Dendrochronological analysis of a yew tree branch from the New Forest, Hampshire

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Report SOMW01/20 T.R. Hindson and A.K. Moir 2020

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Report SOMW01/20

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Summary

A section of yew tree branch Taxus baccata L. was measured to contain 379 tree rings from bark to pith and has yielded the longest chronology from a live yew tree in the UK to date. Furthest from the bole, a series of 357 tree rings spanning 1662 to 2018 was measured. Microscopy was required to identify ring widths to 0.01mm. The section nearest the bole yielded a series of 200 rings spanning 1640 to 1839. A 379-year mean chronology SOMW01 1640 to 2018 was found to produce consistently high *t*-values against both oak and yew reference chronologies. The construction of this long chronology from a minor yew tree branch highlights the potential for branches to yield longer chronologies than those obtained from boles. The length of the branch between sampling cuts was measured to yield mean rates of branch extension. The parent yew tree had a girth of 392cm, and an age of over 400 years has been estimated.

Introduction

Unlike simple ring counts, dendrochronology is able to produce exact ages for some tree species in the UK. A dendrochronological investigation can indicate missing, microscopic or merged tree rings that are usually missed in a simple ring count. Furthermore, wood of uncertain date can be located in time by matching against a dated reference chronology.

A population of large yews in and around the region of Warwick's Copse near Marchwood was noted by Bob Burrows in 2006 for the Ancient Yew Group (AYG), and was verified by Peter Norton. It is monitored by the AYG, who have included the location on their online map of yew sites. This loose cluster of woodland yews up to 5 metres in girth is currently represented on the AYG website by a single example, as the trees have hitherto been considered to be of uncertain significance. The exemplar individual on the AYG website has been categorised as "V-wild" i.e. a veteran yew growing in the wild. A new cross-organisation classification system for heritage trees is being negotiated, and the AYG are collaborating with this effort. Some of the Marchwood yews may in future be classified as “ancient”.

In autumn 2018 a yew growing in woodland on the boundary of a conifer block at SU 37409 09646 was found to have recently lost a minor branch from its canopy by mechanical failure. The yew has been catalogued as SOMW01 for the purposes of this report. In 2018 it had a minimum girth of 392cm near breast height, and the failed branch stub is visible on the yew at *c.*5.5 metres from the ground (Figure 1). Its position and the canopy gap resulting from its loss show that it was a semi-upright division of the main trunk and was bearing upper canopy.

Figure 1: The sampled yew

Yew SOMW01 in autumn 2018. The broken branch stub is visible at the top of the image (ringed). The associated fallen branch material still bears green foliage.

Objectives

The main objective of this study was to identify whether a small yew branch could provide useful dendrochronological information.

Methods

The branch length was sub-sampled for multiple dendrochronological examinations, as shown in Figure 2, and the sections labelled SOMW01A to SOMW01J. Sections in which the pith could be dated were later tabulated by time and distance between them (Table 5) to calculate the branch extension rate.

