**Cultivating Villa Economies: Archaeobotanical and Isotopic Evidence for Iron Age to Roman Agricultural Practices on the Chalk Downlands of Southern Britain**

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**Supplementary Material**

**Site Overviews**

The archaeological sites are located near Stockbridge, Hampshire, in central-southern Britain. Danebury and the Danebury environs sites were excavated by Barry Cunliffe and the University of Oxford overall several decades; Danebury hillfort (1969–1988), Danebury environs (1990–1996), and Danebury Roman environs (1998–2006). The resultant research archive, curated at the Winchester Cultural Trust, provides a high-quality archive of archaeological and environmental remains. The archaeological sequences have been published in a series of monographs (Cunliffe, 1995, 2000; Cunliffe & Poole, 2008a). A recent re-dating project is ongoing (Hamilton et al., 2015). After the initial research project, a number of research projects have conducted a range of scientific analyses on the environmental and human remains; archaeobotanical (Lightfoot & Stevens, 2012), human skeletal (Stevens et al., 2013a), and faunal (Suddern Farm, Nettlebank Copse, Bury Hill, New Buildings, Houghton Down) (Stevens et al., 2013b). For stable isotope analysis, further detail is provided below.

**Danebury hillfort**

Danebury hillfort (SU32 3376) is a large multivallate hillfort located on the highest point within its chalk landscape. It was extensively investigated in a twenty-year excavation programme (Cunliffe, 1984, 1995; Cunliffe & Poole, 1991). The hillfort was occupied in the Early and Middle Iron Age and its phasing is based on a well-stratified sequence behind the ramparts, much of the interior disturbed and was phased with ceramics (Davis, 2013: 354). The major phases of activity consist of an early phase of a univallate hillfort within a hilltop enclosure, and later elaboration of the ramparts in a late period (270–50 bc). During the latter phase, from which the archaeobotanical samples were taken, the wider landscape around Danebury was depopulated. It is suggested that the surrounding landscape was farmed by residents of the hillfort(Cunliffe, 2000)**.**

The assemblage of bioarchaeological remains at Danebury have been subject to a range of isotopic analyses, including humans and fauna with δ13C, δ15N, and δ34S (Stevens et al., 2010; Lightfoot & Stevens, 2012; Stevens et al., 2013a, 2013b; Hamilton et al., 2019), plus re-assessments of the radiocarbon dating (Cunliffe et al., 2015; Hamilton et al., 2015). Re-analysis of Danebury has also focused on the architectural evidence for round houses (Davis, 2013, 2018), and broader settlement history (Sharples, 2010).

**Suddern Farm**

Located 5km south-west of Danebury on a chalk spur overlooking a valley (SU27900 37600), Suddern Farm consists of a series of enclosed settlements. Occupation at the settlement spans from the early Iron Age (eighth/seventh century bc) to the fourth century ad. A high-status site in the Late Iron Age was possibly established there, given an elaboration of the enclosure ditches in this period (Cunliffe & Poole, 2000a). Faunal isotope data is available: δ13C, δ15N, and δ34S (Hamilton et al., 2019) and δ13C, δ15N and human δ13C, δ15N from a Late Iron Age cemetery (Stevens et al., 2013a). Archaeobotanical samples studied here derive from pits in the Late Iron Age phase of activity.

**Nettlebank Copse**

Located to the north-east of Danebury (SU34000 39000), Nettlebank Copse is a Late Iron Age banjo settlement located on shallow spur within a dry valley. Activity at the banjo enclosure spans from *c.* 300 bc to the mid-first century ad. The seasonal basis of site activity has been suggested on the basis of faunal and floral remains (Cunliffe & Poole, 2000b). The site has previously been studied for faunal isotope data (Stevens et al., 2013).

**Dunkirt Barn**

Located at SU31400 41900, this site’s earliest activity was in the form of a Late Iron Age banjo enclosure, followed by a further enclosure with a range of paddocks and enclosures considered to date to the late first century bc. A timber building was constructed in the second century ad within a system of rectilinear enclosures. The first single-roomed masonry building was constructed in the third century ad, followed by the construction of a strip house in the late third century ad, initially with a corn-drying oven, and subsequently with the addition in the early fourth century of a bath house, substantial aisled hall with hypocaust, garden with hexagonal structure, plus numerous masonry buildings located beyond the excavation area. This phase is classified as a large-winged corridor villa, with a series of corn-dryers, and substantial villa estate. Archaeobotanical samples derive from Mid-Roman floor deposits, and a Late Roman corn drier (Cunliffe & Poole, 2008c)**.**

**Grateley South**

The site of Grateley South (SU27650 41150) is located on an area of rich clay soils, 4 km north of Danebury. Occupation spanned the Late Iron Age (*c*. mid-first century bc) to the late fourth century ad. The earliest activity consisted of a Late Iron Age banjo enclosure. In the earlier Roman period (*c.* 50–300 ad), activity was represented by several timber structures and enclosures, considered to be part of a more extensive Roman farmstead, and included a double T-shaped corn-drying oven. A masonry villa complex was constructed, in *c.* 300 ad, including four or five masonry buildings, aisled hall, crop-processing buildings, and corn-drying ovens. Archaeobotanical samples derive principally from the Late Roman corn-drying structures, other burnt grain deposits, ovens, and pits in Building 4 (Cunliffe & Poole, 2008a)**.**

**Methods Statement**

**Archaeobotanical methods**

Quantified charred plant remains data was tabulated from the first Danebury report (M. Jones, 1984), Danebury environs reports (Campbell, 2000a, 2000b, 2000c, 2000d, 2000e), and the Danebury enivrons Roman project e-texts (School of Archaeology, 2021). The number of samples per site is listed in Table S1. The sum of crop items is presented in Table S2.

**Supplementary Table S1.** Summary of archaeobotanical assemblages analysed in this article.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Site** | **Site type** | **Date range** | **No. archaeobotany samples** | **No. crop isotope samples** |
| Bury Hill | Hillfort | Mid Iron Age (5th c. bc–360 bc) | 10 |  |
| Bury Hill | Hillfort | Late Iron Age (50 bc–50 ad) | 1 |  |
| Danebury | Hillfort | Mid Iron Age (270–50 bc) | 10 | 51 |
| Houghton Down | Farmstead | Mid Iron Age | 15 |  |
| Houghton Down | Villa | Late Roman (4th c. ad) | 2 |  |
| Houghton Down | Villa | Roman (43–410 ad) | 2 |  |
| Rowbury Farm | Farmstead | Mid Iron Age | 3 |  |
| Rowbury Farm | Farmstead | Early Roman | 1 |  |
| Rowbury Farm | Farmstead | Roman | 1 |  |
| Grateley | Banjo enclosure | Late Iron Age (50 bc –50 ad) | 5 | 3 |
| Grateley | Banjo enclosure | Early Roman (1st/2nd c. ad) | 1 |  |
| Nettlebank Copse | Banjo enclosure | Late Iron Age (50 bc–50 ad) | 11 | 14 |
| Suddern Farm | Farmstead | Late Iron Age (50 bc –50 AD) | 10 | 18 |
| Thruxton | Farmstead | Late Iron Age (50 bc–50 ad) | 2 |  |
| Thruxton | Villa | Late Roman (4th c. ad) | 2 |  |
| Woolbury | Farmstead | Early Roman (late 1st–2nd c. ad) | 2 |  |
| Woolbury | Farmstead | Roman (2nd–4th c. ad) | 2 |  |
| Dunkirt Barn | Villa | Mid Roman | 2 |  |
| Dunkirt Barn | Villa | Late Roman (4th c. ad) | 5 | 10 |
| Fullerton | Villa | Late Roman (4th c. ad) | 10 |  |
| Grateley South | Villa | Mid/Late Roman (2nd–4th c. ad) | 33 | 28 |

