found. Other food plant remains included broomcorn millet, carrot (*Daucus carota*), and cauliflower (*Brassica oleracea*), while a range of wild plants, considered potential weeds, such as purslane (*Portulaca oleracea*), stinging nettle (*Urtica dioica*), knotgrass (*Polygonum aviculare*), goosefoot, and pigweed (*Amaranthus* sp.) were also present.

At the Newport Medieval Ship site (ship 467), Wales, United Kingdom, waterlogged seeds of *C. album* have also been recovered (not identified at the time of publication, and therefore referred to as "Unidentified common items B" in Carruthers 2014, but subsequently identified by Carruthers as crowberry, pers. comm.). These seeds were possibly associated with dunnage (vegetation used as packaging and located in the bottom of the ship), or may have originated from edible berries consumed on the ship and present as sewage. The majority of the plants recovered from the samples likely originated from southern Portugal or Spain. There are several pieces of evidence to suggest this is the region from which the ship originally set sail and the archaeobotanical assemblage is entirely consistent with this geographical area. The vegetation probably used as

dunnage consisted of heathers from species from Southern Europe (*Juniperus navicularis* or *J. oxycedrus, Calluna vulgaris,* and *Erica* spp.), together with bracken (*Pteridium aquilinum*), broom (*Genista/Cytisus*), gorse spine (*Ulex* sp.), hawthorn (*Crataegus* sp.), birch (*Betula pendula*), alder (*Alnus glutinosa*), and willow (*Salix* sp.). Other plant remains present in the assemblages appear to have been discarded food waste or spillage from previous cargoes, and were also indicative of a southern European, probably Iberian, diet: broomcorn millet, pomegranate, walnut, grape, fig, stone pine nut, and possibly olive and cherry or plum. In addition, cereals such as rye (*Secale cereale*), hard/rivet wheat (*T. durum*/T. *turgidum*), and oats; legumes such as pea and broad bean; and fruits such as hazelnut (*Corylus avellana*), apple (*Malus sylvestris*), and blackberry were found. Components found in smaller quantities included aromatic herbs such as fennel (*Foeniculum vulgare*), wild celery, coriander, crucifers, carrot, and teasel (*Dipsacus* sp.), as well as flax, hemp (*Cannabis sativa*), and hop (*Humulus lupulus*).

Finally, the site Praça do Município in Lisbon, with deposits dated to the sixteenth century, provided waterlogged *C. album* fruit or seed remains (Mateus, Queiroz and van Leeuwaarden 2003). The deposit has been characterized as part food detritus, with possible faecal contribution, and was rich in other fruits such as fig, grape, cherry, plum, and blackberry.

*Other Archaeobotanical Evidence*

Pollen grains have been reported at several Holocene archaeological sites and non-archaeological cores from the sixth millennium onwards in Iberia, such as El Asperillo, Huelva, Spain (Stevenson 1984), among others, and locations in southern Portugal (Queiroz 2004).

Charred and uncharred leaf-needles, preliminary identified as *Erica* sp. but admittedly potentially from crowberry (Stika, pers. comm.), have been found at core drillings on deposits formed during the fifth millennium cal BCE in the Rio Sizandro, Torres Vedras, Portugal (Dambeck et al. 2010). Undetermined Ericaceae-type leaves, again admittedly potentially from crowberry (Carruthers, pers. comm.) have been also recovered at the Newport Medieval Ship site (ship 467) (Carruthers 2014).

A wood charcoal find of *C. album* has been reported in the anthracological samples from the 1970s excavations at the Chalcolithic hillfort site of Castro do Zambujal, Torres Vedras, Portugal (Hopf 1981), together with wood charcoal from *Pinus* sp., *Quercus* sp., *Olea europaea, Arbutus unedo, Crataegus* sp., *Pistacia* sp., *Vitis vinifera, Fraxinus* sp., *Chamaerops humilis, Cistus* sp., *Alnus* sp., *Celtis australis, Populus* sp., *Tilia* sp. and *Viscum album*. Unfortunately, the charred plant remains from those samples were not analyzed and therefore it is not known if crowberry seeds or fruits were also present. Some of these woody taxa were also found as remains of seeds and fruits in the samples from the new excavations (beginning in the 1990s) in different areas of the site (Stika, pers. comm.), but seeds or fruit of *C. album*.

