Routledge
Taylor & Francis Group

Environmental Archaeology

The Journal of Human Palaeoecology

ISSN: 1461-4103 (Print) 1749-6314 (Online) Journal homepage: http://www.tandfonline.com/loi/yenv20

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To cite this article: Edward R. Treasure & Mike J. Church (2017) Can't find a pulse? Celtic bean (Vicia faba L.) in British prehistory, Environmental Archaeology, 22:2, 113-127, DOI: 10.1080/14614103.2016.1153769

To link to this article: http://dx.doi.org/10.1080/14614103.2016.1153769

Can't find a pulse? Celtic bean (*Vicia faba* L.) in British prehistory

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Archaeobotanical research on prehistoric crops in Britain has primarily focussed on cereals and the potential importance of alternative crops, such as pulses, has often been overlooked. This paper reviews evidence for Celtic bean (*Vicia faba* L.) in British prehistory, using a database of archaeobotanical assemblages from 75 sites. Celtic bean is rare in the Neolithic – Early Bronze Age and it only becomes frequent from the Middle Bronze Age (ca. 1500 cal BC) onwards, particularly in southern England. Though there is a paucity of evidence at many sites, it is suggested that this reflects a preservation bias and in some areas at least, Celtic bean formed an important element of past agricultural systems.

Keywords: Pulse, Celtic bean, Prehistoric Britain, Archaeobotany

Introduction

Within the last few decades, knowledge of crops in prehistoric Britain has significantly expanded and benefitted from extensive sampling programmes to recover plant remains. In particular, the expansion of developer-funded archaeology has resulted in the creation of large archaeobotanical datasets (Hall and Kenward 2006). Despite this, archaeobotanical research on prehistoric crops in Britain has primarily focussed on cereals and the potential role of alternative crops has received comparatively little study. There is considerable evidence to indicate that a wide range of crops were cultivated in prehistoric Britain, including oil crops, such as flax, opium poppy and brassicas, and also pulses, such as pea and Celtic bean (Pelling and Campbell 2013, 58). This paper draws upon a large and predominantly untapped archaeobotanical dataset for prehistoric Britain, focussing on evidence for an understudied crop, Celtic bean (*Vicia faba* L.).

Celtic bean (*Vicia faba* L.) (Figs. 1 and 2), also referred to as Horse bean, is a member of the Fabaceae family. Celtic bean seeds are small, suboval and rounded in shape, although significant morphological variability exists between seeds and it is possible that sub-varieties were present across prehistoric Europe (Renfrew 1973, 108; Zohary *et al.* 2012, 89–92).

Written sources indicate that beans were an important component of Medieval diets in Europe, being particularly valued as a protein-rich food, often amongst poorer populations where it served as a substitute for meat (Hanawalt 1986; Dyer 1989; Pounds 1994; Rippon 2001; Moffett 2006). This is clearly reflected in an extract from a late-fourteenth century document which stated that 'labourers of old were not wont to eat of wheaten bread; their meat was of beans …' (Hanawalt 1986, 55). In addition to human consumption, beans also provided a high quality animal fodder alongside other pulse crops, such as peas (Hamilton and Thomas 2012, 52; Moffett 2006, 53; Rippon 2004). In crop husbandry regimes, beans were cultivated as both a garden and field crop and the benefits of cultivating beans to improve soil fertility was well-established and clearly recognised by the Medieval period (Gross and Butcher 1995, 109; Pounds 1994, 200; Rippon 2001; Tusser 1580). Moreover, beans were extensively cultivated across north-west Europe in areas of reclaimed marshland owing to their tolerance of brackish soils (Behre 2004; Hanawalt 1986; Rippon 2001; Rippon *et al.* 2014). Despite the importance of this crop in Medieval Europe, the potential role of Celtic bean in prehistoric Britain has not been studied in detail.

Therefore, the aim of this paper is to review evidence for Celtic bean (*Vicia faba* L.) in prehistoric Britain using evidence from 75 sites. The primary research questions are:

(i) What is the nature of the evidence for Celtic bean in British prehistory?
(ii) What was the nature of crop husbandry practices and cultivation conditions?
(iii) What is the significance of Celtic bean for agriculture in British prehistory?

Review methodology

Evidence for Celtic bean in prehistoric Britain was collated from published and un-published sources. This review includes 73 records of charred plant remains

DOI 10.1080/14614103.2016.1153769

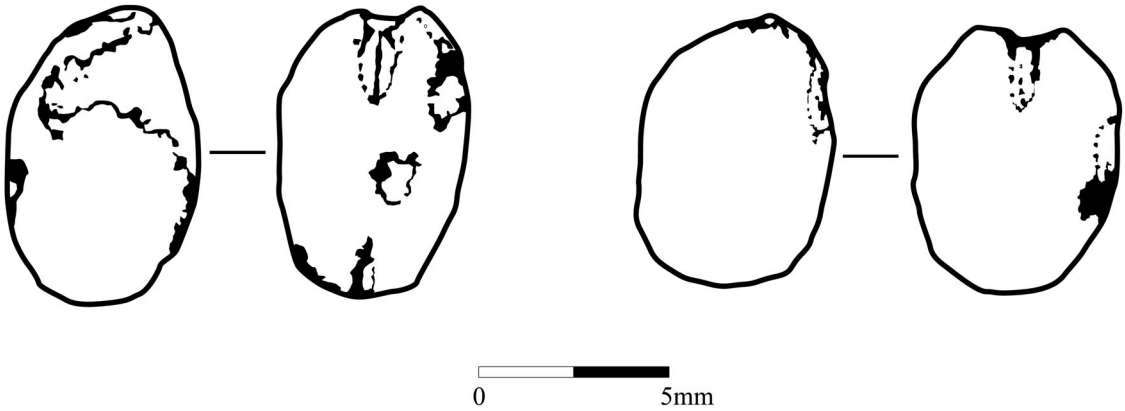

Figure 1 Celtic bean (*Vicia faba* L.) from a Middle Bronze Age site, Le Pinacle, Jersey (Carruthers 2001). Reproduced with permission of the Royal Archaeological Institute.

and two records of pottery impressions. Charred remains identified as 'cf.' (probable/possible) and 4 records of Celtic bean/Pea (*Vicia faba*/*Pisum sativum*) are included.