**Supplementary Table S2.** Summary of all crop counts per period at sites in the study region. EIA: Early Iron Age; MIA: Mid Iron Age; LIA: Late Iron Age; ER: Early Roman; MR: Mid Roman; LR: Late Roman.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site** | **Period** | **No. of samples** | **Total sample vol/l** | **Barley grain** | **Emmer grain** | **Spelt grain** | **Spelt/emmer grain** | **Free-threshing wheat grain** | **Pea** | **Pea/**  **Bean** | **Barley rachis** | **Emmer glume base** | **Spelt glume base** | **Spelt/emmer glume base** | **Free-threshing wheat rachis** | **Rye rachis** |
| Danebury | EIA | 15 |  | 136 | 4 |  | 30 | 37 |  |  | 41 |  |  | 2417 |  | 1 |
| Flint Farm | EIA | 5 |  | 22 |  | 6 | 23 |  |  |  | 18 | 15 | 190 | 722 |  |  |
| Houghton Down | EIA | 1 | 1000 | 1 |  |  | 1 |  |  |  |  |  | 16 | 62 |  |  |
| Nettlebank Copse | EIA | 17 | 1608 | 667 | 5 | 63 | 232 |  |  |  | 109 | 94 | 1257 | 4935 |  |  |
| Rowbury Farm | EIA | 3 | 4075 | 50 |  | 15 | 27 |  |  |  | 38 |  | 110 | 346 |  |  |
| Woolbury | EIA | 1 |  | 2 |  |  |  |  |  |  | 1 |  |  | 3 |  |  |
| Bury Hill | MIA | 10 | 6709 | 7928 | 4 | 4463 | 9073 |  |  |  | 49 | 162 | 17175 | 26996 |  |  |
| Danebury | MIA | 9 |  | 96 | 5 |  | 22 | 3 |  |  | 8 |  |  | 384 |  |  |
| Houghton Down | MIA | 15 | 13303 | 180 | 1 | 26 | 79 |  |  |  | 129 | 40 | 1606 | 5114 | 1 |  |
| Rowbury Farm | MIA | 3 | 4700 | 57 |  | 36 | 76 |  |  |  | 41 |  | 563 | 2019 |  | 8 |
| Bury Hill | LIA | 1 | 214 | 1 |  |  |  |  |  |  |  |  |  | 1 |  |  |
| Danebury | LIA | 1 |  | 44 | 3 |  | 85 | 1 |  |  |  |  |  | 44 |  |  |
| Grateley South | LIA | 5 | 3286 | 368 |  | 9 | 55 |  | 1 | 1 | 35 |  | 201 | 430 |  |  |
| Nettlebank Copse | LIA | 11 | 8285 | 1495 |  | 18 | 85 |  | 2 | 2 | 432 | 8 | 1527 | 9037 |  |  |
| Suddern Farm | LIA | 10 | 11685 | 6792 | 12 | 9574 | 20205 |  | 5 | 5 | 1877 | 25 | 8975 | 16349 |  |  |
| Thruxton | LIA | 2 |  | 64 | 7 | 2 | 9 |  |  |  | 29 | 718 | 21 | 739 |  |  |
| Grateley South | ER | 1 | 95 | 24 |  | 20 | 136 |  |  |  | 4 | 4 | 192 | 532 |  |  |
| Rowbury Farm | ER | 1 | 1400 | 26 |  |  | 8 |  |  |  | 16 |  | 73 | 242 |  | 2 |
| Woolbury | ER | 2 |  | 180 |  | 1 | 6 | 3 |  |  | 5 |  |  | 10 |  |  |
| Dunkirt Barn | MR | 2 | 1325 | 968 |  | 84 | 264 |  |  |  | 12 |  | 96 | 304 |  |  |
| Dunkirt Barn | LR | 5 | 1820 | 440 | 11 | 681 | 1913 |  |  |  | 217 |  | 2922 | 5015 | 1 |  |
| Fullerton | LR | 10 | 6605 | 2053 |  | 102 | 287 |  |  |  | 107 |  | 475 | 1538 | 3 |  |
| Grateley South | LR | 33 | 5820 | 7010 | 680 | 32634 | 62233 | 746 | 32 | 32 | 1216 | 128 | 38504 | 112422 | 64 |  |
| Houghton Down | LR | 2 | 850 | 13 | 1 |  | 4 |  |  |  |  |  | 3 | 11 |  |  |
| Thruxton | LR | 2 |  | 2 | 3 |  | 3 |  |  |  | 2 | 11 | 2 | 13 |  |  |
| Houghton Down | Roman | 2 | 850 | 5 |  | 2 | 4 |  |  |  | 1 |  | 29 | 125 |  |  |
| Rowbury Farm | Roman | 1 | 825 | 9 |  |  | 1 |  |  |  | 1 |  | 13 | 59 |  |  |
| Woolbury | Roman | 2 |  | 1 |  |  | 1 |  |  |  |  |  | 2 | 4 |  |  |

Crop processing analysis was undertaken to assign samples to crop-processing stages. Ratios were calculated following Van der Veen & Jones (2006). Discriminant analysis was undertaken in R package MASS using physical weed types as assigned in previous studies (Lodwick, 2014; McKerracher, 2019), in comparison to ethnographic data from Kolofana following G. Jones (1984). The results of the crop-processing analysis are presented in Table S3.

