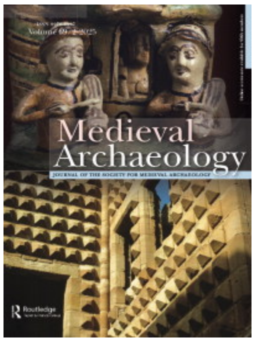

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Medieval Settlement Chronologies: Reflections on an Extensive Radiocarbon Dating Programme

By MARK MCKERRACHER[1], HELENA HAMEROW[2] *and* CHRISTOPHER BRONK RAMSEY[2]

THE FEEDING ANGLO-SAXON ENGLAND (FEEDSAX) PROJECT applied scientific methods to bioarchaeological remains, in order to shed new light on medieval English agriculture. The methodology included an extensive radiocarbon dating programme which, besides helping to date developments in farming at selected case study sites, proved informative in its own right. This paper discusses the key implications of this programme's results, with regard to the general problems of dating medieval settlement phases. First, it has allowed us to devise a new 'universal' chronological schema which aligns conventional phases with the precision currently attainable from calibrated radiocarbon dates. Second, it has revealed frequent discrepancies between the radiocarbon dates of organic remains and their original phasing—usually based upon associated ceramics—often resulting in chronological refinements or revisions, and sometimes revealing hitherto unrecognised periods of activity. In particular, the results highlight that ceramic-based phasing often underestimates the age of organic remains.

Medieval rural settlement archaeology suffers notoriously from broad and imprecise dating. Excavated contexts are typically lacking in coins or other closely datable artefacts, and many sites lack detailed, undisturbed stratigraphic sequences (eg Hey 2004). Ceramic evidence can be plentiful, but is not always: Paul Blinkhorn, for instance, has proposed that western Oxfordshire witnessed a 'ceramic hiatus'—at least in the use of handmade pottery—between the mid-8th and mid-9th centuries (Blinkhorn 2003, 172–4). Even when pottery is abundant, it is seldom closely datable. Many coarsewares are broadly dated as 'early Anglo-Saxon' (c 410–650) or 'early/middle Anglo-Saxon' (c 410–850). It has even been suggested that some such organic-tempered wares, increasingly common around the 7th century, remained in use as late as the 10th or 11th century in some areas (Astill and Lobb 1989, 107; cf Hamerow et al 1994, 12–15). While there are some more closely dated subdivisions of hand-built Anglo-Saxon coarsewares—corresponding with the stamped decorations of 5th- or 6th-century types, for instance—in most cases the fabrics only offer chronological precision to somewhere between 200 and 500 years, with no hard boundary between 'early' and 'middle' types (Vince 2005, 226).

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Two distinctive fabrics are a little more closely dated, although their distributions are biased toward eastern England. First, the shelly Maxey-type Ware is generally dated to c 650–850 (Addyman 1964a)—although, as Paul Spoerry has argued, this dating is apparently reinforced via circular argument since, 'these typical Middle Saxon fabrics should have a Middle Saxon date range' (Spoerry 2016, 5). Second, the mass-produced Ipswich Ware was originally also dated c 650–850, but this was revised by Blinkhorn (2012, 3–8) to c 725–850. This latter revision was based primarily upon a review of associated coinage, which found a lack of secure stratigraphic associations between Ipswich Ware and coins pre-dating the secondary *sceatta* phase. This review was undertaken as part of the Ipswich Ware Project (1994–2008), and it is possible that the assessment may need revision again in the future, to review whether any earlier coins (or other dated material) have since been found in association with Ipswich Ware (Blinkhorn 2012, 8), since the unavoidable problem remains that the sherds themselves are not (yet) directly datable.

In the absence of such dates for potsherds, and to fulfil the unavoidable demand for ceramic-based phasing for excavated sites, the allure of predefined periods such as 'late Saxon', or else rounded calendrical descriptions such as '13th-century', is bound to persist. But how useful, and how historically meaningful, is such an approach to phasing?

CHRONOLOGICAL FRAMEWORKS: ORIGINS AND DEVELOPMENT

The development of discrete phases or periods has, with good reason, occupied archaeologists more than historians, since the latter have traditionally derived chronological frameworks from documentary sources. Frank Stenton's *Anglo-Saxon England (c 550–1087)*, an enduring touchstone of historical study from its first edition in 1943 to its third in 1971, is very largely structured around documented and dated ecclesiastical and political events. There are no 'phases' with strict and exclusive chronological boundaries, but rather broadly defined (and sometimes overlapping) 'ages' such as 'The Age of the Migration', 'The Conversion of the English Peoples', 'The Conquest of Scandinavian England', and 'The 10th-Century Reformation' (Stenton 1943; 1947; 1971). Calendar years are used where possible (eg the conversion narrative runs from the start of Augustine's mission in 597 to the Synod of Whitby in 664), but the various 'ages' do not come with bracketed, rounded timespans in the fashion of archaeological phases—no doubt because the documentary sources already include dates (however approximate or debatable), such that calendrical precision might actually be lost by assigning recorded episodes to arbitrarily defined discrete 'periods' or 'phases'. Chronological flexibility is also a useful literary device in an essentially qualitative account such as Stenton's, which can, for example, describe a 'heroic age of the Anglo-Saxon church' in the 8th century (Stenton 1971, 176).

Archaeology, by contrast, with its increasingly scientific paradigms, has aspired to a more objective, measurable and widely applicable chronological framework. The historiography of periodisation in early medieval archaeology has been discussed in detail by John Hines (2013, 25–30), with particular regard to burials and artefacts, and importantly including perspectives from continental Europe. In the summary account below, we focus principally upon the development of chronological terminology with regard to settlement phasing, especially via the definition and application of ceramic chronologies.

As early as 1913, E T Leeds presented a chronological framework for so-called 'Jutish' gravegoods spanning 450–650:

> For purposes of simplicity, it has been thought well to divide the Kentish graves into four periods, which may be taken to cover a period of fifty years each … The periods also must not be regarded as hard and fast divisions, hedged off from one another by a sharp line of types (Leeds 1913, 106).