Figure 2: Branch sampling locations, also showing sample lengths

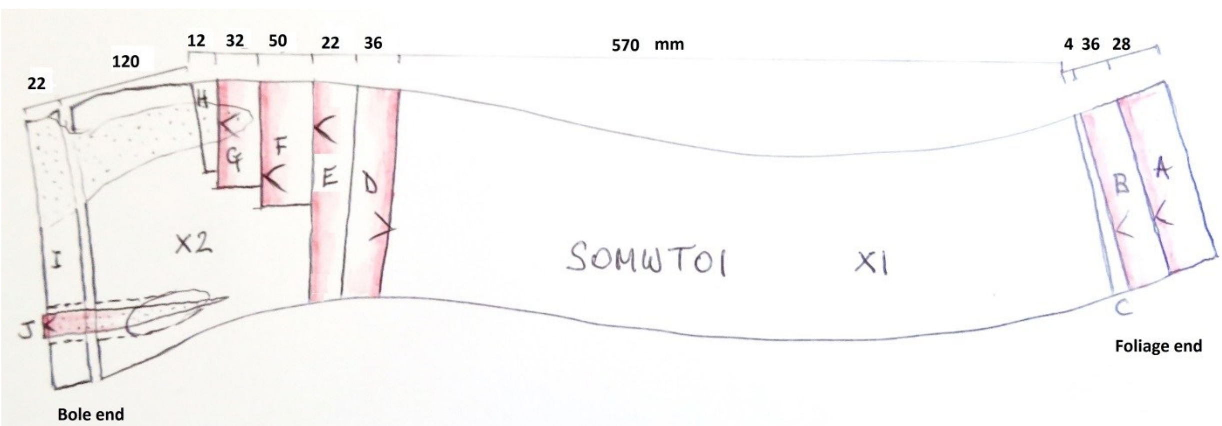


Table 1: Samples from SOMW01

Sample	Outcome	Sample	Outcome
A1	MW01x5, low resolution, discarded	F	SOMW01F
A2	SOMW01A	G	SOMW01G
B	SOMW01B	H	No pith, centre rotted out
C	Fragmented, not analysed	I	No pith, disturbed rings, near branch junction
D	SOMW01D	J	Included branch. Dating failed.
E	SOMW01E	X1, X2	Remainder, not investigated

Round sections were cut from the branch using a 30cm Silky “pull-saw”. Gloves and eye protection were used. The sections were sanded flat using progressively finer grits from P80 to

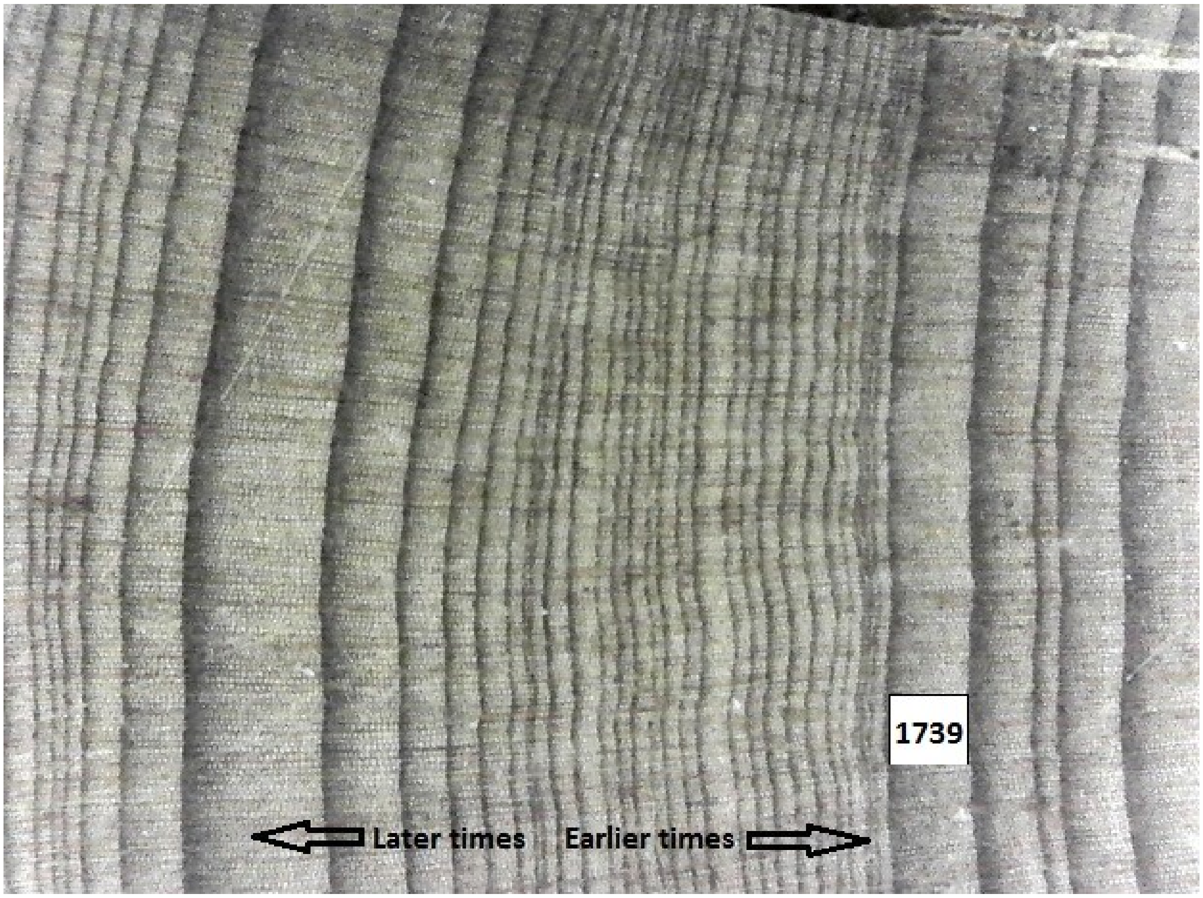
P1200. A surgical mask KN95 was worn during cutting and sanding. The resulting yew dust is extremely fine, and toxic. To identify areas with merging or particularly narrow rings, a free-standing “Plugable” USB 2.0 Digital Microscope was used (Figure 4). Suitable overlapping sub-sections were scanned at 12,800 dpi on an Epson Perfection V370 photo scanner linked to a Panasonic CF-52 laptop running MS Win 7, 64 bit. An SSD was installed to improve speed of image handling. To avoid eye damage, the scanner was covered with a cloth where the sample lifted the lid and exposed the scanning lights.