***Supplementary Table S3.*** *Results of crop-processing analysis.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site/sample** | **Barley grain** | **Barley rachis** | **Coleoptile** | **Culm node** | **FTW grain** | **FTW rachis** | **GW GB** | **GW grain** | **Max barley** | **Max GW** | **Max FTW** | **% barley** | **% GW** | **% FTW** | **Crop type** | **GW ratio** | **Barley ratio** | **FTW ratio** | **PROC** | **Combined outcome** |
| Bury Hill\_103 | 127 | 0 | 1 | 0 | 0 | 0 | 3 | 0 | 127 | 3 | 0 | 98 | 2 | 0 | barley | 0 | 127 |  |  | Mixed |
| Bury Hill\_105 | 13 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 13 | 4 | 0 | 76 | 24 | 0 | barley | 1.3 | 13 |  |  | Mixed |
| Bury Hill\_106 | 7640 | 40 | 560 | 40 | 0 | 0 | 26840 | 9000 | 7640 | 26840 | 0 | 22 | 78 | 0 | GW | 0.3 | 191 |  | 4 | GW FSBP presvd |
| Bury Hill\_113 | 7 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 7 | 2 | 0 | 78 | 22 | 0 | barley | 2 |  |  | 1 | Mixed |
| Bury Hill\_116 | 52 | 0 | 4 | 0 | 0 | 0 | 2 | 17 | 52 | 17 | 0 | 75 | 25 | 0 | barley | 8.5 | 52 |  | 3 | Mixed |
| Bury Hill\_121 | 1 | 0 | 0 | 0 | 0 | 0 | 9 | 7 | 1 | 9 | 0 | 10 | 90 | 0 | GW | 0.8 |  |  |  | Mixed |
| Bury Hill\_130 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 50 | 50 | 0 | mixed | 0 |  |  |  | Mixed |
| Bury Hill\_138 | 9 | 0 | 0 | 0 | 0 | 0 | 6 | 11 | 9 | 11 | 0 | 45 | 55 | 0 | mixed | 1.8 |  |  |  | Mixed |
| Bury Hill\_324 | 23 | 6 | 0 | 1 | 0 | 0 | 65 | 4 | 23 | 65 | 0 | 26 | 74 | 0 | GW | 0.1 | 3.8 |  | 3 | GW FSBP |
| Bury Hill\_94 | 55 | 2 | 1 | 1 | 0 | 0 | 65 | 26 | 55 | 65 | 0 | 46 | 54 | 0 | mixed | 0.4 | 27.5 |  | 3 | Mixed |
| Bury Hill\_97 | 1 | 1 | 1 | 0 | 0 | 0 | 2 | 2 | 1 | 2 | 0 | 33 | 67 | 0 | mixed | 1 |  |  |  | Mixed |
| Danebury\_V2 | 2 | 1 | 0 | 0 | 0 | 0 | 17 | 1 | 2 | 17 | 0 | 11 | 89 | 0 | GW | 0.1 |  |  |  | Mixed |
| Danebury\_V27-28 | 13 | 1 | 0 | 0 | 0 | 0 | 25 | 0 | 13 | 25 | 0 | 34 | 66 | 0 | mixed | 0 | 13 |  | 4 | Mixed |
| Danebury\_V3 | 1 | 1 | 0 | 0 | 0 | 0 | 9 | 0 | 1 | 9 | 0 | 10 | 90 | 0 | GW | 0 |  |  |  | Mixed |
| Danebury\_V32-34 | 5 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 5 | 15 | 0 | 25 | 75 | 0 | GW | 0 |  |  |  | Mixed |
| Danebury\_V39-40 | 27 | 1 | 0 | 0 | 0 | 0 | 62 | 10 | 27 | 62 | 0 | 30 | 70 | 0 | GW | 0.2 | 27 |  |  | Mixed |
| Danebury\_V4 | 12 | 3 | 0 | 0 | 0 | 0 | 38 | 1 | 12 | 38 | 0 | 24 | 76 | 0 | GW | 0 | 4 |  | 4 | GW FSBP presvd |
| Danebury\_V41-46 | 44 | 0 | 0 | 0 | 1 | 0 | 44 | 85 | 44 | 85 | 1 | 34 | 65 | 1 | mixed | 1.9 | 44 |  | 4 | Mixed |
| Danebury\_V5 | 21 | 0 | 0 | 0 | 0 | 0 | 78 | 4 | 21 | 78 | 0 | 21 | 79 | 0 | GW | 0.1 | 21 |  | 4 | GW FSBP presvd |
| Danebury\_V6 | 14 | 0 | 0 | 0 | 0 | 0 | 51 | 2 | 14 | 51 | 0 | 22 | 78 | 0 | GW | 0 | 14 |  | 4 | GW FSBP presvd |
| Danebury\_V8 | 1 | 1 | 0 | 1 | 0 | 0 | 89 | 4 | 1 | 89 | 0 | 1 | 99 | 0 | GW | 0 |  |  | 4 | GW FSBP presvd |
| Dunkirt Barn\_4666 | 120 | 32 | 152 | 0 | 0 | 0 | 1264 | 552 | 120 | 1264 | 0 | 9 | 91 | 0 | GW | 0.4 | 3.8 |  | 3 | GW FSBP |
| Dunkirt Barn\_4690 | 168 | 8 | 352 | 0 | 0 | 0 | 1192 | 1152 | 168 | 1192 | 0 | 12 | 88 | 0 | GW | 1 | 21 |  | 2 | Mixed |
| Dunkirt Barn\_4704 | 22 | 173 | 28 | 4 | 0 | 1 | 2432 | 19 | 519 | 2432 | 1 | 18 | 82 | 0 | GW | 0 | 0.1 |  | 3 | GW FSBP |
| Dunkirt Barn\_4721 | 132 | 8 | 176 | 0 | 0 | 0 | 300 | 224 | 132 | 300 | 0 | 31 | 69 | 0 | mixed | 0.7 | 16.5 |  | 1 | Mixed |
| Dunkirt Barn\_4736 | 13 | 2 | 3 | 0 | 0 | 0 | 75 | 7 | 13 | 75 | 0 | 15 | 85 | 0 | GW | 0.1 | 6.5 |  | 3 | GW FSBP |
| Dunkirt Barn\_4738 | 117 | 2 | 75 | 0 | 0 | 0 | 52 | 183 | 117 | 183 | 0 | 39 | 61 | 0 | mixed | 3.5 | 58.5 |  | 3 | Mixed |
| Dunkirt Barn\_4743 | 836 | 4 | 252 | 0 | 0 | 0 | 4 | 40 | 836 | 40 | 0 | 95 | 5 | 0 | barley | 10 | 209 |  | 3 | Mixed |
| Fullerton\_3828 | 20 | 22 | 74 | 4 | 0 | 0 | 182 | 30 | 20 | 182 | 0 | 10 | 90 | 0 | GW | 0.2 | 0.9 |  | 3 | GW FSBP |
| Fullerton\_3831 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 100 | 0 | GW | 0 |  |  |  | Mixed |
| Fullerton\_3833 | 148 | 36 | 68 | 0 | 0 | 0 | 472 | 108 | 148 | 472 | 0 | 24 | 76 | 0 | GW | 0.2 | 4.1 |  | 3 | GW FSBP |
| Fullerton\_3836 | 2 | 0 | 33 | 1 | 0 | 0 | 309 | 4 | 2 | 309 | 0 | 1 | 99 | 0 | GW | 0 |  |  | 3 | GW FSBP |
| Fullerton\_3871 | 0 | 0 | 0 | 0 | 0 | 1 | 26 | 0 | 0 | 26 | 1 | 0 | 96 | 4 | GW | 0 |  |  |  | Mixed |
| Fullerton\_3892 | 352 | 8 | 52 | 2 | 0 | 2 | 150 | 82 | 352 | 150 | 2 | 70 | 30 | 0 | barley | 0.5 | 44 |  | 4 | Barley FSP |
| Fullerton\_3893 | 1 | 2 | 3 | 0 | 0 | 0 | 30 | 9 | 1 | 30 | 0 | 3 | 97 | 0 | GW | 0.3 |  |  | 3 | GW FSBP |
| Fullerton\_3894 | 8 | 5 | 12 | 2 | 0 | 0 | 14 | 2 | 8 | 14 | 0 | 36 | 64 | 0 | mixed | 0.1 |  |  | 4 | Mixed |
| Fullerton\_38951 | 1516 | 28 | 100 | 0 | 0 | 0 | 128 | 44 | 1516 | 128 | 0 | 92 | 8 | 0 | barley | 0.3 | 54.1 |  | 3 | Mixed |
| Fullerton\_4060 | 6 | 6 | 10 | 2 | 0 | 0 | 227 | 7 | 6 | 227 | 0 | 3 | 97 | 0 | GW | 0 |  |  | 3 | GW FSBP |
| Grateley South\_2734 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 100 | 0 | 0 | barley |  |  |  |  | Mixed |
| Grateley South\_2749 | 0 | 0 | 2 | 0 | 0 | 0 | 36 | 8 | 0 | 36 | 0 | 0 | 100 | 0 | GW | 0.2 |  |  | 4 | GW FSBP presvd |
| Grateley South\_2847 | 284 | 0 | 12 | 0 | 0 | 0 | 72 | 32 | 284 | 72 | 0 | 80 | 20 | 0 | barley | 0.4 | 284 |  | 4 | Barley FSP |
| Grateley South\_2863 | 24 | 4 | 20 | 0 | 0 | 0 | 532 | 136 | 24 | 532 | 0 | 4 | 96 | 0 | GW | 0.3 | 6 |  | 4 | GW FSBP presvd |