Leeds acknowledged not only the simplified convenience of the scheme, but also its loose basis in received, documented chronology.[3] The first period (450–500) aligns with the, 'first fifty years after the generally accepted date of the landing of Hengist and Horsa in AD 449', while the last phase relies on assumptions about, 'how soon the practice of depositing objects with the dead ceased among a converted people', following Æthelbert's baptism in 597 (Leeds 1913, 111–12; 196). Later works adopted essentially the same scheme, dubbing the span AD 450–650 the 'pagan' or 'heathen' period (Fox 1929; Hoskins 1934)—nomenclature with a long heritage, stretching back at least to John Yonge Akerman's work in the mid-19th century (eg, Akerman 1855: *Remains of Pagan Saxondom*). Looking at Leicestershire specifically, W G Hoskins (1934, 122) also identified a subsequent period of 650–850 for 'the later Anglian settlements', from the conversion of Penda of Mercia (c 653) to 850, 'when the attacks of the Danes began in earnest'. This period is followed, logically if less neatly, by 'the Danish settlement (877–919)' and 'the Norwegian settlement (c 950)' (Hoskins 1934, 128; 134).

These emerging chronological conventions crystallised further in the mid-20th century. A seminal and lastingly influential publication on Anglo-Saxon pottery included discrete sections on a 'pagan period' (spanning the 5th to early 7th century) and a 'middle-Saxon' period (AD 650–850) (Dunning et al 1959, 7; 13). For later pottery, the period boundaries were acknowledged by Dunning to be less than firm, with the 'late Anglo-Saxon period' ranging 'from the eighth or ninth century until the twelfth':

> … some of the material lacks precise dating and shows little development during these centuries and later, thus making fine distinctions between the middle- and late-Saxon periods artificial … [while] certain of the pottery groups continue with little change into the twelfth century (Dunning et al 1959, 31).

Despite this candid uncertainty, however, such later fabrics now often fall into conventional periods such as 'late Saxon' and 'high medieval', whose calendrical boundaries are deliberately arbitrary, grounded in convenience rather than an independent historical framework (Spoerry 2016, 5–6). It could be argued, of course, that 1066—which may be used to define a boundary between late Saxon and post-Conquest material—does not represent an arbitrary division. A pre-/post-Conquest distinction has long been fundamental to the discipline: the annual 'Medieval Britain [and Ireland]' reviews in *Medieval Archaeology* have been divided on this basis since their inception (Wilson and Hurst 1957). But the question of whether or not the Norman Conquest had instantaneous seismic consequences for the manufacture and use of pottery is debatable. Indeed, Alan Vince found that '[d]uring the 11th century, and *definitely before the Norman Conquest in some places*, there was an abrupt change in pottery sources, often accompanied by a change in form and technology' (Vince 2005, 232; our emphasis).[4]

[3] Thus: A (450–500), B (500–550), C (550–600), and D (600–650).

[4] The ambiguity regarding the impact of the Conquest is also highlighted in Jervis' study of pottery from medieval Southampton, 'The pre- and post-conquest pottery is different in character; however, the clear distinction suggested by the ceramic phasing is more blurred in reality, with many Anglo-Norman deposits containing large quantities of late Saxon types' (Jervis 2013, 462–3).

Moreover, as Dunning observed and later scholars have reiterated, 'later Saxon' and post-Conquest fabrics are not always more closely datable than their 'early/middle Anglo-Saxon' precursors.[5] Oolitic Sandy Ware, for instance, is very broadly dated (1100–1400), at least in Cambridgeshire (Spoerry 2016, 158). There is also a greater variety of timespans and chronological terms to choose from after 850: phase definitions which sometimes purposefully overlap, and whose names are not consistently used in archaeological literature. For example, whereas Maureen Mellor uses 'Saxo-Norman' (850–1150) and 'Anglo-Scandinavian' (850–1066), Spoerry uses 'late Saxon' (850/875–1050) and 'early medieval or Saxo-Norman' (1050–1200) (Mellor 1994, 3; Spoerry 2016, 5).

'Saxo-Norman' emerges here as a particularly indeterminate case. It seems originally to have been coined by G Baldwin Brown in his identification of a 'Saxo-Norman overlap', an architectural mode which united but did not merge Saxon and Norman characteristics around the time of the Conquest, 'and for perhaps half a century after it' (Brown 1926, 231–2). But the 'Saxo-Norman' phasing employed by Mellor (1994) denotes not so much a cultural overlap as a bridge, straddling the centuries before and after the Norman Conquest. This usage has been adopted by ceramic experts since at least the 1950s, to allow for wares whose pre- and post-Conquest forms cannot be differentiated (Hurst 1956). The problem with employing such a bridging term consistently is that it is easy to move the endpoints so long as they sit either side of 1066. Hence Martin Carver, for instance, can reasonably write of 10th- to 11th-century Durham as 'Saxo-Norman' (Carver 2019, 121), while some ceramicists would typically use the same term to refer to a broader, 9th- to 12th-century period.

Most archaeological chronologies of medieval England have tended, on the whole, to rest upon these conventional ceramic phases, despite their somewhat arbitrary and fluid definitions; they are also sometimes renamed more neutrally to avoid Anglo-centric labelling. For example, a study of medieval British archaeobotany by Marijke van der Veen et al (2013, 153, tab 1) uses periods M1–M5, where M1 approximates to 450–650/700 (and is aligned with an 'early Anglo-Saxon' cultural period), while M5 approximates to 1300–1500 (and is aligned with a 'late medieval' cultural period). Such synthetic studies are bound perforce to try to accommodate the dominant traditional schemas which have been employed at many individual sites, and which have provided important structure and consistency across many publications. For instance, *Medieval Archaeology* has long stipulated specific chronological terminology for contributions, thus further embedding terms and concepts such as 'early Anglo-Saxon' (5th–7th centuries) and 'high medieval' (mid-11th–mid-14th centuries) in the interests of consistency and coherence.[6]

THE CONUNDRUM OF PHASING

The problem thus arises in archaeology that settlement chronologies are largely dependent upon arbitrary and/or elastic period frameworks, resting largely upon ceramic dating conventions which are themselves often broad, sometimes ambiguous, and

[5] A problem which has long been compounded by a lack of, 'stratified sites which are absolutely dated in the crucial periods of the ninth and twelfth centuries' (Hurst 1976, 314).