Cybis Coordinate Recorder was used to create .pos files from ring widths on the scanned images, and these sub-sections were overlapped in Cybis CDendro to yield .wid files of complete runs. To create the elements of the chronology SOMW01 the .pos elements of A, B and D, E, F, and G were cross-correlated to identify bad runs. All series were then imported into a dendrochronological program suite developed by Ian Tyers of Sheffield University (Tyers 1999). The statistical correlations are reported as *t* values derived from the original CROS73 algorithm (Baillie and Pilcher 1973). A value of 3.5 or over is usually indicative of a good match as it represents the value of *t* which should occur by chance only once in every 1000 mismatches (Baillie 1982), and the higher the *t* value, the closer to congruency in the cross-matching. Correlations were made between all viable members A–G of SOMW01 (Table 2). Mean ring widths were calculated from circumference measures and whole radii (Table 3) in addition to the measured ring widths provided in the Appendix.

Figure 3: Branch round SOMW01B

SOMW01B (see Table 2) the section with the pith connected was prepared for scanning.

Figure 4: Investigative microscope image – finding suitable areas for crossing dense ring barriers



Example of a high-density band of rings ×30 magnification in SOMW01. It was difficult to obtain an image that resolves all of these frequently merging rings.

Producing an image of the whole sample at high resolution was not possible. Labels were drawn on the prepared wood surface indicating marker years to facilitate simultaneous work on two separate images of the same area. The images of small areas of wood produced by the scanner at maximum resolution for Coordinate Recorder analysis were thus placed in the context of a larger movable area as viewed via a free-standing microscope, which gave a live high-resolution adjustable image on a simultaneously viewable second screen.

Results

A section of failed yew tree branch was measured to contain 379 tree rings from bark to pith. Furthest from the bole, a series of 357 tree rings spanning 1662 to 2018 was measured. The branch section nearest the bole yielded a series of 200 rings spanning 1640 to 1839. This site chronology was found to produce consistently high *t*-values against reference chronologies, with the first ring of the series at 1640 and the final ring of the series at 2018 (Table 4).

A series of particularly poor growing years was discovered beginning in 1740, possibly the result of weather conditions from October 1739 (Rowley 2020). The tree-ring late wood formed in years 1740–43 was, at its widest point (Figure 4), found compacted into a calculated 0.09 of a radial millimetre. Because of this extreme event, which is consistently represented throughout the sample, 1739 is here recognised as a distinctive marker year followed by the dense band of 23 rings to 1762.

Six series were found to match well together (see Table 2) and were combined to form a 379-year mean tree chronology named SOMW01.

Table 2: List of SOMW01 dendrochronological sequences with cross-correlation and *t*-test results for the elements of SOMW01

Filenames	Start date	End date	SOMW01B	SOMW01E	SOMW01D	SOMW01F	SOMW01G
SOMW01A	AD1662	AD2018	18.33	5.80	14.22	3.80	12.33
SOMW01B	AD1660	AD2018		5.06	18.18	-	11.27
SOMW01E	AD1644	AD1740			6.90	9.05	8.78
SOMW01D	AD1648	AD2018				4.61	10.27
SOMW01F	AD1643	AD1696					6.26
SOMW01G	AD1640	AD1839					

Triangular YR-CROS73 matrix, t-values over 3.00

Table 3: Average ring width by various criteria (mm)

Sample	Years	Circumference mm	By circumference generated mean radius	By measured maximum complete radius	By measured minimum complete radius
SOMW01A	357	520	0.23	0.34	0.12
SOMW01G	379	588	0.25	0.45	0.06