| Grateley South\_2879 | 0 | 0 | 0 | 0 | 0 | 0 | 564 | 4 | 0 | 564 | 0 | 0 | 100 | 0 | GW | 0 |  |  | 3 | GW FSBP |
| Grateley South\_3141 | 56 | 20 | 0 | 0 | 0 | 0 | 268 | 20 | 56 | 268 | 0 | 17 | 83 | 0 | GW | 0.1 | 2.8 |  | 3 | GW FSBP |
| Grateley South\_3196 | 64 | 0 | 1024 | 0 | 0 | 0 | 7232 | 3144 | 64 | 7232 | 0 | 1 | 99 | 0 | GW | 0.4 | 64 |  | 1 | Mixed |
| Grateley South\_3200 | 8 | 0 | 24 | 0 | 128 | 0 | 4672 | 448 | 8 | 4672 | 128 | 0 | 97 | 3 | GW | 0.1 |  | 128 | 3 | GW FSBP |
| Grateley South\_3205 | 584 | 0 | 128 | 0 | 0 | 0 | 3648 | 1368 | 584 | 3648 | 0 | 14 | 86 | 0 | GW | 0.4 | 584 |  | 4 | GW FSBP presvd |
| Grateley South\_3209 | 2400 | 0 | 4544 | 0 | 0 | 0 | 23280 | 22096 | 2400 | 23280 | 0 | 9 | 91 | 0 | GW | 0.9 | 2400 |  | 4 | GW spikelets svd |
| Grateley South\_3210 | 64 | 0 | 256 | 0 | 0 | 0 | 2176 | 2192 | 64 | 2192 | 0 | 3 | 97 | 0 | GW | 1 | 64 |  | 4 | GW spikelets svd |
| Grateley South\_3214 | 48 | 0 | 32 | 0 | 0 | 0 | 336 | 772 | 48 | 772 | 0 | 6 | 94 | 0 | GW | 2.3 | 48 |  | 4 | GW FSP |
| Grateley South\_3218 | 16 | 0 | 16 | 0 | 0 | 0 | 224 | 360 | 16 | 360 | 0 | 4 | 96 | 0 | GW | 1.6 | 16 |  |  | Mixed |
| Grateley South\_3219 | 112 | 0 | 0 | 0 | 112 | 0 | 640 | 1776 | 112 | 1776 | 112 | 6 | 89 | 6 | GW | 2.8 | 112 | 112 | 4 | GW FSP |
| Grateley South\_3223 | 128 | 0 | 128 | 0 | 160 | 0 | 656 | 1672 | 128 | 1672 | 160 | 7 | 85 | 8 | GW | 2.5 | 128 | 160 | 4 | GW FSP |
| Grateley South\_3227 | 256 | 0 | 160 | 0 | 0 | 0 | 1312 | 2740 | 256 | 2740 | 0 | 9 | 91 | 0 | GW | 2.1 | 256 |  | 4 | GW FSP |
| Grateley South\_3240 | 1280 | 0 | 352 | 0 | 96 | 0 | 3328 | 2240 | 1280 | 3328 | 96 | 27 | 71 | 2 | GW | 0.7 | 1280 | 96 | 4 | GW FSBP presvd |
| Grateley South\_3243 | 800 | 32 | 224 | 0 | 64 | 32 | 38912 | 9792 | 800 | 38912 | 64 | 2 | 98 | 0 | GW | 0.3 | 25 | 2 | 4 | GW FSBP presvd |
| Grateley South\_3295 | 36 | 702 | 18 | 0 | 36 | 0 | 18 | 2448 | 2106 | 2448 | 36 | 46 | 53 | 1 | mixed | 136 | 0.1 | 36 | 4 | Mixed |
| Grateley South\_3298 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |  |  |  |  |  | Mixed |
| Grateley South\_3300 | 1 | 0 | 1 | 0 | 0 | 0 | 14 | 0 | 1 | 14 | 0 | 7 | 93 | 0 | GW | 0 |  |  |  | Mixed |
| Grateley South\_3301 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 100 | 0 | 0 | barley |  |  |  |  | Mixed |
| Grateley South\_3302 | 4 | 0 | 74 | 0 | 0 | 0 | 28 | 2 | 4 | 28 | 0 | 12 | 88 | 0 | GW | 0.1 |  |  |  | Mixed |
| Grateley South\_3325 | 20 | 0 | 46 | 0 | 0 | 0 | 160 | 55 | 20 | 160 | 0 | 11 | 89 | 0 | GW | 0.3 | 20 |  | 1 | Mixed |
| Grateley South\_3326 | 3 | 5 | 1015 | 0 | 0 | 0 | 316 | 14 | 3 | 316 | 0 | 1 | 99 | 0 | GW | 0 |  |  | 3 | GW FSBP |
| Grateley South\_3345 | 14 | 10 | 1 | 0 | 0 | 0 | 3 | 0 | 14 | 3 | 0 | 82 | 18 | 0 | barley | 0 | 1.4 |  |  | Mixed |
| Grateley South\_3349 | 64 | 32 | 528 | 0 | 0 | 32 | 11456 | 400 | 64 | 11456 | 32 | 1 | 99 | 0 | GW | 0 | 2 |  | 1 | Mixed |
| Grateley South\_3355 | 40 | 8 | 40 | 0 | 12 | 0 | 608 | 608 | 40 | 608 | 12 | 6 | 92 | 2 | GW | 1 | 5 | 12 | 1 | Mixed |
| Grateley South\_3356 | 12 | 0 | 28 | 0 | 4 | 0 | 180 | 168 | 12 | 180 | 4 | 6 | 92 | 2 | GW | 0.9 | 12 |  | 1 | Mixed |
| Grateley South\_3357 | 16 | 0 | 40 | 0 | 0 | 0 | 160 | 252 | 16 | 252 | 0 | 6 | 94 | 0 | GW | 1.6 | 16 |  | 1 | Mixed |
| Grateley South\_33582 | 16 | 0 | 40 | 4 | 0 | 0 | 84 | 88 | 16 | 88 | 0 | 15 | 85 | 0 | GW | 1 | 16 |  |  | Mixed |
| Grateley South\_3359 | 4 | 0 | 68 | 0 | 0 | 0 | 160 | 148 | 4 | 160 | 0 | 2 | 98 | 0 | GW | 0.9 |  |  |  | Mixed |
| Grateley South\_3360 | 42 | 4 | 264 | 0 | 2 | 0 | 158 | 598 | 42 | 598 | 2 | 7 | 93 | 0 | GW | 3.8 | 10.5 |  | 1 | Mixed |
| Grateley South\_3362 | 10 | 5 | 1 | 0 | 0 | 0 | 59 | 1 | 10 | 59 | 0 | 14 | 86 | 0 | GW | 0 | 10 |  | 4 | GW FSBP presvd |
| Grateley South\_3368 | 4 | 0 | 0 | 1 | 0 | 0 | 28 | 2 | 4 | 28 | 0 | 12 | 88 | 0 | GW | 0.1 |  |  | 4 | GW FSBP presvd |
| Grateley South\_3446 | 32 | 416 | 96 | 0 | 0 | 0 | 320 | 2528 | 1248 | 2528 | 0 | 33 | 67 | 0 | mixed | 7.9 | 0.1 |  | 4 | Mixed |
| Grateley South\_34471 | 0 | 0 | 328 | 0 | 0 | 0 | 3016 | 16 | 0 | 3016 | 0 | 0 | 100 | 0 | GW | 0 |  |  | 3 | GW FSBP |
| Grateley South\_3461 | 800 | 16 | 144 | 0 | 0 | 0 | 6784 | 5456 | 800 | 6784 | 0 | 11 | 89 | 0 | GW | 0.8 | 50 |  | 4 | GW spikelets svd |
| Grateley South\_3462 | 152 | 0 | 160 | 0 | 0 | 0 | 1944 | 840 | 152 | 1944 | 0 | 7 | 93 | 0 | GW | 0.4 | 152 |  | 1 | Mixed |
| Houghton Down\_2238 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 3 | 0 | 50 | 50 | 0 | mixed | 0 |  |  |  | Mixed |
| Houghton Down\_2263 | 16 | 4 | 0 | 3 | 0 | 0 | 24 | 6 | 16 | 24 | 0 | 40 | 60 | 0 | mixed | 0.2 | 4 |  | 4 | Mixed |
| Houghton Down\_2264 | 12 | 6 | 3 | 9 | 0 | 0 | 99 | 7 | 12 | 99 | 0 | 11 | 89 | 0 | GW | 0.1 | 2 |  | 4 | GW FSBP presvd |
| Houghton Down\_2273 | 17 | 15 | 22 | 4 | 0 | 0 | 526 | 19 | 17 | 526 | 0 | 3 | 97 | 0 | GW | 0 | 1.1 |  | 3 | GW FSBP |
| Houghton Down\_2280 | 9 | 10 | 28 | 3 | 0 | 0 | 567 | 7 | 9 | 567 | 0 | 2 | 98 | 0 | GW | 0 |  |  | 1 | Mixed |
| Houghton Down\_2288 | 48 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 48 | 3 | 0 | 94 | 6 | 0 | barley | 0 | 48 |  | 3 | Mixed |
| Houghton Down\_2294 | 5 | 2 | 0 | 31 | 0 | 0 | 8 | 1 | 5 | 8 | 0 | 38 | 62 | 0 | mixed | 0.1 |  |  | 4 | Mixed |
| Houghton Down\_2304 | 3 | 2 | 0 | 4 | 0 | 0 | 10 | 0 | 3 | 10 | 0 | 23 | 77 | 0 | GW | 0 |  |  | 3 | GW FSBP |