[6] <*medievalarchaeology.co.uk/wp-content/uploads/Instructions-for-authors-2022.docx*> [accessed 5 March 2025].

lacking in independent empirical verification. What firm evidence do we—or could we—have to say that Maxey-type Ware, for instance, was produced c AD 650–850? What justification is there for treating those two centuries, or the somewhat shorter span assigned to Ipswich Ware (c 725–850), as a 'middle Anglo-Saxon period'? There is certainly a recognisable period of change in the archaeological record which appears to begin around the middle of the 7th century—involving the emergence of new trading settlements, the manufacture of wheel-turned pottery (Ipswich Ware), and changing burial rites—but how far this observation allows us to devise and redeploy a general, transferable 'middle Anglo-Saxon' chronological label for artefacts, deposits and phases of activity is open to question. The same could be said of later periods, especially the chameleonic 'Saxo-Norman', and even individual centuries, which presuppose (and in turn dictate) that turns-of-the-century have meaningfully impacted the archaeological record.

Given that pottery is often the most abundant datable find at an excavated medieval settlement—at least, for some regions and timespans (see further below)—it is a necessary archaeological convenience to deploy ceramic periods as a basis for defining and dating settlement phases, applying these phases in turn to other features and deposits. This largely unavoidable practice opens us, however, to the inevitable traps of circular phasing and chronological silos. To follow the logic of Spoerry's observation (see above: Spoerry 2016, 5), once Maxey-type sherds have been used as an indicator of conventional 'middle Anglo-Saxon' date (c 650–850) at enough settlements, then it becomes near-impossible ever to re-date either Maxey-type ware or those settlement phases which have been dated by it. Furthermore, if that settlement has a subsequent phase dated by, for example, Thetford-type ware to c 850–1100, then by definition all settlement activity will be dated, one way or another, to these phases; the mid-9th century may thus appear to be a period of transition by default, simply by virtue of a dating schema reliant upon conventional periods.

Hence, the application of conventional dating schemas may result in misleading and oversimplified interpretations of chronological change at medieval settlements. Besides this, there is a more fundamental methodological problem at work: to assume that an excavated context and all its contents must share a date with the accompanying ceramic assemblage is to beg the question. It is clear that pottery (and other finds) can be residual or intrusive, and therefore of a different age to both their parent contexts and the other remains contained therein; yet so often we have little or nothing but ceramics upon which to base a feature's—and, by extension, a whole site's—chronology. There is a further problem, as hinted above, in that all these considerations presuppose that pottery is abundantly available and readily datable at excavated settlements, but that is not necessarily the case in all regions and periods. Indeed, some parts of northern and western England, such as Cumbria and Lancashire, may have been essentially aceramic in the pre-Conquest period (Irving 2011, 32–3); correspondingly greater emphasis is therefore increasingly being placed on radiocarbon dating to identify settlements of this period, in such areas (Rippon and Morton 2020, 3).

THE FEEDSAX RADIOCARBON DATING PROGRAMME

To summarise, there are two related problems here: the arbitrariness of traditional phasing schemas (based on ceramics and/or pseudo-calendrical conventions), and the likelihood of mismatching ceramic dates with associated finds and features. As indicated by the foregoing historiographical review, these problems have long been recognised and variously explicated. They have, however, proved difficult to surmount in medieval settlement studies, particularly at a general level, beyond local schemas developed for individual sites. The dating of early Anglo-Saxon burials, by contrast, has benefited enormously from a far-reaching seminal study which combined artefact typologies, assemblage seriation, radiocarbon dating and Bayesian modelling, to produce high-resolution chronological frameworks for male and female burials in the 6th and 7th centuries (Hines and Bayliss 2013). Unfortunately, the very different (and generally, artefactually poorer) body of evidence available for settlement archaeology does not lend itself readily to a similar approach.

The general difficulties associated with settlement phasing were especially pressing for the *Feeding Anglo-Saxon England* (FeedSax) project, which aimed to synthesise archaeological and palaeoenvironmental data from over 700 sites across England.[7] The FeedSax project drew upon this extensive dataset to investigate longstanding questions about the development of medieval farming, by deploying bioarchaeological methods including both statistical and molecular analyses of plant and animal remains (Hamerow 2022; Hamerow et al 2025). As well as analysing pre-existing data from hundreds of published and unpublished excavation reports, FeedSax also selected case study sites for more detailed analysis, including (in view of the difficulties of dating medieval deposits) radiocarbon dating of charred cereal grains and/or animal bones. Radiocarbon dating—measuring the age of organic remains via the radioactive decay of carbon-14, and calibrating the results to account for fluctuations in atmospheric 14C—offered a well-established, cost-effective and increasingly precise method *directly* applicable to those environmental remains which specifically concerned FeedSax (Bowman 1990; Bronk Ramsey et al 2010).

In total, FeedSax obtained new radiocarbon dates from eight samples of cattle bone and 170 samples of charred cereal grain, from contexts with original phases spanning the 5th to 15th centuries, across 23 sites (Tab 1; Fig 1).[8] The samples selected for dating were chosen on the basis of their abundant and well-preserved organic remains and also, in some cases, because of a particular need to tighten imprecise or uncertain phasing at a site.