**Ethnobotanical Evidence**

*Current Use*

*Corema album* bears an edible fruit that can be eaten raw or cooked and which has been widely consumed in recent times and has even been the object of trade (Fernández de la Cigoña 1988). They have also been important foodstuffs for poor homesteads, as testifies their vernacular name of hunger herb (*herba da fame*), shared with other plants in Galician (Sóñora Gómez 1994).

The berries have a fresh, acidic taste and are often used as appetizers; they can also be made into acid-tasting lemonades, jams, and liquors (León-González et al. 2013). They have been eaten as part of a meal comprising milk and bread (Sóñora Gómez 1994). They can be gathered from July to December (Fernández de la Cigoña 1988).

Furthermore, fruits and fruit-derived beverages have been traditionally used as an antipyretic to treat fevers and as a vermifuge against pinworm infections (Font Quer 1985), and have proven effective against oxidative stress related diseases (León-González et al. 2013).

The dry woody branches of *C. album* have been used as fuel in kitchens and ovens due to the wood's high calorific power and its pleasant smell, which is thought to purify the air; brooms of tied branches have been also used to sweep floors and in floral ritual compositions, as it is believed they bring good luck (Fernández de la Cigoña 1988). It has been hypothesized that the genus name *Corema* of Greek origin might be related to their use as brooms (Villar 1993 in Castroviejo 1986-2012), for which they are particularly useful because the branches do not lose the leaves until long after drying (Sóñora Gómez 1994). Alternative etymological explanations suggest

the name derives from *homaria* or *jomaría* (meaning red) (Colmeiro 1870).

It has been used as an ornamental green fill plant (Sóñora Gómez 1994), particularly in religious ceremonies (Fernández de la Cigoña 1988). Portuguese crowberries are prominent in folklore songs and toponyms (Sóñora Gómez 1994), as well as in legends. Despite all the above, the plant's presence in ethnobotanical compilations of the Iberian Peninsula is infrequent or vague (de Cortes Sánchez-Mata and Tardío 2016).

*Historical Sources*

The distribution of Portuguese crowberries across the Atlantic coast of the Iberian Peninsula has been recorded in the botanical literature since the eighteenth century (Sóñora Gómez 1994). Since 1779, when it was first introduced to the United Kingdom at the Royal Botanic Gardens of Kew, and during the nineteenth and early twentieth centuries, it was grown as an ornamental shrub and featured in a wide range of popular nursery books (e.g., Sweet 1826). The plant was also grown in France (kept in greenhouses in winter; Desfontaines 1809), and contemporary botanical dictionaries suggest the plant was also known in Germany and Italy.

The fruits have traditionally been made into a refreshing acidic drink (Desfontaines 1809; Brehm 1880-1883) used as an antipyretic (Baillon 1867; Bellynck and Segovia y Corrales 1883-1885) and as a vermifuge (Gomez de Ortega 1784); its leaves were also used against scurvy (Hurtado de Mendoza 1840). In Estremadura, a region in southern Portugal, crowberries gathered at dawn on the last Sunday of August were thought to have special healing properties (Pimentel 1899). In Galicia, Northern Portugal, and Southern Spain, the berries were intensively gathered for commercial purposes during the first half of the twentieth century, when the distribution of the plant was broader (Gil López 2011). The branches have also been used as fuel in pottery production (Gomez de Ortega 1784).

## Discussion

Portuguese crowberry plant remains, in different preservation conditions, feature in several archaeological contexts across and outside of the current natural distribution area of the taxon, in sites with occupation deposits from the Early Neolithic to the Medieval period. Most of the archaeological records of *C. album* have originated in sites located within contemporary or recent distribution areas with only two finds recorded outside this area. It is, however, noteworthy that the current distribution likely does not accurately reflect the original breadth of distribution which may have stretched over a much larger area (Figure 2) based on a wide range of evidence, such as relict populations (Aguilella and Laguna 2009; Euro+Med Plantbase 2016) and recent naturalizations (Lainz 1971; Bock 2016). It is not only the references to the plant in the ethnobotanical historical literature that seem to have decreased in the last centuries, but also the scientific literature, produced throughout the last half century, which has witnessed progressive disappearance of Portuguese crowberry at an alarming pace (e.g., Álvarez-Cansino et al. 2013; Boratyński and de la Puente 1995; Marques 2007). This has led to the inclusion of the species in regional Red Lists of Threatened Species (Aguilella and Laguna 2009) and to research focused on the possible causes of its disappearance (Clavijo et al. 2002; Gil López 2011).