| Houghton Down\_2313 | 31 | 60 | 1 | 41 | 0 | 0 | 1480 | 12 | 31 | 1480 | 0 | 2 | 98 | 0 | GW | 0 | 0.5 |  | 4 | GW FSBP presvd |
| Houghton Down\_2322 | 13 | 1 | 0 | 0 | 0 | 1 | 64 | 5 | 13 | 64 | 1 | 17 | 82 | 1 | GW | 0.1 | 13 |  | 4 | GW FSBP presvd |
| Houghton Down\_2327 | 2 | 5 | 0 | 1 | 0 | 0 | 79 | 4 | 2 | 79 | 0 | 2 | 98 | 0 | GW | 0.1 |  |  | 4 | GW FSBP presvd |
| Houghton Down\_2331 | 2 | 1 | 0 | 0 | 0 | 0 | 13 | 0 | 2 | 13 | 0 | 13 | 87 | 0 | GW | 0 |  |  |  | Mixed |
| Houghton Down\_2335 | 0 | 1 | 0 | 0 | 0 | 0 | 8 | 0 | 3 | 8 | 0 | 27 | 73 | 0 | GW | 0 |  |  | 3 | GW FSBP |
| Houghton Down\_2350 | 16 | 17 | 52 | 39 | 0 | 0 | 2102 | 9 | 16 | 2102 | 0 | 1 | 99 | 0 | GW | 0 | 0.9 |  | 3 | GW FSBP |
| Houghton Down\_2360 | 6 | 4 | 0 | 1 | 0 | 0 | 128 | 9 | 6 | 128 | 0 | 4 | 96 | 0 | GW | 0.1 |  |  | 4 | GW FSBP presvd |
| Houghton Down\_2364 | 5 | 1 | 0 | 1 | 0 | 0 | 125 | 4 | 5 | 125 | 0 | 4 | 96 | 0 | GW | 0 |  |  |  | Mixed |
| Houghton Down\_2592 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 13 | 4 | 0 | 76 | 24 | 0 | barley | 0 | 13 |  |  | Mixed |
| Houghton Down\_2593 | 0 | 0 | 0 | 1 | 0 | 0 | 11 | 0 | 0 | 11 | 0 | 0 | 100 | 0 | GW | 0 |  |  |  | Mixed |
| Houghton Down\_2595 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |  |  |  |  |  | Mixed |
| Nettlebank Copse\_1502 | 2 | 0 | 0 | 0 | 0 | 0 | 12 | 2 | 2 | 12 | 0 | 14 | 86 | 0 | GW | 0.2 |  |  |  | Mixed |
| Nettlebank Copse\_1515 | 3 | 0 | 0 | 1 | 0 | 0 | 184 | 0 | 3 | 184 | 0 | 2 | 98 | 0 | GW | 0 |  |  | 4 | GW FSBP presvd |
| Nettlebank Copse\_1571 | 100 | 0 | 10 | 0 | 0 | 0 | 97 | 6 | 100 | 97 | 0 | 51 | 49 | 0 | mixed | 0.1 | 100 |  | 4 | Mixed |
| Nettlebank Copse\_1585 | 253 | 42 | 126 | 1 | 0 | 0 | 223 | 7 | 253 | 223 | 0 | 53 | 47 | 0 | mixed | 0 | 6 |  | 4 | Mixed |
| Nettlebank Copse\_1603 | 12 | 16 | 56 | 308 | 0 | 0 | 3536 | 8 | 12 | 3536 | 0 | 0 | 100 | 0 | GW | 0 | 0.8 |  | 4 | GW FSBP presvd |
| Nettlebank Copse\_1607 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 1 | 0 | 12 | 0 | 0 | 100 | 0 | GW | 0.1 |  |  |  | Mixed |
| Nettlebank Copse\_1617 | 12 | 2 | 3 | 0 | 0 | 0 | 66 | 0 | 12 | 66 | 0 | 15 | 85 | 0 | GW | 0 | 6 |  |  | Mixed |
| Nettlebank Copse\_1645 | 112 | 272 | 312 | 8 | 0 | 0 | 3112 | 16 | 112 | 3112 | 0 | 3 | 97 | 0 | GW | 0 | 0.4 |  | 4 | GW FSBP presvd |
| Nettlebank Copse\_1648 | 40 | 68 | 50 | 12 | 0 | 0 | 1588 | 14 | 40 | 1588 | 0 | 2 | 98 | 0 | GW | 0 | 0.6 |  | 4 | GW FSBP presvd |
| Nettlebank Copse\_1658 | 149 | 21 | 19 | 0 | 0 | 0 | 182 | 23 | 149 | 182 | 0 | 45 | 55 | 0 | mixed | 0.1 | 7.1 |  | 4 | Mixed |
| Nettlebank Copse\_1662 | 812 | 11 | 1 | 0 | 0 | 0 | 25 | 8 | 812 | 25 | 0 | 97 | 3 | 0 | barley | 0.3 | 73.8 |  | 4 | Barley FSP |
| Rowbury Farm\_4197 | 26 | 16 | 7 | 5 | 0 | 0 | 242 | 8 | 26 | 242 | 0 | 10 | 90 | 0 | GW | 0 | 1.6 |  | 3 | GW FSBP |
| Rowbury Farm\_4229 | 3 | 7 | 0 | 1 | 0 | 0 | 67 | 2 | 3 | 67 | 0 | 4 | 96 | 0 | GW | 0 |  |  | 4 | GW FSBP presvd |
| Rowbury Farm\_4235 | 31 | 15 | 15 | 25 | 0 | 0 | 415 | 31 | 31 | 415 | 0 | 7 | 93 | 0 | GW | 0.1 | 2.1 |  | 4 | GW FSBP presvd |
| Rowbury Farm\_4239 | 32 | 20 | 32 | 44 | 0 | 0 | 1596 | 44 | 32 | 1596 | 0 | 2 | 98 | 0 | GW | 0 | 1.6 |  | 3 | GW FSBP |
| Suddern Farm\_332 | 12 | 0 | 0 | 15 | 0 | 0 | 50 | 6 | 12 | 50 | 0 | 19 | 81 | 0 | GW | 0.1 | 12 |  | 4 | GW FSBP presvd |
| Suddern Farm\_335 | 3 | 4 | 0 | 0 | 0 | 0 | 45 | 2 | 3 | 45 | 0 | 6 | 94 | 0 | GW | 0 |  |  | 4 | GW FSBP presvd |
| Suddern Farm\_340 | 5 | 1 | 0 | 0 | 0 | 0 | 50 | 4 | 5 | 50 | 0 | 9 | 91 | 0 | GW | 0.1 |  |  | 3 | GW FSBP |
| Suddern Farm\_344 | 6360 | 233 | 566 | 0 | 0 | 0 | 11056 | 20113 | 6360 | 20113 | 0 | 24 | 76 | 0 | GW | 1.8 | 27.3 |  | 4 | GW FSP |
| Suddern Farm\_346 | 200 | 1608 | 5 | 1 | 0 | 0 | 4593 | 23 | 4824 | 4593 | 0 | 51 | 49 | 0 | mixed | 0 | 0.1 |  | 4 | Mixed |
| Suddern Farm\_356 | 4 | 2 | 0 | 0 | 0 | 0 | 105 | 11 | 4 | 105 | 0 | 4 | 96 | 0 | GW | 0.1 |  |  | 3 | GW FSBP |
| Suddern Farm\_358 | 9 | 11 | 0 | 55 | 0 | 0 | 209 | 0 | 9 | 209 | 0 | 4 | 96 | 0 | GW | 0 |  |  | 4 | GW FSBP presvd |
| Suddern Farm\_362 | 142 | 0 | 4 | 11 | 0 | 0 | 77 | 27 | 142 | 77 | 0 | 65 | 35 | 0 | mixed | 0.4 | 142 |  | 4 | Mixed |
| Suddern Farm\_382 | 49 | 14 | 0 | 75 | 0 | 0 | 156 | 19 | 49 | 156 | 0 | 24 | 76 | 0 | GW | 0.1 | 3.5 |  | 4 | GW FSBP presvd |
| Suddern Farm\_386 | 8 | 4 | 0 | 0 | 0 | 0 | 8 | 0 | 8 | 8 | 0 | 50 | 50 | 0 | mixed | 0 |  |  | 4 | Mixed |
| Thruxton\_4072 | 64 | 29 | 45 | 6 | 0 | 0 | 707 | 9 | 64 | 707 | 0 | 8 | 92 | 0 | GW | 0 | 2.2 |  | 3 | GW FSBP |
| Thruxton\_4073 | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 0 | 0 | 32 | 0 | 0 | 100 | 0 | GW | 0 |  |  |  | Mixed |
| Thruxton\_4138 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 100 | 0 | GW | 0 |  |  |  | Mixed |
| Thruxton\_4179 | 2 | 2 | 0 | 0 | 0 | 0 | 12 | 3 | 2 | 12 | 0 | 14 | 86 | 0 | GW | 0.2 |  |  |  | Mixed |
| Woolbury\_1 | 179 | 4 | 20 | 0 | 3 | 0 | 8 | 6 | 179 | 8 | 3 | 94 | 4 | 2 | barley | 0.8 | 44.8 |  |  | Mixed |
| Woolbury\_10 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 3 | 0 | 0 | 100 | 0 | GW | 0.3 |  |  |  | Mixed |
| Woolbury\_12 | 1 | 1 | 4 | 0 | 0 | 0 | 2 | 0 | 1 | 2 | 0 | 33 | 67 | 0 | mixed | 0 |  |  |  | Mixed |
| Woolbury\_14 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 50 | 50 | 0 | mixed | 0 |  |  |  | Mixed |