Our selected samples are not necessarily representative of medieval features in general. There is, for example, a pronounced geographical bias in the distribution of sites (Fig 1), in accord with overall patterns in the distribution of faunal and botanical remains (Hamerow et al 2025). FeedSax used the divisions developed by Stephen Rippon et al (2015) for the 'Fields of Britannia' project to assess regional patterns in the dataset, and in these terms the sites included in the dating programme are heavily concentrated in the Central Zone (Tab 2). The fact that the other regions are represented by no more than four sites each severely restricts the potential for interregional

[7] Funded by the European Research Council, FeedSax ran from 2017 until 2022 and was based at the Universities of Oxford and Leicester. The project was supported by the European Union's Horizon 2020 Research and Innovation programme under grant agreement no 741751.

[8] Twenty radiocarbon dates were also obtained from pollen cores. Since these do not relate to settlement contexts, however, and therefore cannot be directly compared with conventional archaeological phases, they are beyond the scope of this paper; but the results can nonetheless be found in the digital archive (see McKerracher et al 2023).

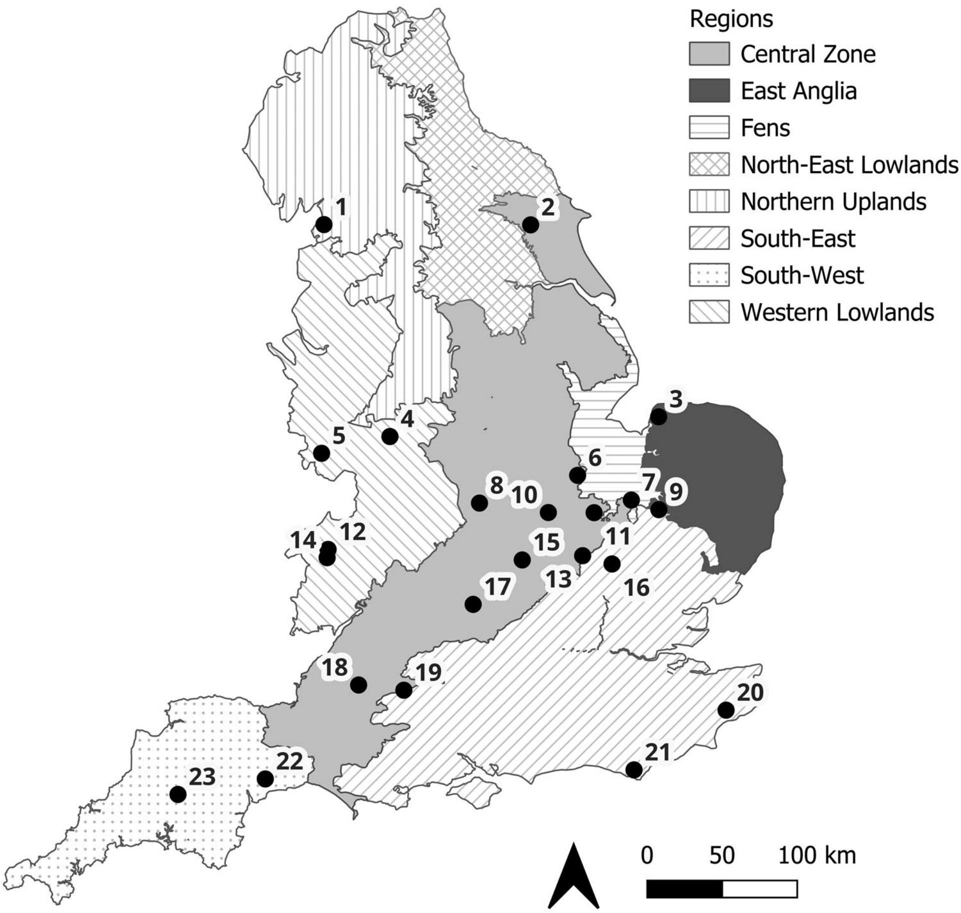

FIG 1
Location of sites included in this study. Regional divisions from Rippon et al 2015. For site numbers see Table 1. *Uses Ordnance Survey Open Data © Crown copyright and database right 2017, under the Open Government licence.*

comparisons; rather, we must bear in mind that the ensuing observations apply particularly—though not exclusively—to settlements in the Central Zone.

This comparatively large dataset nonetheless affords a rare opportunity to assess the extent to which radiocarbon dates from excavated animal and plant remains match the dates assigned to those samples in their original site chronologies. In other words, we may ask: how well do the conventional phasing schemas often employed in excavation reports compare with the results of direct dating? The objective is not only to assess and (where necessary) to adjust the dates of environmental remains analysed by FeedSax; it is also to reassess the utility and applicability of conventional phasing more generally. As discussed above, such phases tend to be used for convenience rather than objective accuracy or verifiability; they are therefore ripe for scrutiny.

Accelerator Mass Spectrometry (AMS) dating of all samples took place at the Oxford Radiocarbon Accelerator Unit between 2018 and 2021. For this paper, the radiocarbon determinations have been calibrated using IntCal20 (Reimer et al 2020)

TABLE 1.
Sites included in this study. 'Map no' refers to Figure 1. 'FeedSax archive doc' identifies the corresponding report for that site in the project's digital archive hosted by the Archaeology Data Service: <*doi.org/10.5284/1057492*> [accessed 7 January 2025].