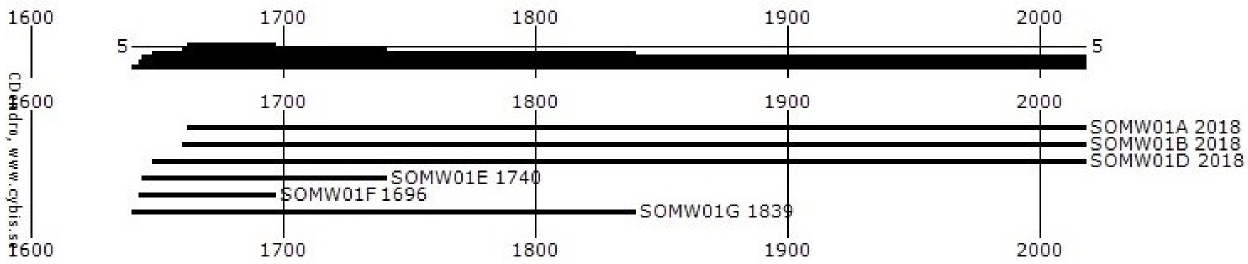
Table 4: Dating evidence for the series SOMW01M against reference chronologies

SOMW01 dated AD 1640 TO AD 2018					
File	Start Date	End Date	*t*-value	Overlap (yr.)	Reference chronology
SOMERST48	AD1095	AD2016	8.80	377	Oak - Somerset mean (Moir, unpublished)
SPGY01	AD1725	AD1984	7.75	260	Yew - Odstock - Wiltshire (Hindson and Moir 2020)
WINCHSTR	AD1635	AD1972	7.38	333	Oak - Winchester - Hampshire (Barefoot 1975)
EAST_MID	AD882	AD1981	6.29	342	Oak - East Midlands (Laxton and Litton 1988)
UKYEW16	AD1690	AD2009	6.25	320	Yew - UK reference chronology (Moir, unpublished)
RUAK01	AD1747	AD1989	6.11	243	Yew branch - Ankerwyke yew - Bucks (Moir 2005a)
OXON93	AD632	AD1987	6.10	348	Oak - Oxfordshire Chronology (Haddon-Reece *et al* 1993 unpubl)
STONE-1	AD1387	AD1998	6.07	359	Oak - Stoneleigh Abbey - Warwickshire (Howard *et al.* 2000)
HRBS01	AD1740	AD2019	5.42	280	Yew - St Andrews - Bridge Sollers - Hereford (Hindson *et al.* 2020)
HVYEW00	AD1789	AD2000	4.89	212	Yew - Happy Valley - Coulsdon - Gt London (North 2000)
HAMYEW04	AD1806	AD2004	4.85	199	Yew - Churchyard - Hambledon - Surrey (Moir 2005b)

Table 5: Branch length extension rate at historic growing point

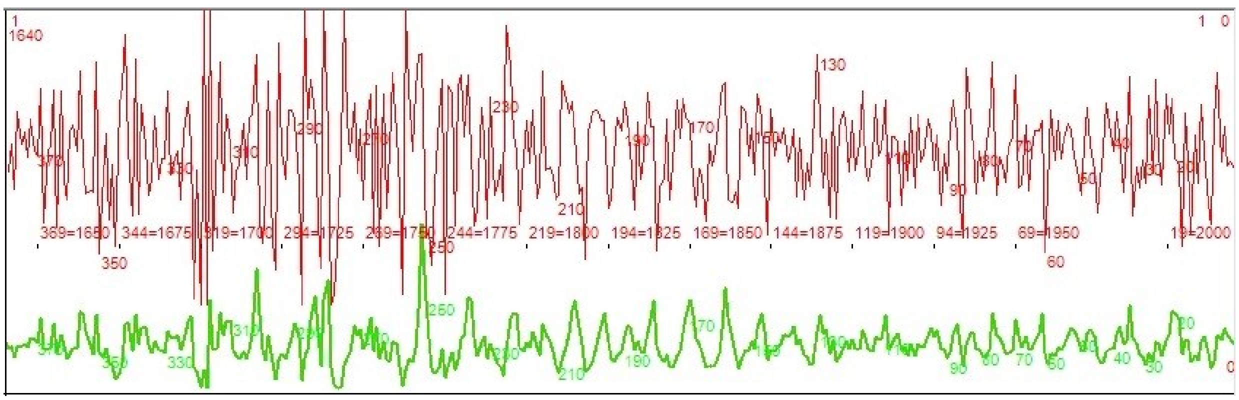
Sample	Distance between samples mm	Years between samples	Pith date	Rate between samples mm/ year	Rate over whole sample (mean) mm/year
SOMW01G	-	-	1640	-	Start
SOMW01G-F	32	4	1640-1643	8.0	-
SOMW01F-E-D	108	5	1643-1648	21.6	-
SOMW01D-B	574	12	1648-1660	47.8	-
SOMW01B-A	36	2	1660-1662	18.0	End
totals	750	23			32.6

Figure 5: SOMW01 constituent sample chronologies in time context



Cybis CDendro visualisation of the SOMW01 .wid sequences against a centennial scale.