Autecological values for weed taxa were obtained from local floras (Brewis et al., 1996; Crawley, 2005; Stace, 2010) and other ecological publications or British Ellenberg numbers and species characteristics (Fitter & Peat, 1994; Hill et al., 2004). Weed autecological values have only been investigated for samples classified by ratio analysis and discriminant analysis as deriving from an unmixed crop-processing stage. Weed physical types were classified following Lodwick (2014). The crop and weed components of samples were explored in correspondence analysis using [ca package] in Rstats.

Functional weed ecology analysis was undertaken through comparing the composition of all samples containing over ten likely weed seeds identified to species or groups of taxa. All samples were used, regardless of crop-processing stage, as crop-processing is not considered to lead to any biases in functional weed ecological inferences of crop management intensity (Bogaard et al., 2005). Samples from Danebury and sites in its environs were entered into discriminant analysis alongside samples from modern studies in Haute Provence (extensive) and fields in Asturias (intensive), following Bogaard and colleagues (2016). Samples from all sites in the Danebury and environs study with sufficient weed seeds were included.

**Isotopic Methods**

**Sample selection and screening**

Cereal grains were selected on the basis of the visual characteristics described by Charles and colleagues (2015) which indicate charring conditions between 220 and 240°C for 4–24 hrs, where grains are optimally charred and identifiable to taxa, while sufficiently well-preserved for further analysis (see Nitsch et al., 2015). All grains were sectioned to enable inspection of the charring conditions. Cereal grains were examined under a low-power binocular microscope, and visible surface roots and soil were removed.

Contamination with calcretes, humics, and nitrates was assessed with FTIR (Fourier Transform Infrared Spectroscopy), following Vaiglova et al. (2014). Three samples per site were analysed in triplicate. The selected samples included barley and spelt from a range of contexts. No indication of contamination was observed and so the samples were not pre-treated. In order to account for the isotopic variability within individual cereal ears and fields, usually ten grains per sample were homogenised (Nitsch et al., 2015). Grains were weighed and placed in glass tubes.

Note on other sites: other settlements were investigated during the Danebury Environs and Danebury Environs Roman programmes. The preservation of cereals grains at other Middle Iron Age to Roman site phases was outside the charring window specified in Nitsch et al., 2015 or insufficient cereal grains were present for analysis.

**Isotopic analysis methods and analytical conditions**

The samples were homogenised and weighed out into tin capsules. Every tenth sample was duplicated to enable precision to be calculated. Carbon and nitrogen isotope compositions were measured separately to take account of the large differences in elemental concentrations (wt%C and wt%N) in the sample material.

Isotopic analyses were undertaken at the Research Laboratory for Archaeology and the History of Art, University of Oxford, on a Sercon 20-22 stable isotope ratio mass spectrometer coupled to a Sercon Europea EA-GSL sample preparation system with helium carrier gas. Raw and drift-corrected results were calculated using an in-house Alanine standard. Plant δ13C and δ15N were calibrated using internal reference materials calibrated against international standards (IAEA-CH-6 and IAEA-CH-7 for carbon, IAEA-N-1 and IAEA-N-2 for nitrogen) (Table S4). A two-point calibration method was followed using a Kragten-type spreadsheet to calculate an individual sample’s measurement uncertainty (Kragten, 1994). Measurement uncertainty following Kragten averaged 0.06‰ for δ13C ranging from 0.04‰ to 0.11‰ for δ15N average of 0.37‰ ranging from 0.31‰ to 0.46‰.

