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RADIOCARBON CALIBRATION IN THE ANGLO-SAXON PERIOD: AD 495–725

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ABSTRACT. Radiocarbon dating has been rarely used for chronological problems relating to the Anglo-Saxon period. The "flatness" of the calibration curve and the resultant wide range in calendrical dates provide little advantage over traditional archaeological dating in this period. Recent advances in Bayesian methodology have, however, created the possibility of refining and checking the established chronologies, based on typology of artifacts, against ^{14}C dates. The calibration process, within such a confined age range, however, relies heavily on the structural accuracy of the calibration curve. We have therefore re-measured, at decadal intervals, a section of the Irish oak chronology for the period AD 495–725. These measurements have been included in IntCal04.

INTRODUCTION

Radiocarbon dating is presently rarely used for archaeological dating in western Europe during the migration period (about AD 400–700). This is because the calibrated dates produced in this period have usually been insufficiently precise to refine existing archaeological chronologies (principally those based on artifact types).

The shape of the existing calibration curve (Stuiver et al. 1998) suggests that the atmospheric concentration of ^{14}C was changing rapidly in the period AD 570–720, and so high-precision ^{14}C measurements might produce calibrated dates spanning 50 yr or less (at 95% probability). Combined with correspondence analysis of the artifact types recovered from graves (Greenacre 1984, 1992; Høilund Nielsen 1995) and Bayesian chronological modeling (Bronk Ramsey 1995; Buck et al. 1996), such dating has the potential to test the chronological basis of Anglo-Saxon artifact typologies in England during this period.

A major research program into the chronology of Anglo-Saxon graves in the period AD 570–720 is currently underway at the Queen's University Belfast. The exact slope and structure of the calibration curve in this period is, however, critical to the project, as is the accuracy of the ^{14}C measurements produced. For this reason, replicate measurement was undertaken of known-age wood samples which were measured quasi-simultaneously with the human skeletons from the artifact-containing graves.

RESULTS AND DISCUSSION

Two independent ^{14}C measurements were made on decadal samples of Irish oak from Brabstown, Co. Kilkenny (AD 575–725); Lemanaghan, Co. Offaly (AD 555); and Little Island, Co. Cork (AD 495–565). Samples were processed and measured as described by Hoper et al. (1998) and McCormac et al. (1998). The results are provided in Table 1 and on the *Radiocarbon* Web site (http://www.radiocarbon.org/IntCal04).

When the original Belfast long oak tree-ring chronology was being constructed, extensive use was made of timbers from destroyed horizontal mill sites throughout Ireland. It was found that these early Christian sites exploited massive and often long-lived oaks, the timbers being preserved due to the waterlogged locations used for mill construction. Two important examples of horizontal mills were Little Island, Co. Cork, dating to AD 630, and Brabstown, Co. Kilkenny, a two-stage mill, dat-

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Table 1 Radiocarbon ages and $\delta^{13}C$ measurements for oak samples from Little Island, Co. Cork; Brabstown, Co. Kilkenny; and Lemanaghan, Co. Offaly.