Figure 6: SOMW01 mean chronology



CDendro output, SOMW01. Upper/Red: P2YrsL: Proportion of last two years' growth LIMITED (2,0,T,1,0). Lower/Green: Heavily detrended ring widths.

Discussion

Chronology

This analysis of a branch extends the UK yew reference chronology, which previously ended in 1690, by 50 years back to 1640.

It was notable that the best match for SOMW01 was the oak chronology SOMERST48 rather than the national yew chronology UKYEW16. This may be because UKYEW16 had a lower overlap, and a further consideration is that SOMERST48 is geographically closer to the New Forest than many of the yews in UKYEW16 and is likely to have been subject to similar weather conditions to SOMW01, suggesting that local yew chronologies would be desirable.

Moir and Leroy (2011) investigated the possibility of a 1,000-year-long yew chronology, but results collated in that work suggest that Pressler coring of yew boles or yew stump analysis will not usually yield chronologies of sufficient length, despite the likelihood that a considerable number of yews over 1,000 years old exist. It is becoming clear that yew material from the widest possible range of structures, including branches, will need to be investigated in order to make a 1,000-year chronology a possibility. However, long floating yew chronologies may potentially be matched with a local oak chronology.

The density of the rings in SOMW01 was very high, particularly at 1740–43, and in the following two decades to 1762. A difficulty in identifying some rings was caused by the trade-off between resolution and image size enforced by the limitations of the scanner. An initial attempt at 4,800 dpi was abandoned, nevertheless producing the 300-year chronology MW01Ax5 (2018–1719) with the assistance of macro photographic images, before failure to cross-match runs into the 1600s. The method was varied, and a free-standing microscope was employed to allow a wide field of view at high resolution, enabling the tracing of merging rings so that the maximum scanner resolution of 12,800 dpi could be successfully employed to create the elements of SOMW01.

Despite the extreme ring density, positive cross-matching was found within the sample (Table 2); and positive matches with established chronologies were also found (Table 4), demonstrating the viability of small branch sampling in yew as a means of producing a climate signal.

Scaling and morphology

Attempts to accurately scale the ring-width images in CooRecorder produced uncertain results, so mean ring widths were recorded in three supporting formats (Table 3):

(1) Mean by circumference, in which the circumference is used to calculate a notional radius (mm) which is then divided by the number of tree rings found on that section radius. The result was similar for both sections investigated in this way.

(2) Mean by maximum measured radius. This measure approximates to measured ring widths in the dendrochronological runs, which tended to be made on areas with the widest rings.

(3) Mean by minimum measured (live) radius. This measure was taken to quantify the density of rings possible in a live area of yew branch, and to illustrate the necessity of choosing the correct part of the branch in the event that a Pressler borer is used to take branch samples. The correct sample point on this branch is likely to be the underside, and travelling almost the whole diameter of the branch to the upper surface. The question of whether it is safe to sample a yew in this way arises. The mean ring-width results for maximum and minimum radii were varied and contrasting and also differed widely from the results for the “mean by circumference”. The difference is due to the offset of the pith towards the upper side of the branch, which was more extreme near the bole, where mechanical leverage was greatest. At the most extreme density,

on the upper surface of samples G and H, a strip of bark had died and the wood below it had rotted to the pith.

The difficulty in identifying all of the rings on such a dense sample is offset by the reduction in convolution, ring distortion, included bark and adventitious growth commonly found in bole material. There is also less lobe production in branch material when compared with bole material. The smaller sample size obtained from branch material increases the ease of studying the rings “in the round” and thus of noting merging rings.

As found in a branch from the Ankerwyke yew tree (Moir 2005a) the branch sample from SOMW01 gives an understanding of the growth of its parent tree that is unlikely to have been obtained by sampling of the living bole. In the Ankerwyke study it is also noted that while the bole of a large yew may be hollow or distorted and impractical to sample, the branches which depend on it may nevertheless be intact. That observation has been borne out in this analysis. Here it is shown that even small branches can be useful in yielding long chronologies. The practice of sampling branches, particularly those which are lost through failure or unavoidable tree surgery, is shown to be a promising direction for extending the yew chronology data.