Sites were classified into generic chronological periods (Table 1) and the location of each site plotted in Fig. 3. The quantity of charred beans were recorded numerically where possible or on a scale of abundance. Two bean halves were recorded as one bean, and three bean fragments were recorded as one bean. To provide a comparison, the quantity of cereal grains was also recorded for each site. The summary dataset is presented in Appendix 1. Evidence for other crops (pea, wheat, barley and flax) was recorded on a presence/absence basis to assess if there was a relationship between the cultivation of Celtic bean and other crops (Supplementary Data 1). Where possible, Celtic bean dimensions and evidence for weed seeds associated with concentrations of beans were noted to provide a broad indication of crop husbandry practices. Although this review is comprehensive, it is inevitable that a small number of sites have been overlooked, especially unpublished assemblages in grey literature.

Figure 2 Modern Celtic black broad bean (*Vicia faba* L.), which produces seeds that are morphologically similar to prehistoric finds of Celtic bean.

Results

In total, 75 records of Celtic bean were identified through the literature review, including six Neolithic – Earlier Bronze Age sites, 34 Later Bronze Age sites and 35 Iron Age sites. The primary results are summarised below and in Fig. 4:

(i) Small assemblages of Celtic bean, typically fewer than 25 beans, or even smaller quantities, are present at most sites.
(ii) Large caches of Celtic bean, consisting of hundreds or thousands of beans, are rare and have only been identified at a small number of sites.

Neolithic and Early Bronze Age (ca. 4000–1500 cal BC)

Evidence for Celtic bean in the Neolithic and Earlier Bronze Age is rare, with only five records dating to this period. Two of the earliest dated records are a

Table 1 Chronological periods used in this study based on Roberts *et al* (2013) and Cunliffe (2005)

Period	Date range	
Mid Neolithic	3500–3000	cal BC
Late Neolithic	3000–2200	cal BC
Early Bronze Age	2200–1500	cal BC
Middle Bronze Age	1500–1100	cal BC
Late Bronze Age	1100–800	cal BC
Early Iron Age	800–400/300	cal BC
Middle Iron Age	400/300–100	cal BC
Late Iron Age	100 cal BC–100	cal AD

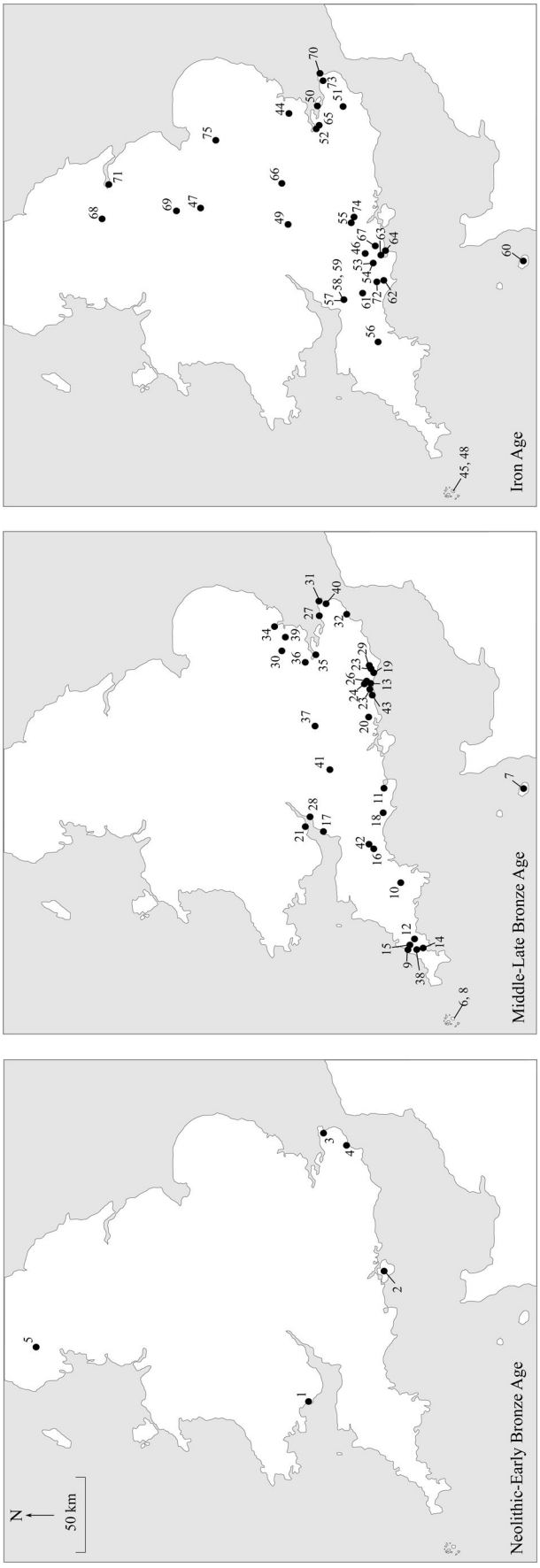

Figure 3 Sites with evidence for Celtic bean in Britain from the Neolithic to the Iron Age. The site numbers correspond to Appendix 1.