Map no	Site	Reference	FeedSax archive doc
1	Howgill Brook (Lancashire)	Bradley and Howard-Davis 2018	C07
2	Wharram Percy (North Yorkshire)	Stamper and Croft 2000; Treen and Atkin 2005; Wrathmell 2012	C24
3	Sedgeford (Norfolk)	Faulkner and Blakelock 2020; Faulkner 2022	C16, C17
4	Stafford (Staffordshire)	Carver 2010; Dodd et al 2014	C18
5	Mytton Oak Road, Shrewsbury (Shropshire)	Bradley 2016	C12
6	Botolph Bridge (Peterborough)	Spoerry and Atkins 2015	C02
7	Ely: Walsingham Way (Cambridgeshire)	Slater 2011	C20
7	Ely: West Fen Road (Cambridgeshire)	Mortimer et al 2005	C23
8	Coton Park (Warwickshire)	Maull 2001	C03
9	Mildenhall (Suffolk)	Havard et al 2019	C11
10	Raunds: Burystead (Northamptonshire)	Audouy and Chapman 2009	C13
10	Raunds: Furnells (Northamptonshire)	Audouy and Chapman 2009	C13
10	Raunds: West Cotton (Northamptonshire)	Chapman 2010	C22
11	Houghton (Cambridgeshire)	Smith et al 2021	C06
12	Wellington Quarry (Herefordshire)	Jackson and Miller 2011	C21
13	Stratton (Bedfordshire)	Shotliff and Ingham 2022	C19
14	Holmer (Herefordshire)	Arnold et al 2018	C05
15	Wolverton Mill (Buckinghamshire)	Thompson et al 2011	C25
16	Pudding Lane, Barley (Hertfordshire)	Woolhouse 2019	C15
17	Yarnton (Oxfordshire)	Hey 2004	C26
18	Eckweek (Avon)	Young 2020	C04
19	Market Lavington (Wiltshire)	Williams and Newman 2006	C10
20	Lyminge (Kent)	Thomas 2013; 2023	C09
21	Bishopstone (East Sussex)	Thomas 2010	C01
22	Ottery St Mary (Devon)	Mudd et al 2018	C14
23	Lydford (Devon)	Addyman 1964b; Wilson and Hurst 1967, 263; Green 1980	C08

and OxCal 4.4.2 (Bronk Ramsey 2009). The cereal grains selected for dating were photographed at the University of Oxford prior to analysis; these photographs and all other project data—including an individual radiocarbon dating report for each site, and a

Table 2.
Distribution of sites and radiocarbon-dated samples by region. Regional divisions are adopted from the Fields of Britannia project (Rippon et al 2015).

Region	# Sites	# Samples
Central Zone	10	89
East Anglia	2	17
Fens	1	12
Northern Uplands	1	6
South East	3	23
South West	2	7
Western Lowlands	4	24
Total	**23**	**178**

summary table of all radiocarbon data—are freely available in the FeedSax digital archives (McKerracher et al 2023).[9] The data analysed in this paper are also included in tabular form in Electronic Supplementary Material 1. While the principal purpose of this paper is to present general reflections on the dating programme as a whole, and to consider its wider implications for the phasing of medieval settlements, site-by-site summaries are also included in Electronic Supplementary Material 2.

It should be noted that the radiocarbon dates, as presented and discussed in the electronic supplementary material, result from the calibration of *individual* samples, rather than representing Bayesian modelling of wider site sequences. Bayesian probability models for sequences of dates accommodate 'constraining' information, such as the relative stratigraphic position of samples, and can thus potentially tighten the probability distributions for dates in the series (Buck et al 1991; Bronk Ramsey 2009). For almost all of the sites in this study, however, the available chronometric data were too few, and the stratigraphic relationships too uncertain, for Bayesian modelling substantially to narrow the date ranges in this way. In the case of Stafford, modelling offered some additional refinements to the original chronologies; but, ultimately, the overall precision of the revised phasing sequence was rarely substantially higher than that attained for individual samples.[10] For this reason, and above all in the interests of inter-site comparability, this study focuses on individually calibrated date ranges, rather than the site-specific results of Bayesian modelling.

DISCUSSION

EMERGING TRENDS

The site-by-site accounts (Electronic Supplementary Material 2) summarise how the new radiocarbon dates obtained by FeedSax often affirm or refine a site's original chronology; but they also indicate that the new dates can—sometimes drastically—

[9] Within the digital archive, the individual site reports are in Section C, while the radiocarbon dataset as a whole is summarised in document A38, which represents a table from the project's Haystack database: <*doi.org/10.5284/1057492*> [accessed 7 January 2025].

[10] The method and results for Stafford are presented in Digital Archive Document C18: <*doi.org/10.5284/1057492*> [accessed 7 January 2025].

TABLE 3.
Classification of samples radiocarbon-dated by FeedSax, in terms of chronological relationship to original phasing.

Movement	**No samples (n = 172)**	**% Samples**
Shifted earlier	54	31.4
Refined earlier	11	6.4
No pronounced change	53	30.8
Refined later	25	14.5
Shifted later	29	16.9

contradict the phasing of some environmental material, and even reveal hitherto unrecognised or conjectural phases of activity. It is worth considering the nature of these adjustments in more detail: how many samples they affect, by how many years, and in what direction (ie earlier or later). In order to characterise such a large number of dates (178, including both animal bones and plant remains), some simplification is necessary. The following analysis will be based upon a comparison between, on the one hand, the start and end dates of the phases used in original reports, and on the other hand, the start and end dates of the new calibrated radiocarbon date ranges. These values are not entirely straightforward, and have required some arbitrary decisions to obtain comparable data. For example, if a site had an original phase described as 'late 8th- to early 10th-century', we would translate this to a span of 775–925; in other words, unless otherwise specified by available reports, intervals of 25 years have generally been used to subdivide centuries. Elsewhere, conventional terms (eg early Anglo-Saxon, middle Anglo-Saxon and late Saxon, or close equivalents) have been translated to years (450–650, 650–850 and 850–1066 respectively), unless available reports indicate otherwise. Where more debatable phasing terms have been named in environmental reports, such as 'Saxo-Norman' or 'medieval', we have referred to other sections of the available reports—such as pottery analyses, or narrative conclusions—to ascertain what centuries are intended.

For the radiocarbon dates, we have used a calibrated date range with 95.4% probability or, where this results in separate 'sub-ranges', we have used the sub-range with the highest probability provided that this exceeds 50%. Where no single calibrated range offers more than 50% probability, those with the next highest combined probability have been used together. For instance, if the ranges are cal AD 680–746 (with 43.6% probability) and 785–878 (with 46.8% probability), then we have used 680 and 878 as the start and end dates respectively. We acknowledge the arbitrariness of this simplification process, and the loss of precision which it necessarily entails. Since we only intend, however, to make broad comparisons between original phases and new radiocarbon dates—essentially, to establish whether they point in an earlier, later or similar direction—we contend that the overall trends are likely to be instructive even if some precision has been lost at the level of individual samples.