Site	Tree number	Laboratory ID	Year AD	^{14}C BP	Error	$\delta^{13}C$ (‰)
Little Island	Q3676/Q3681	UB-4630	494.5	1650	21	–25.1
Little Island	Q3676/Q3681	UB-4631	494.5	1595	20	–25.0
Little Island	Q3676/Q3681	UB-4628	504.5	1611	21	–25.2
Little Island	Q3676/Q3681	UB-4629	504.5	1606	20	–25.0
Little Island	Q3676/Q3681	UB-4626	514.5	1556	21	–24.5
Little Island	Q3676/Q3681	UB-4627	514.5	1595	20	–25.0
Little Island	Q3676/Q3681	UB-4624	524.5	1607	21	–24.8
Little Island	Q3676/Q3681	UB-4625	524.5	1613	20	–24.7
Little Island	Q3676	UB-4622	534.5	1571	20	–24.5
Little Island	Q3676	UB-4623	534.5	1598	20	–24.5
Little Island	Q3676	UB-4620	544.5	1538	20	–24.0
Little Island	Q3676	UB-4621	544.5	1572	20	–24.3
Lemanaghan	Q9795	UB-4618	554.5	1511	17	–24.6
Lemanaghan	Q9795+B16	UB-4619	554.5	1534	19	–24.8
Little Island	Q3676/Q3679/Q3674	UB-4616	564.5	1524	20	–24.4
Little Island	Q3676/Q3679/Q3674	UB-4617	564.5	1510	20	–24.4
Brabstown	Q3693/Q3685	UB-4379	574.5	1475	24	–23.8
Brabstown	Q3693/Q3685	UB-4380	574.5	1499	24	–23.8
Brabstown	Q3693/Q3685	UB-4381	584.5	1486	24	–24.8
Brabstown	Q3693/Q3685	UB-4382	584.5	1464	24	–24.7
Brabstown	Q3693/Q3685	UB-4383	594.5	1504	24	–24.6
Brabstown	Q3693/Q3685	UB-4384	594.5	1442	24	–24.6
Brabstown	Q3693/Q3685	UB-4385	604.5	1439	24	–24.0
Brabstown	Q3693/Q3685	UB-4386	604.5	1478	24	–24.1
Brabstown	Q3693	UB-4387	614.5	1423	24	–23.8
Brabstown	Q3693	UB-4388	614.5	1452	24	–23.8
Brabstown	Q3693	UB-4389	624.5	1425	24	–24.3
Brabstown	Q3693	UB-4390	624.5	1451	24	–24.2
Brabstown	Q3693	UB-4391	634.5	1415	22	–24.3
Brabstown	Q3693	UB-4392	634.5	1432	22	–24.3
Brabstown	Q3693	UB-4393	644.5	1424	22	–24.7
Brabstown	Q3693	UB-4394	644.5	1425	22	–24.7
Brabstown	Q3693	UB-4395	654.5	1373	22	–25.0
Brabstown	Q3693	UB-4396	654.5	1371	22	–25.1
Brabstown	Q3693	UB-4397	664.5	1343	22	–25.0
Brabstown	Q3693	UB-4398	664.5	1321	22	–25.4
Brabstown	Q3693	UB-4399	674.5	1305	22	–26.0
Brabstown	Q3693	UB-4400	674.5	1285	22	–26.0
Brabstown	Q3693	UB-4401	684.5	1281	24	–25.6
Brabstown	Q3693	UB-4402	684.5	1281	24	–25.5
Brabstown	Q3693	UB-4403	694.5	1249	24	–25.7
Brabstown	Q3693	UB-4404	694.5	1271	24	–25.8
Brabstown	Q3693	UB-4405	704.5	1264	24	–25.7
Brabstown	Q3693	UB-4406	704.5	1263	24	–25.9
Brabstown	Q3693	UB-4407	714.5	1238	22	–25.2
Brabstown	Q3693	UB-4408	714.5	1266	22	–25.2
Brabstown	Q3693	UB-4409	724.5	1279	22	–25.5
Brabstown	Q3693	UB-4410	724.5	1249	22	–25.5

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ing to AD 760 and 913 ± 9, respectively (Baillie 1982). Correlation values up to $t = 7.1$ (Baillie and Pilcher 1973) served to link the ring patterns from a complex of 9 sites from the Irish Republic. All of the mills, including another four from the north of Ireland, were found to belong to a building episode spanning AD 630 to about AD 930. The resultant Belfast chronology for the last 2 millennia was found to cross-match precisely with an independent German chronology constructed by workers in Köln and Hohenheim (Pilcher et al. 1984).

It was sample blocks from these long-lived archaeological timbers that were supplied for the original Belfast calibration program (Pearson et al. 1986). The long-lived nature of the trees was important because long runs of samples could be cut consecutively from individual timbers, a factor useful for eliminating any possibility of sampling error. When it was proposed to repeat the calibration at decadal resolution (the original calibration was at bidecadal resolution), further replicate samples were obtained in almost every case from the same timbers that had been used in the 1986 calibration. Where additional wood was required, it was obtained from timbers, the ring patterns of which cross-dated with the Belfast long chronology to the same level of statistical and visual matching that had underpinned the construction of the original chronology (the sequence from Lemanaghan, Co. Offaly cross-matches with the samples supplied to Gordon Pearson at $t = 7.9$). Thus, these new samples represent exact replication of the original calibration and can be compared with the Pearson et al. (1986) calibration results by combining appropriate decade pairs.

CONCLUSION

The decadal pairs have been combined and can be used as a bespoke set of data for specific calibration within the period AD 495–720. They have been incorporated within the larger IntCal04 data set. Further measurements, replicating calibration data in the periods AD 395–485 and AD 735–805, continues.

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