The oldest find of *C. album* in the archaeobotanical record is a Pleistocene fossil find in the Midlands, United Kingdom, dated to 700,000 yrs (Parfitt et al. 2005). This find could either evidence a much wider past distribution or the existence of events of long-distance dispersal by endozoochory. An alternative and remotely possible explanation for this find could be a rare case of contamination with recent material, potentially present in the area due to so-called "reintroduction" efforts (which consider the species to be previously native) that seem to have been made in the past century (Fernández de la Cigoña 1988), or due to its widespread cultivation as an ornamental plant two centuries ago (Sweet 1826).

Though an accidental presence may account for this particularly early find, it is unlikely to be the case in other archaeobotanical records, since Portuguese crowberry is and has been historically considered a useful plant in many respects: for medicinal, technological, or culinary purposes, whether raw, cooked, or transformed in products like jams and liquors (Gil-López 2011). Still, an accidental pathway should always be considered as a possibility for its presence in archaeological deposits, due to the potential arrival of the seeds in animal droppings or within the digestive system of hunted animals. Unfortunately, (from the archaeologist's point of view), as the plant is adapted to endozoochory, excreted seeds are usually intact (Calviño-Cancela,

pers. comm.; Piazzon et al. 2012; with the exception of badgers, which destroy them, Fedriani and Delibes 2009) and no macroscopic differences can be seen between digested and undigested seeds. Preservation does not vary according with differences in seed gut-passage time, in lizards (Piazzon et al. 2012), gulls, blackbirds, rabbits, and hares (Calviño-Cancela and Martín-Herrero 2009). Although the positive identification of pellets might be easily carried out, the only secure method for ruling out animal dispersal in the case of detached seeds would depend on potential microscopic traces which need to be further researched. Still, the contextual information for most of the archaeological finds to date is, in the case of the seeds, strongly suggestive of human intentionality. It is difficult to ascertain what type of technological uses could have been made of the branches and stems through the charred wood fragments (Hopf 1981), which only indicate the likely final use as fuel.

Archaeologically, the culinary use potentially documented as early as the Early Neolithic in the case of Lapiás das Lameiras, where a pressed berry was found (López-Dóriga 2015-2016). Further finds in assemblages with other edible plant remains and processing byproducts, such as Early Neolithic S. Pedro de Canaferrim (López-Dóriga 2015-2016) or Chalcolithic Alcalar (Stika and Heiss 2014) are also evocative of its intentional exploitation. Due to its recovery within an assemblage of plant remains strongly suggestive of arboricultural practices (Pérez-Jordà et al. 2017), it can be hypothesized that *C. album* might have also been the object of some sort of management in Phoenician times, together with grapevines, olive trees, pomegranates, and almond trees. Two exceptionally well preserved Medieval deposits in Lisbon, Rua dos Correeiros (Bugalhão and Queiroz 2005) and Casa dos Bicos (Queiroz and Mateus 2011), which were dominated by waterlogged assemblages of edible taxa with a very likely sewage origin, have provided unmistakable evidence of the use of the plant in Andalusian times. More examples have probably been found in other assemblages studied by these authors but for which grey literature reports are currently unavailable. In Rua dos Correeiros, a few seeds from a sediment sample accounting for just 7% of the total volume of the deposit could involve more than 50 seeds of crowberry in the whole deposit. The Andalusian case of Alto da Vigia (Jesus et al. 2017) is still under study and an interpretation cannot yet be made; however, the carbonized remains of crowberries, together with those of cereals, is strongly suggestive of processing. Portuguese crowberries were still exploited in the sixteenth century in Lisbon, as attested in the assemblage recovered from a gully with domestic refuse in Praça do Município (Mateus et al. 2003).