Of the 178 samples, six (from Houghton) had not been closely phased at the time when FeedSax worked on them, so they have been excluded from the following analysis. The remainder have been categorised as follows (Tab 3). We have drawn a distinction between *shifts* and *refinements*: a chronological *shift* is a pronounced date-change, tantamount to the re-phasing of a sample, whereas a chronological *refinement* may overlap in part or in full with an original phase, but with a tendency towards either the earlier or the later part of the original range. Sample-by-sample results can be found in the electronic supplementary material, with particular reference to the 'characterisation' column (Electronic Supplementary Material 1).

1. **Shifted earlier:** the start date has moved earlier by at least 50 years.
2. **Refined earlier:** the end date has moved earlier by more than 50 years, and the start date has moved by a lesser degree (whether earlier or later).
3. **No pronounced change:** neither start nor end date has changed by more than 50 years; or, if either or both dates have changed by more than 50 years, then the difference between the changes is no more than 50 years. In other words, there is a general tolerance of 50 years: shifts in start and end dates must be more clearly pronounced before we consider them to be significant.
4. **Refined later:** the start date has moved later by more than 50 years, and the end date has moved by a lesser degree (whether earlier or later).
5. **Shifted later:** the end date has moved later by at least 50 years.

The key implications of this exercise are, first, that more than two thirds of the new radiocarbon dates occasion some revision of the samples' original phasing, ie they are either 'refined' or 'shifted'. Second, most of these revisions point in the direction of *earlier* date ranges, especially when we consider the most pronounced shifts. In other words, these results suggest that there is a tendency for palaeoenvironmental remains to be assigned to phases which appear to be too late; their ages are more often underestimated than overestimated. The discrepancy can often be large: of the 54 samples which we have shifted earlier, 35 have shifted by more than 100 years, and 12 of those by more than 200 years. By contrast, only 16 have shifted *later* by more than 100 years, and only two of those by more than 200 years.

There are chronological patterns among these 'shifted' samples. Most of the dated samples had original start dates either between 850 and 1000 (59 samples) or between 1100 and 1250 (61 samples). Despite these original distributions, with those two ranges being near-equally well represented, only 15 in the former group were shifted earlier, compared to 35 in the latter group; by contrast, only three samples had their start dates 'shifted later' *into* this 1100–1250 range. In other words, there is a particularly marked tendency for older remains to be 'under-aged' to the 12th and 13th centuries; by comparison, very few samples from that period have been 'over-aged' to an earlier phase.

Considering that most dating is based upon ceramics, one likely explanation for these chronological discrepancies comes to mind. If deposits tend to be dated by the latest potsherds discovered in associated contexts (which we believe is a reasonable working assumption), and if the availability of datable ceramic fabrics generally increases over time (as appears to be the case, at least in some regions: eg Spoerry 2016), then it is inherently likely that any environmental remains which have been at all disturbed—either reworked into later deposits, or subject to the occasional intrusive sherd—will be erroneously dated to a later (younger) period.

It is also possible that the conventional ages of some ceramic types have themselves been underestimated, although this is unlikely to account for all of the affected samples, many of which are shifted earlier by more than 100 years. The conventional ceramic dates clearly have a firm basis in reality, and our results in fact show reasonable support for them, given that 53 (30.8%) of the newly dated samples show 'no pronounced change' in date. The 'refinements', which are broadly consistent with the original, conventional date ranges but are narrower or otherwise subtly different, are more relevant here, suggesting, unsurprisingly, that phases of activity were not always bounded by conventional years such as 650, 850, 1066, 1100, 1200 or 1300.

TOWARDS A UNIVERSAL CHRONOLOGY

If we are to make any kind of inter-site comparisons, however, then we must have some means of characterising phases in line with a standardised, transferable chronology, much as a shoe shop employs a standard range of sizes rather than making each pair exactly to the measurements of each customer's feet. That is, after all, the justification for using the conventional chronological schemas outlined earlier in this paper. The problem arises—as demonstrated by the 'refinements' observed in this study—when radiocarbon dates, used as an independent empirical measure of age, do not match those conventional boundaries. For example, if we have re-dated a sample originally assigned to a 'middle Anglo-Saxon' phase of c 650–850, and obtained a result of cal AD 772–894, then there is no easy way of reapplying a conventional period without significantly losing precision: the best single fit is the Ipswich Ware period (c 725–850), or alternatively a 'middle/late Saxon' phase of 750–950 could perhaps be inferred or 'reverse-engineered' to straddle the conventional periods. Either way, we would lose precision, and potentially lose comparative compatibility with sequences at other sites.

We contend that a more useful, and more universal, dating schema can be devised on the basis of radiocarbon dates. Phases with this basis would be empirically verifiable via radiocarbon dating, whereas the conventional ceramic dates are not directly verifiable. On the other hand, given that the conventional periods are deeply embedded in British archaeology, and also that radiocarbon dates are too expensive to be systematically obtained in a typical excavation project, any schema approaching universal applicability must somehow accommodate the conventional phases alongside the likely ranges obtained from calibrated radiocarbon determinations.

With these goals in mind, we have proposed a new chronological schema in Table 4. This chronology is designed to accommodate both conventional period boundaries and calibrated radiocarbon date ranges, to maximise inter-site compatibility. The 'phases' in the schema can more accurately be termed *irreducible verifiable intervals* (IVIs). The rationale behind this proposal is that conventional periods such as 850–1066 do not represent empirically verifiable intervals, whereas IVIs do.

The IVI schema rests on the premise that, at the time of writing, with the precision currently attainable by AMS dating and calibration with IntCal20 (Reimer et al 2020), it is unlikely that organic remains could be dated *verifiably* to a much more closely defined interval than one of these. The application of Bayesian modelling could potentially yield tighter chronologies, but these modelled sequences would be dependent upon site-specific factors (such as clearly stratified sequences with firmly dated boundaries—a rare circumstance at medieval rural settlements) and would therefore be unsuitable for inter-site comparisons.