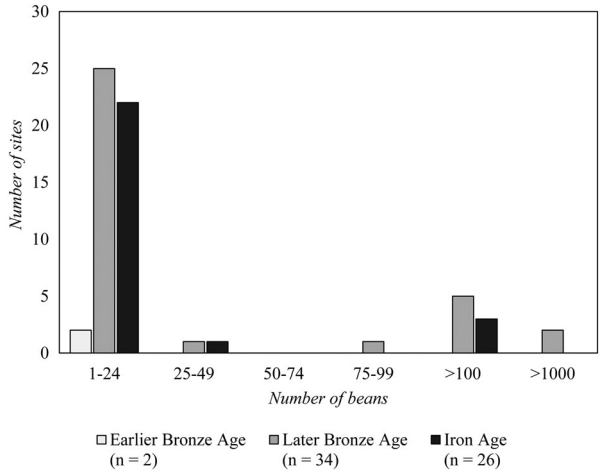

Figure 4 Number of sites in the Earlier Bronze Age, Later Bronze Age and Iron Age with the number of beans present in each assemblage (1–24, 25–49, 75–99, >100 and >1000). The number of sites in each grouping is indicated in parentheses.

Middle Neolithic pottery impression at Ogmore, Galmorgan (Site 1: Hillman 1981a; Gibson 1998) and an Early Bronze Age pottery impression from Newbarn Down, Isle of Wight (Site 2: Scaife 1982). At Monckton Road, Kent, charred Celtic bean fragments and spelt wheat (directly dated to the EBA) have been recovered from Early Bronze Age features (Site 3: Martin *et al.* 2012). Possible evidence for Celtic bean has also been recovered from an Early Bronze Age barrow ditch at Saltwood Tunnel, Kent (Site 4: Stevens 2006a). All of these sites are situated in close proximity to the coast across southern Britain.

Celtic bean was recovered from a feature associated with an Early Bronze Age cairn at Hardendale Nab, Cumbria (Site 5: Huntley 1988; Williams and Howard-Davis 2005), although later Roman/Medieval disturbance could indicate that the remains are intrusive. Celtic bean recovered from Neolithic features at Capel Eithin, Anglesey (Williams 1999) and Whitehorse Stone, Kent (Giorgi 2006a) are probably intrusive and therefore excluded from this review. At Whitehorse Stone, Kent, a possible Celtic bean was recovered from the post-hole of an Early Neolithic structure, however the sample also contained an iron nail and modern glass (Giorgi 2006a). At Capel Eithin, Anglesey, a single Celtic bean was recovered from a Late Neolithic context, however, the author notes that there is strong evidence for intrusive plant remains at the site (Williams 1999). Celtic bean was possibly recovered from a Chalcolithic/Late Neolithic context at Le Pinacle, Jersey, although the precise context of these finds are uncertain (Site 7: Carruthers 2001).

Table 2 Weed seed data from pit W207 at Saltwood Tunnel, Kent (Site 32: Stevens 2006a)

Common name	Quantity	%
Bracken	1	0·5
Scarlet Pimpernel	1	0·5
Curled Dock	1	0·5
Dock	2	0·9
Black-bindweed	2	0·9
Pale Persicaria/Redshank	2	0·9
Grasses	2	0·9
Wall/Thyme-leaved Speedwell	2	0·9
Oat/Brome	4	1·8
Goosefoot	7	3·2
Brome	9	4·1
Oat	13	5·9
Fat-hen	41	18·6
Tare/Pea	41	18·6
Henbane	44	19·9
Cleavers	49	22·2
Total number of weed seeds	221	n.a.
Cereal grains/chaff	109	n.a.
Celtic bean	6801	n.a.

Middle–Late Bronze Age (1500–800 cal BC)

Evidence for Celtic bean significantly increases from the Middle Bronze Age onwards, with sites distributed across southern England and often in close proximity to the coast. All of the evidence has been recovered from contexts associated with settlement activity. Though evidence for Celtic bean is extremely sparse at most sites, large caches have been recovered from eight sites. The evidence from two late Bronze Age sites, Foster's Field, Dorset (Site 33: Jones 2009, 2012) and Saltwood Tunnel, Kent (Site 32: Stevens 2006a), stand out in particular due to the recovery of near-pure caches consisting of thousands of charred beans. A near-pure assemblage of Celtic bean was recovered from Mackie Avenue, West Sussex (Site 24: Smith 2010), whilst large caches of Celtic bean, consisting of hundreds of charred beans, have been recovered from Le Pinacle, Jersey (Site 7: Carruthers 2001), Frog Hall Farm, Essex (Site 34: Murphy 2001), Lower Hoddern Farm, Kent (Site 19: Allot 2010) and Trevilson, Cornwall (Site 15: Jones 2004).

Evidence for weed seeds associated with concentrations of Celtic bean was either absent or extremely sparse at Mackie Avenue (Site 24: Smith 2010), Frog Hall Farm (Site 34: Murphy 2001), Trevilson (Site 15: Jones 2004) and Foster's Field (Site 33: Jones 2009, 2012). However, at Saltwood Tunnel (Site 32: Stevens 2006a) a substantial quantity of weed seeds (>200) were associated with a deposit of more than 6000 beans and predominantly comprised of fat-hen (*Chenopodium album* L.), tare/pea (*Vicia* L./*Lathyrus* sp. L.), henbane (*Hyoscyamus niger* L.) and cleavers (*Galium aparine* L.) (Table 2).

Iron Age (800 cal BC–43 cal AD)

Evidence for Celtic bean during the Iron Age is present at 35 sites and there is a similar geographical trend to the Later Bronze Age with most sites located across southern England. In central and northern England,

evidence for Celtic bean is rare and should be treated with caution as only possible records of Celtic bean were identified at Gamston, Nottinghamshire (Site 69: Moffett 1991), Wanlip, Leicestershire (Site 47: Monckton 1998) and Dragonby, Lincolnshire (Site 71: van der Veen 1996a). Equally, the evidence from Ferrybridge, West Yorkshire (Site 68: Alldritt 2005) is uncertain and may be intrusive as charred grape seeds (*Vitis* sp.) were also present, a plant which is common in the Roman/Medieval period (Pelling *et al*. 2015). Evidence for Celtic bean has only been recovered from contexts associated with settlement activity.