Measurement and analytical uncertainty were also observed using EMA-P2 (Table S4) and sample duplicates following (Szpak et al., 2017) **(**Table S5). Measurement precision (the pooled standard deviations of calibration standards, the P2, and the sample duplicates) was calculated to be ±0.07‰ for the δ13C and ±0.26‰ for the δ15N. Systematic error was determined to be ±0.17‰ for δ13C and ±0.46‰ for δ15N based on the difference between the known and measured δ values of the check standard and the long-term standard deviation of the check standard.

Total analytical uncertainty, calculated as per Szpak (2017), was estimated to be 0.19‰ for δ13C and 0.53‰ for δ15N. Following Nitsch et al. (2015) and Styring et al. (2017), a charring correction of -0.11‰ for δ13C and -0.31‰ for δ15N was applied. Statistical analyses were carried out using Rstats (R Core Team, 2020.

**Supplementary Table S4.** Mean and standard deviation of all check and calibration standards for the analytical sessions from which the data presented are derived.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Standard** | **Number** | **δ13C mean** | **δ13C Sd** | **Session** |
| CH6 | 5 | -10.45 | 0.03 | 180924 |
| CH7 | 5 | -32.15 | 0.04 | 180924 |
| P2 | 6 | -28.33 | 0.04 | 180924 |
| ALANINE | 11 | -27.18 | 0.03 | 180924 |
| CH6 | 2 | -10.45 | 0.03 | 180906 |
| CH7 | 3 | -32.15 | 0.02 | 180906 |
| P2 | 4 | -28.24 | 0.04 | 180906 |
| ALANINE | 7 | -27.15 | 0.03 | 180906 |
| CH6 | 5 | -10.45 | 0.02 | 180905 |
| CH7 | 5 | -32.15 | 0.02 | 180905 |
| P2 | 6 | -28.26 | 0.03 | 180905 |
| ALANINE | 11 | -27.17 | 0.03 | 180905 |
| CH6 | 3 | -10.45 | 0.12 | 180813a |
| CH7 | 3 | -32.15 | 0.07 | 180813a |
| P2 | 4 | -28.29 | 0.13 | 180813a |
| ALANINE | 8 | -27.11 | 0.08 | 180813a |
| CH6 | 4 | -10.45 | 0.01 | 190430 |
| CH7 | 4 | -32.15 | 0.01 | 190430 |
| P2 | 4 | -28.27 | 0.03 | 190430 |
| ALANINE | 8 | -27.17 | 0.03 | 190430 |
| **Standard** | **Number** | **δ15N mean** | **δ15N Sd** | **Session** |
| N1 | 6 | -0.40 | 0.31 | 180925 |
| N2 | 4 | 20.30 | 0.43 | 180925 |
| P2 | 6 | -2.12 | 0.28 | 180925 |
| ALANINE | 11 | -2.23 | 0.11 | 180925 |
| N1 | 5 | -0.40 | 0.32 | 180907A |
| N2 | 5 | 20.30 | 0.14 | 180907A |
| P2 | 6 | -1.53 | 0.15 | 180907A |
| ALANINE | 11 | -1.74 | 0.20 | 180907A |
| N1 | 3 | -0.40 | 0.41 | 180926 |
| N2 | 4 | 20.30 | 0.11 | 180926 |
| P2 | 6 | -2.25 | 0.20 | 180926 |
| ALANINE | 10 | -2.24 | 0.17 | 180926 |
| N1 | 4 | -0.40 | 0.21 | 190513 |
| N2 | 4 | 20.30 | 0.14 | 190513 |
| P2 | 3 | -1.62 | 0.41 | 190513 |
| ALANINE | 8 | -1.77 | 0.30 | 190513 |

**Supplementary Tables S5a and S5b.** The δ13C and δ15N values for duplicated samples with the analytical sessions from which the Danebury Environs material derives.

|  |  |  |  |
| --- | --- | --- | --- |
| **ID** | **RunfileC** | **δ13C Dulp A** | **δ13C Dulp B** |
| DAN046 | 180924 | -22.18 | -22.20 |
| DAN053 | 180924 | -22.73 | -22.78 |
| DAN060 | 180924 | -21.75 | -21.71 |
| DAN037 | 180924 | -21.80 | -21.79 |
| DAN035 | 180906 | -21.97 | -21.90 |
| DAN019 | 180905 | -22.30 | -22.34 |
| GRT016 | 180905 | -22.46 | -22.02 |
| GRT020 | 180905 | -22.63 | -22.56 |
| GRT022 | 180905 | -22.83 | -22.80 |
| STM023 | 180813a | -24.65 | -24.86 |
| DAN052 | 180813a | -22.61 | -22.59 |
| GRT026 | 180813a | -23.57 | -23.60 |
| RGS010 | 190430 | -23.79 | -23.49 |
| BPL017 | 190430 | -23.94 | -23.94 |
| GRT026 | 190430 | -22.58 | -22.61 |

|  |  |  |  |
| --- | --- | --- | --- |
| **ID** | **RunfileN** | **δ15N Dulp A** | **δ15N Dulp B** |
| DAN035 | 180925 | 3.4 | 3.4 |
| GRT023 | 180925 | 1.9 | 2.2 |
| GRT019 | 180925 | 3.1 | 2.9 |
| GRT022 | 180925 | 2.2 | 2.0 |
| DAN018 | 180907A | 5.3 | 5.8 |
| DKB008 | 180907A | 4.9 | 4.8 |
| DAN032 | 180907A | 2.6 | 2.4 |
| DAN025 | 180907A | 3.2 | 3.3 |
| DAN046 | 180926 | 3.3 | 3.0 |
| DAN090 | 180926 | 2.6 | 2.7 |
| GRT024 | 180926 | 3.5 | 3.6 |
| GRT031 | 180926 | 0.8 | 1.2 |
| RGS006 | 190513 | 5.1 | 5.0 |
| GRT016 | 190513 | 3.2 | 3.0 |
| BPL001 | 190513 | 6.0 | 5.6 |

**Statistical tests of isotopic results**

***Supplementary Table S6.*** *Welch T test used due to unequal variance, comparing two crops within a single site.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Welch T test** | **Degrees of freedom** | **P-value** |
| Danebury, barley and spelt | δ13C | -10.244 | 44.767 | **<0.001** |
|  | δ15N | -0.5976 | 41.503 | 0.553 |
| Nettlebank Copse, barley and spelt | δ13C | -3.933 | 11.972 | **0.002** |
|  | δ15N | 1.3884 | 4.2407 | 0.234 |
| Suddern Farm, barley and spelt | δ13C | -6.6847 | 15.801 | **<0.001** |
|  | δ15N | -0.1613 | 11.679 | 0.875 |
| Dunkirt Barn, barley and spelt | δ13C | -3.5546 | 7.7313 | **0.008** |
|  | δ15N | 0.74813 | 6.1382 | 0.482 |
| Grateley, barley and spelt | δ13C | -5.2354 | 16.9 | **<0.001** |
|  | δ15N | -0.4425 | 18.125 | 0.663 |

Levene’s test homogeneity of variance across groups showed the variances of groups were equal, and a Tukey post hoc test was selected.