In addition, crowberry remains have been recently identified in the case of the Newport Medieval Ship site (reported as "Unidentified common items B" by Carruthers 2014), found in Wales, United Kingdom, but containing a cargo from the Iberian Peninsula. As Carruthers points out, the remains could correspond to sewage and the use of the berries as food, or the use of the branches as dunnage. A further, potentially more interesting explanation would be their deliberate use as an anti-scurvy medicine, a function recorded in some historical references (Hurtado de Mendoza 1840). This interesting find suggests the possibility of encountering the plant outside its natural distribution area as an object of trade, especially via the sea. Given the importance and the range of Iberian maritime trade in late medieval and early modern history, the potential presence of the taxon in the archaeological record is very high for many different parts of the world.

The role played by *C. album* in human interactions with the wild plant resources might have been until now undervalued due to scientific bias: crowberry remains found in archaeobotanical samples have likely remained in the category "indeterminate" or "unidentified" (e.g. Carruthers 2014). Although the plant remains can turn up far removed from the current habitat, as the case of Newport has shown, archaeobotanists knowledgeable in more general floras would have not necessarily been aware of its existence due to the fairly limited current distribution of the taxon and its rarity in modern botanical reference collections. In addition, difficulties in the taxonomic determination of wood remains and pollen grains from the Ericaceae and related families (Queiroz and van der Burgh 1989, Kim Nilsson and Praglowski 1988, Mateus 1989) hamper the identification of other types of remains in the archaeological record.

Further work is needed to correctly understand the past history of this plant, both for a better comprehension of its role in human subsistence but also for an additional insight into its current conservation problems. This work should include revisions of unidentified plant remains from assemblages of maritime archaeological origin from

anywhere with trading connections with the Iberian Peninsula and southwestern France, as well as from deposits of those regions themselves. Ethnobotanical references from earlier periods, such as Andalusian agricultural texts, also need to be researched further.

## Conclusions

*Corema album* has been an important plant in human culture since the Holocene, as attested in archaeological, historical, and ethnobotanical sources, and it still plays an important role, particularly in the folklore of older generations. Its historical importance is still not fully understood as it is possible the taxon has not always been correctly identified in the archaeobotanical record, nor cited in generalist ethnobotanical sources. This relative rarity of references is potentially a result of the limited current distribution of the plant and the lack of awareness among researchers from outside its habitat range. Unfortunately, this limited current distribution is likely a result of the species being currently threatened, due to a variety of reasons such as habitat loss and competition from invasive species, and possibly over-exploitation. This paper has reviewed the botanical, archaeobotanical, and ethnobotanical literature, with the aim to promote the identification of the taxon in the archaeobotanical record. It is also hoped that this paper has served to raise awareness of the need to preserve this important plant in our biodiversity heritage.

## Notes

[1]Comparative reference material for the identification of *C. album* seeds is available at the Laboratório de Paleoecologia e Arqueobotânica of the Directorate General for Cultural Heritage (DGPC, Lisbon, Portugal), at the Departament of Environmental Archaeology of the Research Center of Biodiversity and Genetic Resources of the University of Porto (Portugal), at the Bioarchaeology laboratory of the Cantabria International Institute for Prehistoric Research of the University of Cantabria (Spain), at the Institute of Botany of the University of Hohenheim (Germany) and at the Environmental Department at Wessex Archaeology LTD. (Salisbury, United Kingdom). Institutions qualifiying for collaboration through the *Index Seminum* may obtain reference material from the seed bank of the Tapada da Ajuda botanical garden in Lisbon (*Banco de Sementes Parque Botânico da Tapada da Ajuda*). Seeds gathered from the wild may be purchased (subject to seasonal availability) in Semillas Cantueso S.L.

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## References Cited

Aedo, C. and S. Castroviejo. 2012. *Proyecto Anthos: Sistema de Información de las Plantas de España* [web page]. URL: http://www.anthos.es/dispatch.es.html. Accessed on July 17, 2017.

Aguilella, A. S. F. and E. Laguna. 2009. *Catálogo Valenciano de Especies de Flora Amenazadas*. Colección Biodiversidad 18: Conselleria de Medi Ambient, Aigua, Urbanisme i Habitatge. Generalitat Valenciana, Valencia.