As with the preceding Later Bronze Age, evidence for Celtic bean is extremely sparse at many sites, and only four sites have produced large quantities of Celtic bean. In particular, excavations at the Glastonbury and Meare Lake Villages in the early–mid 20th century recovered abundant evidence, with 'many litres' of charred beans recovered (Site 57: Helbaek 1953; Reid 1917). Later excavations at Meare Lake Village also produced samples rich in Celtic bean (Site 58: Caseldine 1987; Housley 1987). Large quantities of Celtic bean have also been recovered at Green Island, Dorset (Site 64: Wessex Archaeology 2003) and Le Câtel de Rozel, Jersey (Site 60: Campbell 1992b). At both these sites, and at Meare, evidence for insect infestation has been identified.

Evidence for weed seeds associated with concentrations of Celtic bean was recorded at Meare Village East (Site 58: Caseldine 1987), Le Câtel de Rozel (Site 60; Campbell 1992b) and Green Island (Site 64; Wessex Archaeology 2003). In all three sites, weed seeds were extremely sparse and the quantities too small to permit any meaningful interpretation.

Comparative analysis of dimensions

The dimensions of Celtic bean have been recorded from nine sites dating between the Middle Bronze Age to Late Iron Age (Table 3). Small variation is evident in bean dimensions between sites, particularly in length, with the largest beans present in the Middle Bronze Age at Le Pinacle, Jersey (Site 7: Carruthers 2001) and Bestwall Quarry, Dorset (Site 11; Carruthers 2009). In comparison, Celtic bean from the Late Bronze Age site at Frog Hall Farm, Essex (Site 34; Murphy 2001) and the Middle–Late Iron Age sites at Le Câtel de Rozel, Jersey (Site 60; Campbell 1992b) and Meare and Glastonbury, Somerset (Sites 57 and 58; Helbaek 1953) appear to be slightly smaller. However, it should be noted that there is significant overlap in the dimensions of beans between all the sites and only a small number of beans have been measured from some sites.

Discussion

Research question 1: what is the nature of the evidence for Celtic bean in British prehistory?

In comparison to the abundant evidence for cereals in prehistoric Britain, evidence for Celtic bean is relatively sparse and the crop is often represented only sporadically by small quantities of beans in archaeobotanical assemblages. However, this does not necessarily indicate that the crop was insignificant and the paucity of evidence for Celtic bean has often been attributed to a preservation bias (e.g. Allot 2010; Campbell and Straker 2003; Carruthers 1991a, 2009). A number of factors can influence the presence of charred plant remains in archaeobotanical assemblages.

Firstly, different plant species and plant components have differing probabilities of preserving when charred. Charring experiments undertaken in hearths suggest that the seeds of *V. faba* can preserve well during charring and in contrast, similar experiments suggest that cereals are more sensitive to charring and are less likely to preserve (Gustaffson 2000; Guarino and Sciarrillo 2004). From the above, it is

Table 3 Size measurements for Celtic bean (*Vicia faba* L.) from British prehistoric sites. The numbers in the parentheses represent the range of the measurements. Measurements rounded to one decimal place

Site	Length (mm)	Breadth (mm)	Height (mm)
Le Pinacle (Middle Bronze Age)	7·1	5·1	5·0
n = 183	(5·6–8·9)	(3·6–7·1)	(3·5–7·1)
Bestwall Quarry (Middle Bronze Age)	7·4	5·1	4·8
n = 7	(6·6–7·8)	(4·0–5·7)	(3·8–5·2)
Rowden (Middle Bronze Age)	6·7	4·7	4·6
n = 48	(5·6–8·0)	(4·3–5·7)	(4·0–5·3)
Trethellan Farm (Middle Bronze Age)	6·3	5·2	5·1
n = 3	(6·1–6·5)	(5·0–5·5)	(4·9–5·4)
Frog Hall Farm (Late Bronze Age)	6·2	4·2	4·6
n = 30	(4·4–8·1)	(3·4–5·6)	(3·0–6·6)
Springfield Lyons (Late Bronze Age)	7·1	5·1	No data
n = 3	(6·8–7·5)	(4·5–5·8)	
Le Câtel de Rozel (Middle–Late Iron Age)	6·5	4·6	4·1
n = 36	(5·1–7·8)	(3·1–5·4)	(2·6–5·8)
Meare and Glastonbury (Middle–Late Iron Age)	6·7	5·1	4·8
n = ?	(4·8–7·9)	(3·5–6·2)	(3·5–5·7)

probable the sparse evidence for Celtic bean in comparison to cereals cannot be attributed to poor preservation during charring. However, Celtic bean chaff (pods, stems) is extremely rare and has only been recorded at two sites, Saltwood Tunnel (Site 32: Stevens 2006a) and Le Câtel de Rozel (Site 60: Campbell 1992b). Charring experiments indicate that Celtic bean chaff is quickly destroyed when charred (Treasure 2014).

Secondly, the presence of plant remains in archaeobotanical assemblages is strongly influenced by crop-processing methods and requirements (Hillman 1981b; van der Veen 1992, 81–89, 2007). Celtic bean is considered to be under-represented in archaeobotanical assemblages as it does not require contact with fire during processing, reducing the possibility of accidental charring (Carruthers 2009; Dennell 1976). Moreover, Celtic bean may have been harvested as a green summer vegetable and therefore unlikely to come into contact with fire, unless accidentally charred during crop processing or food preparation (Hubbard in Hinton 1982; Carruthers 1991a, 2009). Pulses may become accidentally charred during crop processing if they are parched, roasted or dried (using fire) prior to storage or consumption, particularly in wetter regions such as Britain where it can be difficult to dry crops naturally (Butler 1990, 463–464; Fuller and Harvey 2006). For example, drying ovens or kilns were used to dry beans in Medieval Britain (Hanawalt 1986, 42) and accidents involving the charring of crops were commonplace in these structures (e.g. Graham 1812, 117). However, parching, roasting or drying (using fire) are not necessary stages of processing and the paucity of evidence for Celtic bean in prehistoric Britain may be linked to an absence of these practices (Allot 2010; Carruthers 2001; Hinton 1982). In comparison, parching is often viewed as a pre-requisite for processing glume wheats (emmer, spelt wheat), increasing the probability of charring, though other practices such as oven drying may equally have resulted in accidental charring (Halstead 2014; Nesbitt and Samuel 1996; Peña-Chocarro and Zapata 2014).