Branch extension

The branch extension data (Table 5) shows the branch initially growing in length at less than 1cm per year but accelerating to nearly 5cm per year.

The possibility of introducing the “extension dimension” of growth into the dendrochronological investigation may allow the consideration of the speed of branch development in the context of canopy development, as outlined by Thomas (2014). Little can be divined with certainty about the meaning of the branch extension data at this stage, because little is known about the typical extension development of yew branch material. However, if this work is done, then branch extension rates may have the potential to be revealing.

The branch extension element of this report is also a demonstrative microstudy in the high-resolution tree-ageing work that is at present only possible using dendrochronology.

Sampling branches for yew age estimates

Currently the only precise way to determine the age of a living tree is to count the annual tree rings from a section or increment core which intersects the pith of the tree (Moir 2005a). This method is not effective in the case of very large or hollow yews because of the radial distance to any pith, and the non-existence of pith and other central bole material which has usually rotted away. Further difficulties exist in analysing yew core samples because the bole wood in particular is often convoluted and may contain multiple centres and included branches which cannot easily be distinguished from the earliest pith in a Pressler core sample.

Our results here suggest that the opportunistic use of branch material can be a valuable tool in providing minimum ages for yew trees, if an intact branch round can be reliably dated to the year. It is acknowledged here that the method for using branch growth rates to calculate yew ages will require additional study to incorporate the location of the sample on the tree. Nevertheless, this method is a considerable advance over estimates based on girth alone.

An assessment of the age of the yew SOMW01 can be based on the idea that the 379-year-old branch developed directly as part of maiden growth, but with some branch competition and selection during normal canopy development. The young tree is unlikely to have produced competitive canopy at the sampling point 5.5 metres from the ground in significantly less than the 40–100 years estimated for canopy development by White (1998). The yew SOMW01 is therefore likely to be over 400 years in age.

Summary outcomes

The 392cm-girth yew SOMW01 is certain to significantly exceed 379 years in age and has a projected age of over 400 years.

It is possible to determine branch extension rate by means of dendrochronological analysis.

The 379-year chronology SOMW01 (1640–2018), can be added to the yew data available.

The dual-screen microscopic method of observing and recording narrow and merging rings was successfully utilised on this very high-density sample.

Conclusion

An opportunistically sampled fallen branch from the 392cm-girth yew SOMW01 has yielded a likely age of over 400 years for the parent yew, and the longest yew chronology from a live tree in the UK to date at 379 years. These results would not have been practical to obtain by taking Pressler cores from the bole. Dendrochronological investigation of yew branches is promising in terms of dating not only individual yews but the features of which they are composed. For instance, we have detected and quantified a growth rate of 23 years of branch extension from 1640–62 using dendrochronological analysis, with supporting microscopy, and such data may eventually assist our understanding of canopy development in the context of yew ageing. It is evident that opportunistically collected yew wood which is the product of storm, disease or accident, and which can be made available to dendrochronology, will be of value in advancing our understanding of the species.

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Appendix

Mean Chronology

Title : SOMW01

Raw Ring-width UNKN data of 379 years length
Dated AD1640 to AD2018
Average ring width 30.93   Sensitivity 0.30

23	20	21	16	21	22	25	24	30	30
29	45	27	27	28	43	25	38	31	22
25	30	30	53	50	37	28	21	40	19
16	18	11	10	5	7	11	26	27	17
33	21	29	30	22	18	23	19	18	17
26	22	21	21	15	17	24	25	8	7
2	8	2	37	18	19	36	27	35	37
24	21	19	23	19	24	31	62	37	19
14	23	12	5	11	11	9	12	16	20
16	4	12	15	25	32	19	8	26	30
6	2	1	1	4	5	5	7	6	7
5	6	9	5	8	4	6	4	4	7
8	6	2	7	11	11	17	34	69	37
21	9	7	9	15	5	8	12	7	11
19	21	36	36	21	14	19	21	13	19
14	11	10	7	18	33	37	37	22	21
26	24	32	23	18	32	28	25	21	15
11	18	26	34	48	54	40	31	14	16
21	28	37	46	57	38	27	26	33	38
54	67	68	45	55	45	43	65	77	91
44	34	28	35	25	23	33	36	52	66
80	65	44	39	33	20	21	19	19	25
40	65	46	32	24	16	22	29	28	33
28	42	53	42	23	31	30	33	35	41
38	38	44	32	35	25	23	18	19	38
48	37	40	25	34	21	25	33	38	33
41	36	38	58	53	43	42	58	56	57
82	45	50	55	59	40	43	35	44	34
44	41	40	50	57	50	56	38	37	30
35	50	57	39	21	38	49	50	37	37
30	32	39	74	54	52	47	38	39	43
74	57	45	54	41	41	47	54	67	32
24	32	30	37	35	38	46	53	51	45
33	34	46	48	42	27	22	22	31	35
35	46	52	39	42	71	45	40	31	29
23	34	29	48	47	37	55	62	90	86
78	39	51	47	26	29	23	32	32	22
13	16	28	26	31	28	26	23	20	