Álvarez-Cansino, L., M. Zunzunegui, M. Díaz Barradas, O. Correia, and M. Esquivias. 2013. Effects of Temperature and Rainfall Variation on Population Structure and Sexual Dimorphism Across the Geographical Range of a Dioecious Species. *Population Ecology* 55:135–146. DOI:10.1007/s10144-012-0336-3.

Baillon, H. 1867. *Histoire des Plantes*. Librairie Hachette, Paris. DOI:10.5962/bhl.title.40796.

Bellynck, A. and A. Segovia y Corrales. 1883-1885. *Curso Elemental de Botánica*. Escuela Tipográfica del Hospicio, Madrid.

Bock, B. 2016. *Tela Botanica—Référentiel des Trachéophytes de France Métropolitaine* [web page]. URL: http://www.tela-botanica.org. Accessed on July 17, 2017.

Boratyński, A. and M. L. V. de la Puente. 1995. The Empetraceae on the Iberian Peninsula. *Willdenowia* 25:39–53. Available at: http://www.jstor.org/stable/3996971. Accessed on July 17, 2017.

Brehm, A. E. 1880–1883. *Historia Natural: La Creación*. Montaner y Simon, Barcelona.

Bugalhão, J. and P. F. Queiroz. 2005. Testemunhos do Consumo de Frutos no Periodo Islamico em Lisboa. In *Al-Ándalus Espaço de Mudança. Balanço de 25 Anos de Historia e Arqueologia Medievais. Homenagem a Juan Zozaya Stabel-Hansen*, p. 195. Asociación Española de Arqueología Medieval, Mértola, Portugal.

Calviño-Cancela, M. and J. Martín-Herrero. 2009. Effectiveness of a Varied Assemblage of Seed Dispersers of a Fleshy-Fruited Plant. *Ecology* 90:3503–3515. DOI:10.1890/08-1629.1.

Carlquist, S. 1989. Wood and Bark Anatomy of Empetraceae; Comments on Paedomorphosis in Woods of Certain Small Shrubs. *Aliso* 12: 497–515.

Carruthers, W. J. 2014. The Waterlogged Plant Remains. In *Newport Medieval Ship (467)*, edited by N. Nayling and T. Jones. Newport Museums and Heritage Service, Newport, RI.

Castroviejo, S. 1986-2016. Flora Iberica: Plantas Vasculares de la Peninsula Ibérica e Islas Baleares [web page]. 1-8, 10-15, 17-18, 21 Real Jardín Botánico, CSIC, Madrid. URL: http://www.floraiberica.es/. Accessed on July 17, 2017.

Clavijo, A., M. C. Díaz Barradas, F. Ain-lhout, M. Zunzunegui, and O. Correia. 2002. A Fragmentação e as Espécies Invasoras como Causa Principal da Redução do Habitat de *Corema album* na Sua Área de Distribuição. *Revista Biologica* 20: 109–120.

Colmeiro, M. 1870. *Exámen Histórico Crítico de los Trabajos Concernientes a la Flora Hispano Lusitana: Fragmento que Alcanza hasta Fines del Siglo XVI*. Tomas Rey, Madrid.

de Cortes Sánchez-Mata, M. and Tardío, J., 2016. *Mediterranean Wild Edible Plants: Ethnobotany and Food Composition Tables*. Springer, New York, NY. DOI:10.1007/978-1-4939-3329-7.

Dambeck, R., H. Thiemeyer, N. Herrmann, A.J. Kalis, M. Kunst, A. Lord, H. Rittweger, H-P. Stika, and A. Stobbe. 2010. Holozäne Talentwicklung und Landschaftswandel am Rio Sizandro. Geoarchäologische Beiträge zum Projekt Sizandro-Alcabrichel (Torres Vedras, Portugal). *Madrider Mitteilungen* 51: 9–46.

Desfontaines, R.L. and M. Desfontaines. 1809. *Histoire des Arbres et Arbrisseaux qui Peuvent être Cultivés en Pleine Terre sur le Sol de la France*. J. A. Brosson, Paris.

Euro+Med Plantbase —The Information Resource for Euro-Mediterranean Plant Diversity [web page]. URL: http://ww2.bgbm.org/EuroPlusMed/ Accessed on July 17, 2017.