Other factors could have influenced the preservation of Celtic bean in archaeobotanical assemblages. For example, ethnographic evidence and documentary records attest to the use of pulse crops, including beans, as animal fodder (Jones 2005; Moffett 2006; Palmer 1996; Rippon 2001). Crops intended for fodder require less processing and may have been stored away from settlements (Jones 1996) and are subsequently less likely to become charred (Carruthers 2009; Dennell 1976). Moreover, the quantity of plant remains recovered is influenced by the scale of sampling and flotation undertaken (van der Veen 1984). For example, extensive sampling and flotation of thousands of litres of soil at the Iron Age site at Ham Hill, Somerset has resulted in the relatively frequent recovery of small quantities of Celtic bean (Ballantyne 2014; Stevens 2006b, 2012, 2013).

Finally, it is necessary to consider the significance of large quantities of Celtic bean which have only been rarely recovered from prehistoric sites in Britain (see Fig. 4). These large quantities typically consist of a cache of charred beans, indicating that charring took place in a single 'event'. This could be accidental (i.e. conflagration of a stored crop) or deliberate (i.e. burning of a spoilt/insect-infested crop, ritual activity). Such 'events' may be termed rare and are not expected to occur at *all* sites (van der Veen and Jones 2006; van der Veen 2007). For example, large caches of Celtic bean may never have been destroyed in large conflagrations at some sites. Large scale conflagrations are unselective and often preserve plant taxa that are unlikely to come into contact with fire (Carruthers 2009). Whilst regional variation in crop husbandry regimes probably existed, the lack of evidence for similar large caches of Celtic bean at more sites is not necessarily an indication that the crop was unimportant, but rather, it reflects a preservation bias.

Research question 2: what was the nature of crop husbandry practices and cultivation conditions?

An indication of cultivation conditions may be obtained from the analysis of Celtic bean dimensions as seed size is influenced by the health of the crop, soil nutrients and water availability (Carruthers 2009, 345; Treasure *et al.* 2015). Genetic factors will also affect both the size and shape of Celtic bean (Carruthers 2009, 345) and it has been suggested that a number of varieties of Celtic bean may have been present across prehistoric Europe (see discussion in Carruthers 1991a, 110–111 and Carruthers 2001, 47–50). At present, there is insufficient data available to analyse in detail variation in Celtic bean dimensions between different sites and across different periods. The collection of larger datasets of Celtic bean dimensions would provide useful information (Carruthers 1991a, 111; Carruthers 2009, 346). Despite these limitations, it is possible to make a small number of observations concerning the dimensions of Celtic bean from archaeological sites.

The largest beans were present at the Middle Bronze sites at Le Pinacle, Jersey (Site 7: Carruthers 2001) and Bestwall Quarry, Dorset (Site 11; Carruthers 2009) and this could indicate better growing conditions. For example, manuring is known to increase the size, particularly length, of modern Celtic Black broad bean (Treasure *et al.* 2015). Interestingly, naked barley grains at Bestwall Quarry were also larger

than those recovered from contemporary sites which could be taken to indicate better growing conditions (Carruthers 2009). However, due to the small numbers of beans measured at Bestwall Quarry ($n = 7$), this interpretation should be treated with caution. It is unclear whether the smaller sizes of the beans present at other sites is due to environmental conditions or genetic factors, or a combination of both.

Despite the small quantity of data available, the considerable overlap in bean dimensions between different sites suggests that on a purely morphological basis there is little variation between Celtic bean from the Middle Bronze Age (ca. 1500 cal BC) to the later Iron Age (ca. 400 cal BC–100 cal AD). This suggests a remarkable phenotypic stability in the bean size and shape for over 1500 years in prehistoric Britain. In comparison large-seeded *V. faba* seeds appear to have diffused throughout Europe at a later date, during the Roman or Medieval periods (Zohary *et al.* 2012, 90). Therefore, there is potential to develop a paired ancient DNA and radiocarbon analysis on Celtic beans from archaeological sites (cf. Brown *et al.* 2015), to assess the timing and nature of genetic turnover in bean populations. This could then be related to wider issues of trade and exchange of crops in prehistoric and Roman/Medieval Europe.

The analysis of weed seeds associated with samples of Celtic bean can also provide useful information on crop husbandry practices and cultivation conditions. Weed seeds associated with remains of Celtic bean potentially derive from arable weed flora associated with the beans during cultivation, although, this form of analysis can only be undertaken where weed seeds are directly associated with concentrations of Celtic bean. Evidence for weed seeds was either absent or extremely sparse in most concentrations of Celtic bean, however, at Saltwood Tunnel, Kent (Site 32: Stevens 2006a) a pit containing >6000 beans was associated with a substantial quantity of weed seeds (>200). The dominant weed seeds included fat-hen, tare/pea, henbane and cleavers, all of which would be expected to occur in arable fields (Stevens 2006a; Stace 2010). Henbane typically grows on light sandy nutrient-rich soils, such as manured environments, and particularly in proximity to the sea, whilst fat-hen often grows on disturbed nutrient-rich soils, including manured soils (Grime *et al.* 1988; Stace 2010). This suggests local cultivation in a coastal area and potentially manuring (Saltwood Tunnel is situated in proximity to the coast). Interestingly, whilst henbane and cleavers were frequent in the deposit of beans, neither of these species was common in contemporary assemblages of weed seeds associated with cereals, suggesting that Celtic bean was cultivated under different conditions.