**Supplementary Table S7.** Summary of ANOVA single crop across sites. \*only significant P values reported below 0.01. Below 0.05 considered to be statistically significant.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Isotopic data** | **F-ratio** | **Degrees of freedom** | **P-value** | **Tukey post hoc** | **P value\*** |
| Spelt, all sites | δ13C | 4.694 | 5 | 0.001 | Suddern Farm – Danebury  Suddern Farm – Dunkirt Barn  Suddern Farm – Grateley Villa | **<0.001**  **0.017**  **0.031** |
| Spelt, all sites | δ15N | 6.712 | 5 | <0.001 | Danebury – Grateley Villa  Suddern Farm – Grateley Villa  Grateley Villa – Dunkirt Barn | **<0.001**  **0.005**  **0.002** |
| Barley, all sites | δ13C | 2.814 | 5 | 0.0247 | Suddern Farm –Dunkirt Barn  Suddern Farm- Grateley Villa | 0.089  **0.014** |
| Barley, all sites | δ15N | 6.765 | 5 | <0.001 | Grateley Villa – Dunkirt Barn  Nettlebank Copse – Grateley Villa  Suddern Farm – Grateley Villa  Grateley Villa – Danebury | **<0.001**  **<0.001**  **0.011**  **0.008** |

**Functional Weed Analysis**

Functional weed ecology analysis was conducted on the samples listed in Table S8.

***Supplementary Table S8.*** *Samples used for FIBS analysis.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Site** | **Period** | **Feature no.** | **Context no.** | **Sample no.** | **Feature type** |
| Bury Hill | Mid Iron Age |  | P21/1 | 94 | Pit |
| Bury Hill | Mid Iron Age |  | F32/L160 | 106 | Ditch |
| Bury Hill | Mid Iron Age |  | P45/3 | 116 | Pit |
| Bury Hill | Mid Iron Age |  | P45/10 | 113 | Pit |
| Bury Hill | Mid Iron Age |  | P57/8 | 324 | Pit |
| Danebury | Late Iron Age |  | 1078 |  | Pit |
| Danebury | Mid Iron Age | 458 | 458 |  | Layer |
| Danebury | Mid Iron Age | 472 | 472 |  | Layer |
| Danebury | Mid Iron Age | 478 | 478 |  | Layer |
| Danebury | Mid Iron Age |  | 547 |  | Layer |
| Danebury | Mid Iron Age |  | 1041 |  | Pit |
| Danebury | Mid Iron Age |  | 460 |  | Layer |
| Fullerton | Late Roman |  | F883/5 | 3893 | Tile hearth |
| Fullerton | Late Roman |  | F939/2 | 3833 | Corndrier stokehole |
| Fullerton | Late Roman |  | F995/1 | 4060 | Oven large 2a corndrier |
| Fullerton | Late Roman |  | F951/3 | 3894 | Oven, keyhole, 2b |
| Fullerton | Late Roman |  | F893/3 4 | 3892 | Ditch |
| Fullerton | Late Roman |  | F8821/ 2 | 3895 | Ditch |
| Fullerton | Late Roman |  | F919/2 | 3828 | Corndrier central chamber |
| Fullerton | Late Roman |  | F920/2 | 3836 | Corndrier flue |
| Grateley | Late Iron Age |  | F815/2 | 3345 |  |
| Grateley | Mid Roman | CD1 left | F827.1 | 3326 | Corndrier |
| Grateley | Late Roman | CD3 left | F844/2 | 3325 | Corndrier |
| Grateley | Late Roman | CD 3 left | F845/6/7/8 | 3349 | Corndrier |
| Grateley | Late Iron Age |  | F708/3 | 2847 |  |
| Grateley | Late Roman | CD4 | SQ1/1 | 3196 | Corndrier |
| Grateley | Late Roman | CD4 | SQ4/2 | 3223 | Corndrier |
| Grateley | Late Roman | CD4 | SQ5/1 | 3209 | Corndrier |
| Grateley | Late Roman | CD4 | SQ5/2 | 3227 | Corndrier |
| Grateley | Late Iron Age |  | F735/3 | 3141 |  |
| Grateley | Late Roman |  | F769/6 | 3462 | Oven |
| Grateley | Late Roman |  | F782/2 | 3461 | Oven |
| Grateley | Late Iron Age |  | F739/8 | 3362 | Ritual shafts |
| Grateley | Late Iron Age |  | F793/14 | 3368 | Ritual shafts |
| Houghton Down | Mid Roman |  | F564/2 | 2593 | Oven |
| Houghton Down | Mid Iron Age |  | P331/8 | 2304 | Pit |
| Houghton Down | Mid Iron Age |  | P348/4 | 2331 | Pit |
| Houghton Down | Mid Iron Age |  | P364/9 | 2350 | Pit |
| Houghton Down | Mid Iron Age |  | P368/4 | 2360 | Pit |
| Nettlebank Copse | Mid Iron Age |  | P275/12 | 1603 | Pit |
| Nettlebank Copse | Late Iron Age |  | F155/12/3 | 1658 | Ditch |
| Nettlebank Copse | Late Iron Age |  | F155/24/8 | 1662 | Ditch |
| Nettlebank Copse | Mid Iron Age |  | P249/2 | 1502 | Pit |
| Nettlebank Copse | Late Iron Age |  | P251/7 | 1515 | Pit |
| Nettlebank Copse | Late Iron Age |  | P272/1 | 1571 | Oven |
| Nettlebank Copse | Late Iron Age |  | P274/3 | 1585 | Quarry |
| Nettlebank Copse | Late Iron Age |  | P276/3 | 1607 | Pit |
| Nettlebank Copse | Late Iron Age |  | P283/3 | 1617 | Pit |
| Nettlebank Copse | Late Iron Age |  | F148/0/5 | 1645 | Ditch |
| Nettlebank Copse | Late Iron Age |  | F148/12/6 | 1648 | Ditch |
| Rowbury Farm | Mid Iron Age |  | P408/9 | 4229 | Pit |
| Rowbury Farm | Mid Iron Age |  | P418/6 | 4235 | Pit |
| Rowbury Farm | Mid Iron Age |  | P434/17 | 4239 | Pit |
| Rowbury Farm | Early Roman |  | P410/2 | 4197 | Pit |
| Rowbury Farm | Roman |  | F1185/3/2 | 4235 | Ditch |
| Suddern Farm | Mid Iron Age |  | P120/4 | 356 | Pit |
| Suddern Farm | Late Iron Age |  | P89/3 | 335 | Pit |
| Suddern Farm | Late Iron Age |  | P128/1 | 363 | Pit |
| Suddern Farm | Late Iron Age |  | P104/4 | 344 | Pit |
| Suddern Farm | Late Iron Age |  | P104/6 | 346 | Pit |
| Suddern Farm | Late Iron Age |  | P84/5 | 332 | Pit |
| Suddern Farm | Mid Roman |  | F99/2 | 340 | Pit |

**Data Availability**

Figures 2, 3, 4, 6, 8 and 9 of the main article are reproducible through the code available in Zenodo at this link https://doi.org/10.5281/zenodo.6923308.

The crop processing analysis used weed data from Kolofana supplied by Amy Bogaard which is not available here. The output of the crop-processing analysis is provided in Table S3.

The FIBS analysis (Figure 5 of the main article) used models and functional traits supplied by Amy Bogaard which are not available here.

Code and data are available at this repository: https://doi.org/10.5281/zenodo.6923308.

Isotopic data is supplied in an excel spreadsheet (EJA\_cereal\_data) and included in the published Supplementary Materials.

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