A sequence of letters and numbers, from A1 to G2, has been applied as a shorthand for the IVIs. These codes are necessarily arbitrary but, for convenience when

Table 4.
The FeedSax chronological schema, including examples of radiocarbon date ranges which would fit into each IVI, and proposed concordance with traditional phases (IVI: irreducible verifiable interval).

Traditional phase	**IVI**	**Years**	**Example radiocarbon range (probability)**	**Lab code**
early Anglo-Saxon	A1	420–530	421–539 (95.4%)	OxA-39867
	A2	530–600	528–602 (71.9%)	OxA-37812
	B1	600–630	583–653 (95.4%)	OxA-40146
	B2	630–670	639–685 (84.6%)	OxA-37502
middle Anglo-Saxon	C1	670–720	674–779 (76.2%)	OxA-40333
	C2	720–770		
	C3	770–820	784–880 (79.7%)	OxA-40411
	C4	820–880		
late Saxon	D1	880–920	877–993 (91.2%)	OxA-37302
	D2	920–950		
	D3	950–980		
	D4	980–1030	973–1032 (88.2%)	OxA-37726
Saxo-Norman/ early medieval	E1	1030–1060	1028–1158 (95.4%)	OxA-37408
	E2	1060–1080		
	E3	1080–1120		
	E4	1120–1160		
	E5	1160–1220	1161–1222 (95.4%)	OxA-38511
13th century	F1	1220–1270	1222–1276 (95.4%)	OxA-37727
	F2	1270–1300	1278–1306 (65.0%)	OxA-39545
14th century	G1	1300–1360	1310–1409 (95.5%)	OxA-39344
	G2	1360–1400		

attempting concordance between different datasets (as discussed further below), the letter elements correspond broadly with conventional periods: ‘A–B’ with early Anglo-Saxon (‘A’ more specifically with the 5th to 6th centuries), ‘C’ with middle Anglo-Saxon, ‘D’ with late Saxon, ‘E’ with early medieval or some variants of Saxo-Norman, ‘F’ with the 13th century and ‘G’ with the 14th century.

The IVIs are intended to be universally applicable to medieval assemblages from sites across (and beyond) England. The start and end dates of most calibrated radiocarbon ranges, as well as conventional ceramic phases, should fall within c 30 years of the beginning and end of one or more IVIs—ie they should not qualify for a ‘shift’ (as defined above) in relation to an IVI. The example calibrated radiocarbon date ranges shown in Table 4 demonstrate the complex ways in which the IVIs can map onto actual radiocarbon dating results. There is not always a close, direct correspondence between an individual IVI and a calibrated range, but IVIs can be combined to give a match within c 30 years of the start and/or end date. Thus IVIs are intended to be both irreducible and combinable—basic component units for a chronology.

As proposed above, the same combinability is meant to assist in matching IVIs to conventional and/or ceramic phases, too. One specific example might be where, in excavations at Worcester College, Oxford, ‘Phase 1’ was dated on ceramic grounds to c 1175–1225 (Teague and Ford 2016, 188), which is a fair match for ‘E5’ (1160–1220) in the IVI schema. More generally, phases assigned to the 13th century map reasonably and intentionally well onto 'F' (F1–F2: 1220–1300), while the 14th century maps directly onto 'G' (G1–G2: 1300–1400). For conventional phases like 'middle Anglo-Saxon', a greater degree of subjective judgement may be required. A middle Anglo-Saxon phase dated by Ipswich Ware—in the relatively small parts of the country where sites yield significant amounts of it—would correspond well with C2–C4 (720–880), whereas a broader, more traditional middle Anglo-Saxon phase (c 650–850) would align better with C1–C4 (670–880), or perhaps B2–C4 (630–880). For the purposes of large-scale comparative analyses in FeedSax, 'middle Anglo-Saxon' and equivalent terms such as 'mid Saxon' were—unless otherwise qualified in excavation reports—taken by definition to correspond with 'C' on the IVI schema, while 'late Saxon' approximated to 'D' (or D–E1) and 'Saxo-Norman' and equivalent variants approximated to 'E'.

Such subjectivity is not, however, without complications or controversy. For example, by aligning a conventional 'middle Anglo-Saxon' period (650–850) with our 'C' (670–880), are we arbitrarily re-dating archaeological finds, abruptly pushing them later by 20–30 years? The answer must be 'yes', but it is a qualified yes. Where a date of 650–850 has been assigned purely out of convention—as will usually be the case—then we do not lose any real knowledge or precision by shifting the years by two or three decades. The years 650 and 850 will most often have no independent, verifiable basis. Rather, by replacing the conventional span with an IVI, we move the phase onto a more empirically verifiable and interoperable footing: the dates could be directly tested by radiocarbon dating, and could also be employed in comparisons with other sites—which might have radiocarbon dates available as a basis for establishing chronologies—and thus circumvent the phasing conventions which may change over time and between excavators and countries. Ultimately, with the most popular chronometric tools currently available, 650–850 is not a verifiable interval, but 670–880 and its constituent IVIs are.

CONCLUSION

We therefore contend that, as radiocarbon dating grows in precision, affordability and ubiquity, it offers a more useful basis for establishing archaeological chronologies than do the conventional 'phases'—chiefly attached to pottery fabrics and then, by extension, to associated features—which ultimately derive from the convenient rounding of historical horizons. We would therefore argue in favour of more extensive use of radiocarbon dating in general, both in immediate post-excavation work and in synthetic research projects which revisit archive materials; but we would also contend that a phasing schema based on radiocarbon dating is appropriate and beneficial even for projects which cannot undertake extensive radiocarbon dating, because the schema should nonetheless support verifiability and interoperability in the longer term. The IVI schema proposed in this paper supports the definition of verifiable or falsifiable phases which, because they are independent of local pottery cultures or documented events, should be interoperable between sites, regions and countries. Moreover, it ought to be fully extensible in line with the IntCal20 calibration curve, admitting both earlier and later phases at sites with pre- and post-medieval activity, while bypassing names with (potentially misleading or inappropriate) cultural associations, such as 'Roman' or 'Saxon'. It might be contended that such a reliance upon a radiocarbon calibration curve introduces artificial horizons and plateaux of its own, reflecting the shape of the curve rather than any historically meaningful sequence. We maintain, however, that such a caveat is inevitable when applying *any* kind of transferable framework; the purpose of the IVI schema is not to transcend this problem, but to move it onto an empirically verifiable footing.