The cultivation of beans in areas of re-claimed salt marshland appears to have been widely practiced across north-western Europe during the Medieval period due to their tolerance of brackish soils (Behre 2004; Hanawalt 1986; Rippon 2000, 2001; Rippon *et al.* 2014). It is possible that the exploitation of coastal areas for the cultivation of beans has antecedents in the Bronze Age considering the location of many sites in close proximity to the coast (e.g. Trethellan Farm (Site 9: Straker 1991), Bestwall Quarry (Site 11: Carruthers 2009) and Brean Down (Site 17: Straker 1990)). The evidence from the Later Iron Age sites at Glastonbury and Meare provides potential evidence for the cultivation of beans in re-claimed salt marshland. In both these areas, there is substantial Later Medieval documentary evidence to indicate the specialised cultivation of beans on re-claimed marshland (Rippon 2001, 2004). It is possible that weed seeds associated with beans cultivated on these soils may include salt-tolerant taxa (van Zeist 1974), although this has yet to be identified and further evidence is required to confirm this. Moreover, beans cultivated in coastal areas on brackish soils may exhibit high nitrogen isotope ($\delta^{15}N$) values (cf. Britton *et al.* 2008), although high $\delta^{15}N$ could also reflect intensive manuring (Treasure *et al.* 2015). There is considerable potential to undertake stable isotope analysis ($\delta^{15}N$; $\delta^{13}C$) on Celtic bean from archaeological sites, in conjunction with an analysis of weed ecology to investigate crop husbandry practices and cultivation conditions (e.g. Bogaard *et al.* 2016; Fraser *et al.* 2011; Treasure *et al.* 2015).

Research question 3: what is the significance of Celtic bean for agriculture in British prehistory?

Currently, the earliest reliable evidence for Celtic bean, or any pulse, in prehistoric Britain is a Middle Neolithic pottery impression from the coastal site at Ogmore, Glamorgan (Site 1: Hillman 1981a; Gibson 1998). Pulses appear to be absent in Neolithic Britain (Bogaard and Jones 2007; Fairbairn 2000; Jones and Rowley-Conwy 2007) and north-western Europe as a whole (Kirleis *et al.* 2012; McClatchie *et al.* 2014; Salavert 2011). This may, however, reflect a preservation bias, rather than their actual absence (McLaren 2000). Recent evidence for Celtic bean potentially dating to the late 4th millennium BC has been identified at Beg ar Loued, Brittany (Pailler and Stéphan 2014), although direct dating is necessary to confirm this. As further archaeobotanical studies are undertaken, greater evidence for Celtic bean in Neolithic Britain may be recovered. For example, Neolithic material from Lower Hoddern Farm, East Sussex includes a number of large-seeded pulses with morphological similarities to Celtic bean (Allot 2010). To confirm the presence of Celtic bean in

Neolithic Britain, a systematic programme of directly radiocarbon dating bean macrofossils recovered from Neolithic contexts is needed.

Evidence for Celtic bean increases in frequency across Europe throughout the Bronze Age (Stika and Heiss 2013). Recent excavations at Monkton Road, Kent, suggest that Celtic bean may have been introduced (or re-introduced) together with spelt wheat in the Early Bronze Age (Site 3: Martin *et al*. 2012). However, there is currently little evidence for Celtic bean in the Early Bronze Age and it only becomes more common from the Middle Bronze Age (1500 cal BC) onwards. Between the Neolithic and Middle Bronze Age, evidence for Celtic bean is primarily present in coastal areas and this patterning may reflect the introduction of the crop from Europe during the Neolithic/Earlier Bronze Age and its protracted diffusion across mainland Britain during the Later Bronze Age and Iron Age.

The increased frequency of archaeobotanical finds of Celtic bean from the Middle Bronze Age is coincident with wider changes in agriculture throughout the Later Bronze Age, including greater crop-diversity (Pelling and Campbell 2013) and potentially a major period of agricultural intensification (Barrett 1994, 146–153; Bradley 2007, 181–193; Stevens and Fuller 2012; Yates 2007). In particular, there is evidence for spelt wheat (Carruthers 2009; Monckton 2005; Pelling 2003; Smith 2011), flax (Carruthers 2006; Stevens 2006a, 2014) and peas (Pelling 2011; Stevens 2014). Interestingly, substantial evidence for Celtic bean at Saltwood Tunnel (Stevens 2006a) and, to a lesser extent, at Cliffs End Farm (Stevens 2014) occurs alongside spelt wheat, peas and flax, possibly indicating the development of more intensive and developed crop husbandry practices at some sites during this period. These crops have also been recorded at the Later Iron Age site of Hengistbury Head (Nye and Jones 1987). However, at the majority of sites there is no clear relationship between evidence for Celtic bean and other crop types throughout the Later Bronze Age and Iron Age. Fig. 5 indicates the number of different crop types (pea, wheat, barley, flax) which have been recorded at sites with evidence for Celtic bean. In most instances, evidence for Celtic bean is associated with barley and wheat (predominantly emmer and spelt wheat), and to a lesser extent alongside either pea of flax (Supplementary Data 1).

Celtic bean may have been used in crop-rotation or as a mixed crop with cereals to improve soil fertility (Carruthers 1991a; Campbell and Straker 2003; Jones 2009). Possible evidence for crop-rotation has been identified in the Late Bronze Age at Black Patch, East Sussex (Hinton 1982). A 50 g sub-sample from a cereal grain rich storage pit produced a small

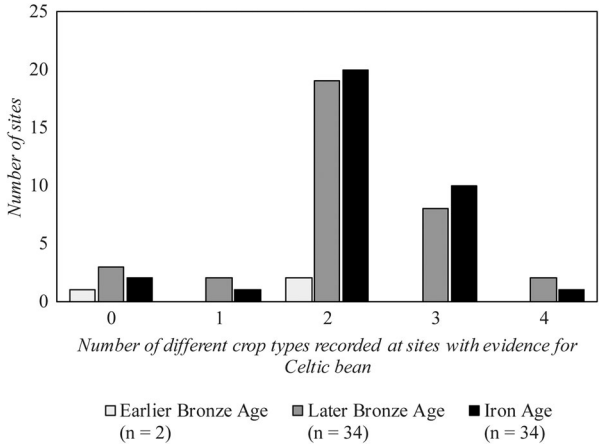

Figure 5 Number of different crop types (pea, wheat, barley and flax) recorded at sites with evidence for Celtic bean. The number of sites in each grouping is indicated in parentheses. See Supplementary Data 1 for further information.