Chronology Elements A-G

Title : SOMW01A
Raw Ring-width UNKN data of 357 years length
Dated AD1662 to AD2018
Average ring width 32.59 Sensitivity 0.32

22	61	46	31	62	34	44	15	15	19
12	6	3	2	8	16	22	11	19	9
18	18	20	22	20	14	16	11	11	10
12	14	9	13	7	9	8	14	1	7
4	26	8	14	27	18	24	25	13	11
11	19	16	21	25	37	18	8	9	17
9	2	13	13	9	10	15	21	13	2
11	16	31	42	23	7	31	38	8	2
1	1	2	5	4	7	6	6	5	8
11	7	12	4	6	4	6	8	10	7
3	8	13	15	22	43	62	27	16	9
6	5	9	6	6	11	7	10	14	19
25	25	11	10	18	20	13	18	12	8
8	6	16	36	34	27	17	15	20	20
26	18	16	32	28	26	21	13	11	20
30	40	46	52	36	20	13	14	18	22
31	35	57	46	33	35	49	51	48	55
54	38	44	45	35	53	59	71	54	45
38	47	36	37	47	52	77	86	90	70
45	47	47	32	34	30	28	34	49	61
48	34	28	24	37	47	47	44	45	62
77	52	32	36	39	42	46	63	50	53
60	45	39	28	23	20	22	42	49	36
42	28	43	30	27	45	51	36	52	49
59	69	65	50	45	55	54	67	96	52
65	66	54	53	60	54	64	55	71	61
61	64	64	48	66	41	44	27	34	55
63	40	26	42	61	60	48	50	40	44
56	95	66	57	59	42	41	55	60	57
52	53	33	61	57	72	76	27	19	24
25	31	33	35	42	41	37	33	23	23
28	29	28	20	16	15	25	33	34	39
31	34	33	55	34	37	32	30	33	45
39	58	52	41	62	65	92	90	77	45
60	44	27	31	24	33	27	26	14	20
35	34	39	39	29	31	25			

Title : SOMW01B
Raw Ring-width UNKN data of 359 years length
Dated AD1660 to AD2018
Average ring width 27.62 Sensitivity 0.31

46	44	59	89	68	93	47	21	65	34
23	19	17	10	8	12	19	23	25	15
19	9	18	20	18	12	18	12	12	13
18	18	16	21	10	10	15	16	1	4
3	5	5	15	12	22	36	20	25	27
13	13	12	20	18	32	32	49	27	10
11	21	12	6	14	15	11	13	17	25
21	7	11	16	27	37	27	11	32	41
7	3	1	2	5	6	9	9	8	6
5	7	12	8	9	5	7	7	6	11
8	5	1	6	11	14	22	34	68	32
19	10	7	10	16	5	9	15	8	11
12	18	24	30	15	14	19	28	17	26
20	13	12	8	23	46	51	46	27	24
32	27	31	19	16	30	30	28	23	18
13	23	32	47	50	53	39	32	14	17
23	32	29	35	34	27	21	24	28	36
55	65	59	39	52	48	40	56	57	63
39	28	26	31	19	15	24	30	44	63
87	77	56	44	32	16	14	15	15	19
42	69	49	36	24	14	18	24	21	26
19	26	34	31	16	28	26	30	33	36
40	40	40	30	36	24	20	15	16	31
40	36	34	22	31	19	23	29	29	31
30	24	25	41	41	38	37	49	39	36
49	33	38	43	35	21	25	21	22	16
21	24	20	32	34	29	35	19	25	24
26	34	35	24	13	25	26	27	15	17
17	18	25	42	30	37	34	23	23	27
32	33	30	35	36	35	42	57	68	30
24	38	35	39	40	41	51	61	56	48
35	36	42	49	42	27	24	23	36	37
37	50	59	38	47	76	49	42	38	36
27	36	34	51	44	35	37	43	57	54
52	27	34	31	15	21	17	21	21	15
10	10	20	17	25	22	22	17	18	