Fedriani, J. M. and M. Delibes. 2009. Functional Diversity in Fruit-Frugivore Interactions: A Field Experiment with Mediterranean Mammals. *Ecography* 32: 983–992. DOI:10.1111/j.1600-0587.2009.05925.x.

Fernández de la Cigoña, E. 1988. La Camariña: Distribución Histórica y Actual. Posibilidades de Recuperación en Galicia. *Revista de Estudios Provinciais* 5: 115–128.

Font Quer, P. 1985. *Plantas Medicinales: El Dioscórides Renovado*. Ediciones Península, Barcelona.

Gil-López, M.J. 2011. Etnobotánica de la Camarina (*Corema album,* Empetraceae) en Cádiz. *Acta Botanica Malacitana* 36: 137–144.

Gomez de Ortega, C. 1784. *Continuacion de la Flora Española o Historia de las Plantas de España que Escribia Don Joseph Quer*. Joachin Ibarra, Madrid.

Hopf, M. 1981. Pflanzliche Reste aus Zambujal. In *Zambujal Die Grabungen 1964 bis 1973*, edited by E. Sangmeister and H. Schubart, pp. 315–340. Deutsches Archäologisches Institut, Madrid.

Hurtado de Mendoza, M. 1840. *Vocabulario Médico-quirúrgico o Diccionario de Medicina y Cirugía que Comprende la Etimología y Definición de Todos los Términos Usados en Estas dos Ciencias por los Autores Antiguos y Modernos*. Boix, Madrid.

Jesus, A., A. Gonçalves, and J.P. Tereso. 2017. *Estudo Carpológico do Sítio Islâmico do Alto da Vigia (Sintra)*. Poster presented at the 1st Iberian Carpology Meeting. Porto, Portugal.

Kim, K. H., S. Nilsson, and J. Praglowski. 1988. A Note on the Pollen Morphology of the Empetraceae. *Grana* 27: 283-290. DOI: 10.1080/00173138809429950.

Láinz, M. 1971. Aportaciones al Conocimiento de la Flora Gallega VII. *Anales del Instituto Forestal de Investigaciones y Experiencias* 12: 1–39.

Larrinaga, A. R. and P. Guitián. 2016. Intraspecific Variation in Fruit Size and Shape in *Corema album* (Ericaceae) Along a Latitudinal Gradient: From Fruits to Populations. *Biological Journal of the Linnean Society* 118: 940–950. DOI:10.1111/bij.12794.

León-González, A. J., P. Truchado, F. A. Tomás-Barberán, M. López-Lázaro, M. C. D. Barradas, and C. Martín-Cordero. 2013. Phenolic Acids, Flavonols, and Anthocyanins in *Corema album* (L.) D. Don Berries. *Journal of Food Composition and Analysis* 29: 58–63. DOI:10.1016/j.jfca.2012.10.003.

López-Dóriga, I. 2015-2016. *The Use of Plants During the Mesolithic and the Neolithic in the Atlantic Coast of the Iberian Peninsula*. Doctoral Dissertation, Instituto Internacional de Investigaciones Prehistóricas de Cantabria, Universidad de Cantabria, Santander, Spain. Available at: https://repositorio.unican.es/xmlui/handle/10902/8427. Accessed on July 17, 2017.

Marques, E. M. M. d. S. 2007. *Caracterização das Populações de Camarinha* (Corema album L.*) no Cabo Carvoeiro*. Master's thesis, Universidade de Lisboa, Faculdade de Ciências, Departamento de Biologia Vegetal, Lisbon, Portugal. Available at: http://repositorio.ul.pt/handle/10451/1332. Accessed on July 17, 2017.

Mateus, J. 1989. Pollen Morphology of Portuguese Ericales. *Revista de Biologia 14*:135–208.

Mateus, J. E., P. F. Queiroz, and W. van Leeuwaarden. 2003. O Laboratório de Paleoecologia e Arqueobotânica-Uma Visita Guiada aos Seus Programas, Linhas de Trabalho e Perspectivas. In *Paleoecologia Humana e Arqueciencias: um Programa Multidisciplinar para a Arqueologia sob a Tutela da Cultura*, pp. 104–188. Instituto Português de Arqueologia, Lisbon, Portugal.