quantity of beans and it is possible that they are the remains of a previous crop (Hinton 1982). Crop-rotation could have been a particularly important component of crop husbandry regimes in areas such as the south-west with poor, acidic soils as for example at Bestwall Quarry, Trethellan Farm, Trevilson and Rowden (Carruthers 1991a, 2009; Straker 1991; Jones 2004). It is notable that barley, which is tolerant of poor soils (Campbell and Straker 2003), was also dominant at these sites. A contrasting pattern is evident at Heathrow Terminal 5, Perryoaks and Runneymede in the Thames Valley, areas of fertile soils, with emmer and spelt wheat dominant whilst pulses are absent (Carruthers 2010a). These differences between the south-west and the Thames Valley probably reflect the development of regionality in crop husbandry regimes. However, it should be noted that Celtic bean has been recovered from sites where emmer and spelt are dominant, for example, at Foster's Field (Jones 2009, 2012) and Saltwood Tunnel (Stevens 2006a).

Evidence for Celtic bean is relatively frequent during the Iron Age, with a clustering of sites in central-southern England. There is a notable shift in the distribution of sites compared with Later Bronze Age, with a decline in the number of sites situated in the south-west and south-east, particularly around Sussex. This shift may be attributed to regional differences in crop husbandry which could in turn reflect different cultural preferences in the crops cultivated or that Celtic bean was not a necessary component of agricultural systems, for example, in terms of crop-rotation or provision of animal fodder.

Interestingly, the geographical patterning of sites across central-southern England broadly overlaps with evidence for the development of intensive cereal agriculture during the Later Iron Age (Cunliffe 2005,

410; van der Veen and Jones 2006). Evidence for peas becomes more frequent during the Later Iron Age (Campbell 2000; Campbell and Straker 2003) potentially indicating greater crop-diversity to manage risk (cf. Marston 2011) or reflecting the increasing importance of crop-rotation to facilitate intensive cultivation (see van der Veen and O'Connor 1998). The Later Iron Age sites at Meare and Glastonbury in Somerset provide strong evidence for the importance of beans in some areas at least, and possibly also at other sites where only small quantities of beans have been recovered, especially considering the preservation biases discussed earlier. The evidence from Glastonbury and Meare stands out in particular as these sites provide potential evidence for the development of highly specialised crop husbandry involving the cultivation of beans in re-claimed salt marshland (discussed above). This form of specialised cultivation may have developed during the Later Bronze Age considering the location of a number of sites in close proximity to the coast.

Conclusion

This paper has reviewed evidence for Celtic bean from 75 sites in prehistoric Britain. Neolithic and Earlier Bronze Age evidence is rare and Celtic bean only becomes frequent from the Middle Bronze Age onwards. At the majority of sites, evidence for Celtic bean is present in very small quantities and it has only been recovered in large quantities from a few sites. The paucity of archaeobotanical evidence at many sites does not necessarily indicate that Celtic bean was an unimportant crop, but rather is likely to reflect a preservation bias. From the Middle Bronze Age to the Late Iron Age, Celtic bean appears to have been a more important crop than is currently proposed for British prehistoric agriculture.

Acknowledgements

Edward Treasure holds a Northern Bridge AHRC studentship (Grant Number: AH/L002558/1). We thank the reviewers for their constructive comments and C. Smith for help with proof-reading. E. Treasure would like to thank Richard James for providing access and permission to unpublished data for Centenary House and to Martin Jones for commenting on the evidence from Holne Moore. All other unpublished reports have been accessed online.

Appendix 1: Evidence for Celtic bean in prehistoric Britain. Plant remains were recorded numerically where possible or on a scale of abundance ('R', rare; 'P', present; 'A', abundant). The symbol '*' indicates the estimated quantity of beans present. Radiocarbon dates were calibrated using IntCal13 (Reimer *et al.* 2013) and OxCal 4·2 (Bronk-Ramsey 2013). Calibrated dates are expressed at 95·4% probability.

	Site name	Period	Comments	Beans	Peas/ beans	Cereals	References
1	Ogmore	MN-LN	Pottery impression (Peterborough Ware)				Hillman (1981a)
2	Newbarn Down	EBA	Pottery impression (EBA Urn)				Scaife (1982)
3	Monkton Road	EBA		R		P	Martin *et al.* (2012)
4	Saltwood Tunnel	EBA		5		5	Stevens (2006a)
5	Hardendale Nab	EBA?	Possibly intrusive	2		0	Huntley (1988), Williams and Howard-Davis (2005)
6	Porth Killier	MBA		2		6	Ratcliffe and Straker (1996)
7	Le Pinacle	MBA	*V. faba* directly dated. 1730–1120 cal BC (3170 ± 110 bp; OxA-2519)	478*		P	Carruthers (2001)
8	Porth Cressa	MBA		1		23	Ratcliffe and Straker (1996)
9	Trethellan Farm	MBA		14		1901	Straker (1991)
10	Holne Moor	MBA?	Possibly later in date	P		P	Jones (1984), M. Jones pers comm.
11	Bestwall Quarry	MBA	*V. faba* directly dated. 1420–1130 cal BC (3045 ± 40 bp; GrA-23692) 1420–1230 cal BC (3071 ± 33 bp; OxA-12491)	P (R)		A	Carruthers (2009)
12	Scarcewater	MBA		5		48	Jones (2010)
13	Downsview	MBA		125*		78	Hinton (2002a)
14	Tremough	MBA		2		15	Jones (2015)
15	Trevilson	MBA	Abundant *V. faba* fragments.	293*		81	Jones (2004)
16	Hayne Lane	MBA		11		419	Clapham (1999a)
17	Brean Down	MBA-LBA		3		107	Straker (41990)