Alphanumeric codes have been applied to the medieval IVIs presented in this paper, principally for ease of reference in the FeedSax project's analyses. These codes are admittedly bland, compared with the well-known and perhaps more evocative terms like 'early Anglo-Saxon' or 'high medieval'. We do not therefore expect our alphanumeric codes to taken up with any enthusiasm, nor would widespread take-up necessarily be helpful: far better would be to cite directly *the years and intervals* in question, and then to test, refine and revise these as and where necessary. In this way, archaeological chronologies—for the medieval period and beyond—may over time gain in rigour, precision, and reliability.

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No potential conflict of interest was reported by the author(s).

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Résumé

Chronologie des peuplements médiévaux : réflexions sur un programme extensif de datation radiocarbone Par Mark McKerracher, Helena Hamerow et Christopher Bronk Ramsey

Le projet *Feeding Anglo-Saxon England* (La nourriture de l'Angleterre anglosaxonne, ou FEEDSAX) a appliqué des méthodes scientifiques aux restes bioarchéologiques afin d'éclairer sous un nouveau jour l'agriculture médiévale anglaise. La méthodologie faisait intervenir un programme extensif de datation radiocarbone qui, outre sa contribution à la datation des développements dans les pratiques agricoles de certains sites d'étude sélectionnés, s'est révélé luimême riche en information. Ce papier traite des principales implications découlant des résultats de ce programme, au vu des problèmes généraux soulevés par la datation des phases de peuplement au Moyen-Âge. Tout d'abord, il nous a permis de concevoir un nouveau schéma chronologique « universel » qui permet d'aligner les phases conventionnelles avec le niveau de précision actuellement possible à partir de dates radiocarbone calibrées. Ensuite, il a révélé des disparités fréquentes entre les dates radiocarbone de restes organiques et leur datation initiale – habituellement fondée sur les associations de céramiques – aboutissant dans bien des cas à des raffinements ou révisions chronologiques, et révélant parfois des périodes d'activité qui n'étaient jusque-là pas répertoriées. Les résultats ont notamment souligné le fait que les datations sur la base des céramiques associées sous-estimaient souvent l'âge des restes organiques.

Zussamenfassung

Die Chronologie mittelalterlicher Siedlungen: Überlegungen zu einem umfangreichen Radiokarbondatierungsprogramm Von Mark McKerracher, Helena Hamerow und Christopher Bronk Ramsey

Das Projekt *Feeding Anglo-Saxon England* (FEEDSAX) wandte wissenschaftliche Methoden auf bioarchäologische Überreste an, um neue Erkenntnisse über die mittelalterliche englische Landwirtschaft zu gewinnen. Die Methodik umfasste ein umfangreiches Radiokarbondatierungsprogramm, das nicht nur dazu beitrug, landwirtschaftliche Entwicklungen an ausgewählten Fallstudienstandorten zu datieren, sondern auch selbst informative Erkenntnisse lieferte. In diesem Beitrag werden die wichtigsten Implikationen der Ergebnisse dieses Programms im Hinblick auf die allgemeinen Probleme bei der Datierung mittelalterlicher Siedlungsphasen diskutiert. Erstens konnten wir im Rahmen des Programms ein neues „universelles" chronologisches Schema entwickeln, das einen Abgleich der konventionellen Phasen mit der derzeit für kalibrierte Radiokarbondaten erreichbaren Genauigkeit bietet. Zweitens kamen häufige Diskrepanzen zwischen den Radiokarbondaten organischer Überreste und ihrer ursprünglichen, in der Regel auf zugehörigen Keramikfunden basierenden Zuordnung zu einer Phase zum Vorschein. Dies führte oft zu einer Verfeinerung oder Korrektur der Chronologie und offenbarte manchmal bisher unbekannte Aktivitätsperioden. Die Ergebnisse zeigen insbesondere, dass die auf Keramikfunden basierende Zuordnung zu einer Phase das Alter organischer Überreste oft unterschätzt.

Riassunto

Cronologie degli stanziamenti medievali: riflessioni su un vasto programma di datazioni al radiocarbonio *Di* Mark McKerracher, Helena Hamerow *e* Christopher Bronk Ramsey

Il progetto FEEDSAX (*Feeding Anglo-Saxon England*) ha applicato metodi scientifici a reperti bioarcheologici per gettare nuova luce sull'agricoltura medievale in Inghilterra. La metodologia ha compreso un ampio programma di datazioni al radiocarbonio il quale, oltre a fornire utili elementi per datare gli sviluppi dell'agricoltura in siti di studio selezionati, si è dimostrato di per sé informativo. Questo studio discute le implicazioni chiave dei risultati del programma prendendo in considerazione i problemi generali di datazione delle fasi degli stanziamenti medievali. Innanzitutto esso ci ha permesso di ideare un nuovo schema cronologico "universale" che allinea le fasi convenzionali con la precisione

attualmente ottenibile con le datazioni al radiocarbonio calibrate. In secondo luogo esso ha rivelato le frequenti divergenze tra le date al radiocarbonio dei reperti organici e quelle della programmazione fase per fase originaria – spesso basata sulle ceramiche associate – il che ha portato spesso a ritocchi cronologici o a revisioni, e a volte ha rivelato periodi di attività finora sconosciuti. In particolare i risultati mettono in evidenza il fatto che la programmazione originaria fase per fase basata sulle ceramiche spesso sottostima l'età dei reperti organici.