Padulosi, S., K. Hammer, and J. Heller. 1996. Hulled Wheats: Proceedings of the First International Workshop on Hulled Wheats, 21-22 July 1995, Castelvecchio Pascoli, Tuscany, Italy. Biodiversity International, Rome, Italy. Available at: https://www.bioversityinternational.org/index.php?id=244&tx_news_pi1%5Bnews%5D=148&cHash=7de9d50f97676192303fc08a19002211. Accessed on December 17, 2017.

Parfitt, S. A., R. W. Barendregt, M. Breda, I. Candy, M. J. Collins, G. R. Coope, P. Durbidge, M. H. Field, J. R. Lee, A. M. Lister, R. Mutch, K. E. H. Penkman, R. C. Preece, J. Rose, C. B. Stringer, R. Symmons, J. E. Whittaker, J. J. Wymer, and A.J. Stuart. 2005. The Earliest Record of Human Activity in Northern Europe. *Nature* 438:1008–1012. DOI:10.1038/nature04227.

Pérez-Jordà, G., L. Peña-Chocarro, M. García Fernández, and J.C. Vera Rodríguez. 2017. The Beginnings of Fruit Tree Cultivation in the Iberian Peninsula: Plant Remains from the City of Huelva (Southern Spain). *Vegetation History and Archaeobotany* 26:527–538. DOI:10.1007/s00334-017-0610-6.

Piazzon, M., A. R. Larrinaga, J. Rodríguez-Pérez, L. Latorre, L. Navarro, and L. Santamaría. 2012. Seed Dispersal by Lizards on a Continental-Shelf Island: Predicting Interspecific Variation in Seed Rain Based on Plant Distribution and Lizard Movement Patterns. *Journal of Biogeography* 39:1984–1995. DOI:10.1111/j.1365-2699.2012.02718.x.

Pimentel, A., 1899. *Historia do Culto de Nossa Senhora em Portugal.* Libanio Guimarães, Lisbon, Portugal.

Queiroz, P. F. and J. van der Burgh. 1989. Wood Anatomy of Iberian Ericales. *Revista de Biologia* 14:95–134.

Queiroz, P.F. and J.E. Mateus. 2004. Paleoecologia Litoral entre Lisboa e Sines: Do Tardiglaciário aos Tempos de Hoje. In *Evolução Geohistórica do Litoral Português e Fenómenos Correlatives*, edited by A.A. Tavares, M.J.F. Tavares, and J.L. Cardoso. Universidade Aberta, Lisbon, Portugal.

Queiroz, P. F. and J.E. Mateus. 2011. *Estudo Paleoecológico do Depósito Orgânico Medieval Conservado na Estratigrafia Arqueológica da Casa dos Bicos, Lisboa*. Terra Scenica—Territorio Antigo Report no. 25.

Sánchez García, I. 2000. *Flora Amenazada del Litoral Gaditano*. Consejería de Medio Ambiente, Junta de Andalucía, Diputación de Cádiz, Spain.

Stevenson, A. C. 1984. Studies in the Vegetational History of S.W. Spain. III. Palynological Investigations at El Asperillo, Huelva. *Journal of Biogeography* 11:527–51. DOI:10.2307/2844798.

Stika, H.-P. and A.G. Heiss. 2014. *Shifting Diversities: Examples for Changes in Crop Use from the Chalcolithic to the Bronze Age in Western and Central Europe*. Paper presented at the 20th Annual Meeting of the

European Association of Archaeologists. Istanbul, Turkey.

Sweet, R. 1826. *Hortus Britannicus: Or a Catalogue of Plants Cultivated in the Gardens of Great Britain, Arranged in Natural Orders*. W. Simpkin and R. Marshall, London.

Sóñora Gómez, F. X. 1994. A Camariña (*Corema album*) en Galicia. *Braña, Revista de la Sociedade Galega de Historia Natural* 1:13–25.

Wolverton, S. and R. L. Lyman, 2012. Introduction to Applied Zooarchaeology. In *Conservation Biology and Applied Zooarchaeology,* edited by S. Wolverton and R. L. Lyman. University of Arizona Press, Tucson, AZ.