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	Site name	Period	Comments	Beans	Peas/ beans	Cereals	References
18	Rowden	MBA-LBA		129*		15,784	Carruthers (1991a)
19	Lower Hoddern Farm	MBA-LBA	*V. faba* directly dated. 1420–1220 cal BC (3060 ± 35 bp; SUERC-30725)	A		A	Allot (2010)
20	Claypit Lane	MBA-LBA		1		1074	Hinton (2006)
21	Redwick	MBA-LBA		1		1	Caseldine *et al.* (2013)
22	Mile Oak Farm	MBA-LBA		10		990	Hinton (2002b)
23	Blackpatch	MBA-LBA		11		185	Hinton (1982)
24	Mackie Avenue	MBA-LBA	*V. faba* directly dated. 1200–970 cal BC (2890 ± 30 bp; SUERC-20209)	55	30		Smith (2010)
25	Poundbury	MBA-LBA		8	4	5749	Pelling (2011)
26	Patcham Fawcett B	MBA-LBA		1		P	Hinton (1997 cited in Tapper 2011, 199)
27	Herne Bay	LBA		2		24	Stevens n.d.
28	Kite's Corner	LBA		P		P	Walker *et al.* (1999 cited in Bell 2013)
29	Centenary House	LBA		1		36	Hinton (forthcoming)
30	Springfield Lyons	LBA	*V. faba* directly dated. 1010–840 cal BC; 2785 ± 29 bp; OxA-20522)	3		1487	Murphy (2013)
31	Broadley Road	LBA?		6		17	Stevens and Challinor (2009)
32	Saltwood Tunnel	LBA	*V. faba* pod fragments present. Evidence for insect infestation. *V. faba* directly dated. 1120–910 cal BC (2847 ± 35 bp; NZA-19637)	6931*		2602*	Stevens (2006a)
33	Foster's field	LBA		2238*		14,282	Jones (2009, 2012)
34	Frog Hall Farm	LBA	*V. faba* directly dated. 1120–790 cal BC (2760 ± 80 bp; HAR-2502)	500*			Murphy (2001)
35	Cobham Golf Course	LBA		1		10	Davis (2006)
36	South Hornchurch	LBA?		1		P	Scaife (2000)
37	Reading Business Park	LBA		1		14	Campbell (1992a)
38	Callestick	LBA		1		7	Gilbert and Straker (1999)
39	Lofts Farm	LBA		1		218	Murphy (1988)
40	Cliffs End Farm	LBA	*V. faba* directly dated. 980–810 cal BC (2740 ± 30 bp; SUERC-24079)	26		639	Stevens (2014)
41	Chisenbury	LBA-EIA		1?		43	Carruthers (2010b)
42	Hayne Lane	LBA-EIA		17		2099	Clapham (1999a)
43	Highdown School	LBA-EIA?		1		P	Allot (2009)
44	Slough House Farm	EIA		1		19	Murphy (1998)
45	Samson	EIA		1		330	Straker (1992)
46	Gussage All Saints	EIA		2		P	Evans and Jones (1979)
47	Wanlip	EIA-MIA			2	405	Monckton (1998)
48	Halangy Porth	MIA		3			Murphy (1983)
49	Gravelly Guy	MIA		1		3761	Moffett (2004)
50	Kingsborough	MIA		3		128	Stevens (2008)
51	Beechbrook Wood	MIA		12		19	Giorgi (2006b)
52	Stanford Wharf	MIA			1	1426	Hunter (2012)
53	The Moor	MIA-LIA		37		694	de Carle (2014)
54	Sigwells West	MIA-LIA		4		4108	de Carle (2014)
55	Winnal Down	MIA-LIA		1		P	Monk and Fasham (1980)
56	Blackhorse	MIA-LIA		1		392	Clapham (1999b)
57	Glastonbury Lake Village	MIA-LIA	'Many litres' of beans	A		A	Reid (1917), Helbaek (1953)
58	Meare Village East	MIA-LIA	Evidence for insect infestation.	666*		2684	Caseldine (1987), Helbaek (1953), Housley (1987)
59	Meare Village West	MIA-LIA		14/A		2328	G. Jones (1981, 1986), Coles *et al.* (1986)
60	Le Câtel de Rozel	MIA-LIA	*V. faba* chaff present. Evidence for insect infestation	229		81	Campbell (1992b)
61	Ham Hill	MIA-LIA		P		A	Stevens (2006b, 2012, 2013), Ballantyne (2014)
62	Maiden Castle	MIA-LIA		18		992	Palmer and Jones (1991)

Continued

Continued

	Site name	Period	Comments	Beans	Peas/ beans	Cereals	References
63	West Creech	MIA-LIA		1		P	Carruthers (1991b)
64	Green Island	LIA	Evidence for insect infestation	105*		71	Wessex Archaeology (2003)
65	Springhead	LIA		1		1192	Stevens (2011)
66	Aston Clinton Bypass	LIA		1		1336	Scaife (2008)
67	Hengistbury Head	LIA		R		P	Nye and Jones (1987)
68	Ferrybridge	LIA	Possibly intrusive.	1		P	Alldritt (2005)
69	Gamston	LIA			1	425	Moffett (1991)
70	Westwood	LIA			2	151	Pelling *et al.* (2008)
71	Dragonby	LIA		1(+1?)		771	van der Veen (1996a)
72	Portland Gas Pipeline	LIA-RB	Possibly Roman.	1		P	Wessex Archaeology (2007)
73	Thanet Earth	IA		A		A	Allison *et al.* (2010)
74	Owslebury	IA		P		P	Murphy (1977 in M.K. Jones)
75	Stonea	MIA-RB	Possibly Roman	1		331	van der Veen (1996b)

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