Title : SOMW01D
Raw Ring-width UNKN data of 371 years length
Dated AD1648 to AD2018
Average ring width 29.91   Sensitivity 0.36

49	41	41	65	27	25	28	47	22	32
25	19	14	20	23	38	29	17	9	13
23	9	9	14	8	8	3	13	4	15
11	8	17	14	41	41	30	24	27	17
14	14	27	22	24	25	21	19	29	27
1	6	1	10	1	36	7	12	24	26
29	34	29	25	23	26	23	29	22	32
17	10	8	21	11	6	9	9	12	12
21	21	18	5	11	12	18	21	14	6
24	27	7	3	2	2	7	6	2	6
1	6	1	5	4	3	8	7	7	1
3	3	8	6	4	6	10	9	11	20
44	24	23	9	8	11	17	5	10	13
8	14	22	18	25	24	12	12	16	15
10	14	10	7	6	6	12	21	27	33
19	20	23	22	26	20	12	22	15	17
14	11	9	13	16	20	26	25	17	18
8	13	17	20	27	33	40	26	22	19
23	25	34	39	35	24	23	25	31	41
56	59	40	31	20	28	20	17	30	28
35	51	63	48	31	27	20	12	15	13
14	23	31	66	42	27	21	12	12	16
18	30	20	39	49	44	21	30	26	28
28	26	25	21	34	23	30	23	26	20
20	42	57	39	44	26	30	16	27	27
35	32	42	36	32	65	55	41	44	70
76	69	102	50	49	57	89	47	46	31
47	31	42	39	39	55	74	73	69	56
43	39	46	61	74	53	25	48	60	64
50	46	33	36	37	85	67	62	49	49
55	49	130	81	54	76	56	29	43	33
57	41	30	36	31	41	32	38	45	58
60	54	42	45	69	66	57	34	26	28
34	35	36	49	67	47	47	83	53	43
24	21	10	22	15	37	47	35	67	80
122	115	106	47	59	66	38	37	30	44
50	26	17	20	29	27	31	23	29	21
18									

Title : SOMW01E
Raw Ring-width UNKN data of 97 years length
Dated AD1644 to AD1740
Average ring width 23.27 Sensitivity 0.45

23	24	27	22	23	16	25	30	19	16
20	37	27	63	32	25	29	34	24	38
56	28	14	13	41	19	17	17	9	9
6	1	5	18	38	23	57	39	32	34
19	12	25	14	12	13	29	25	26	22
17	20	28	43	20	5	7	9	1	44
30	27	59	41	58	59	44	36	33	33
28	30	20	34	27	9	12	23	11	3
9	9	6	10	10	16	16	5	16	20
26	28	13	5	11	11	8			

Title : SOMW01F
Raw Ring-width UNKN data of 54 years length
Dated AD1643 to AD1696
Average ring width 29.37 Sensitivity 0.30

16	19	18	24	26	24	21	22	49	30
29	34	44	29	40	41	24	22	30	30
52	53	32	20	22	41	23	18	23	13
14	7	7	16	54	40	25	59	38	32
35	20	16	25	32	33	33	51	37	32
27	22	23	39						

Title : SOMW01G
Raw Ring-width UNKN data of 200 years length
Dated AD1640 to AD1839
Average ring width 30.07 Sensitivity 0.40

23	20	21	16	22	26	24	24	27	43
31	38	35	39	30	45	23	20	26	21
16	26	24	41	52	25	17	24	31	18
16	20	12	13	5	9	15	32	26	20
29	22	35	36	29	23	24	26	21	18
23	22	21	19	11	17	30	33	12	8
2	10	3	68	37	23	35	30	39	42
23	21	20	17	14	12	60	159	98	60
30	35	17	8	14	12	11	19	20	20
16	3	13	14	25	33	18	12	32	35
2	1	1	2	3	5	7	9	10	10
10	7	10	5	4	1	6	5	3	7
6	9	3	8	11	8	16	40	104	65
27	10	10	13	18	4	7	9	7	11
30	32	73	66	46	22	23	22	14	19
16	16	14	10	22	31	39	44	25	28
31	27	46	37	28	46	42	31	27	18
13	18	26	31	70	87	69	57	21	22
28	41	64	84	100	56	35	27	34	40
79	111	126	81	104	65	68	113	136	173