A Dendrochronology Study of Select Framing Timbers from the Joseph Noyes House, Newburyport, Massachusetts

Photo provided by David Carlson

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Introduction

On August 1st, 2023, a selection of timbers were cored by William Flynt from the Joseph Noyes house, located at 8 Bromfield Street, Newburyport, Massachusetts for the purposes of conducting a dendrochronology study. All samples were mounted, sanded, measured, and analyzed by the author back in Dummerston, Vermont.

Background

Dendrochronology, or the study of tree ring growth patterns to date the age of archeological timbers, was initially developed in the 1920's by Andrew E. Douglass using long-lived Ponderosa pines in the Southwest United States. An astronomer by training, Douglass was interested in historical sun spot activity and its relationship to earth's climate. He surmised that by looking at yearly growth ring sequences in long-lived trees growing in an arid environment where moisture is key, he might be able to ascertain yearly variations in climate attributable to sunspot activity. (Baillie, 1982). To push the tree ring database back past the age of living trees, samples were taken from roof poles in Pueblo ruins that turned out to eventually overlap the living tree data. Besides fulfilling his research needs, this work revealed the feasibility of dating archeological structures.

In the 1980's the advent of computer programs to collate data, run comparative analyses, and compile master chronologies enabled unknown samples to be compared to known masters with a high degree of accuracy in more temperate climates. Pioneering work in Eastern Massachusetts focusing on Oak (Krusic and Cook 2001, Miles, Worthington and Grady 2002, 2003, 2005) and in the Connecticut River valley initially concentrating on Pitch pine (Krusic 2001,Flynt 2004) and expanding into oak, chestnut, hemlock, spruce, and white pine, has revealed the suitability of using dendrochronology as a mainstream research tool for analyzing and establishing construction timber felling dates in the Northeast, a region heretofore considered too variable climatically to provide reliable results. It should be pointed out that this science is now one more tool in building archaeologists extensive analytical toolbox that allows them to study historic structure construction details with ever greater precision.

Over the past 20 years conducting such studies of historic structures throughout New England and eastern New York state, the author has been able to develop numerous site and regional dated masters for all of the species noted above. These are constantly being updated as additional material is dated and added to the appropriate masters to further enhance the chances of successfully dating future projects. As well, additional New England dated chronologies for some of these species, available online at the International Tree-Ring Databank, are also used as needed.

It should be remembered that trees were usually felled in the winter months with frame preparation occurring shortly thereafter, so the earliest a frame could be raised would be in the year following the felling date delineated in a dendrochronology study such as this.

Procedures

In procuring samples suitable for dendrochronology research, the analyst must be on the lookout for timbers, framing, and boards that exhibit several parameters. First, a bark, or waney, edge must be present if one wishes to establish with certainty the last year of growth. Second, there needs to be a sufficient number of rings in a sample to span several distinctive climactic variations that register as patterns of wide and narrow rings. Ideally, having 100 or more years of growth is best, but more often than not, samples will range from 50 to 100+ years. While it is feasible to get dates on young samples (50-60 rings), spurious results are possible and thus must be reviewed carefully both with longer-lived samples from the same structure as well as with what documentary and stylistic research uncovers. Third, enough samples need to be obtained (10-15 per building episode is usually reasonable) to allow for comparison and the fact that often some will not align for one reason or another. It is also critical that an assessment be made of the building frame to ascertain that the members from which samples are extracted were not reused or inserted at a later date, or, if so, are duly noted. Fourth, all samples must be labeled and entered into a log book that notes the position of each sampled timber within the structure, its species, whether or not it has wane, and any other information pertinent to the sample. In labeling the samples the following code was employed; NJN (Newburyport, Joseph Noyes). The numbers that follow simply refer to the sequence in which the samples were taken.

Samples were extracted using a custom coring bit, chucked into a 20 volt, ½" battery-powered drill, that creates a 9/16" hole out of which is obtained a 3/8" core. As well, "cookies" were cut from several removed rafters stored in the basement. The core samples were glued into custom wood mounts (oriented so as to be looking down, or up, the tree when viewed through the microscope) and sanded using successively finer grit paper (150-600 grit) both on a bench top belt sander and by hand sanding to create a mirror-smooth finish. The "cookies" were sanded in similar fashion. All samples were then viewed under an Amscope 7.5-45X binocular microscope fitted with cross hairs in one eyepiece to count and mark the number of rings per sample. This was followed with a careful visual review, again under magnification, in an attempt to determine if site-specific growth patterns could be ascertained in order to help cross date the samples. Each sample was then placed under the microscope on a Velmex UniSlide Encoder stage calibrated to read to the nearest micron (.001mm). Measuring begins at the outer, or last year of growth ring (LYOG), established as 1000, and proceeds to the center of the sample or first year of growth, as measured (FYOG). It should be noted that not all cores reach the center of the tree, thus the first year of growth does not necessarily reflect when the tree began to grow. At the junction of each growth ring, the analyst registers the interface electronically, which sends the measurement to the computer via a VMO Digital Readout.

In all of the work in this study, the measuring program MEASURE J2X was used to compile each sample's raw data files. The program transforms the ring widths into a series of indices that relate each ring's growth to its neighbors, thus standardizing the climate-related influences on a year-to-year basis (Krusic 2001). Thus trees from a

similar location but growing at different rates should exhibit similar indices. With the raw data in hand, using the program COFECHA (Holmes, 1983) the samples from this site can be compared with each other to determine if all were cut at the same time or within the span of several years or more. The hope is that a floating chronology can be developed revealing the felling relationship between some, if not all of the samples within each species found in the structure. The samples are also compared against one or more dated regional master chronologies or site masters of the same species to determine the exact year or years when the samples in question were felled. As strong samples are uncovered, these are added to a fledgling site master and the raw data is again run against this site master to see if additional samples align.

With COFECHA samples are broken down into ring groups of 50 years that are then compared to either the other undated samples (to create a floating site master) or with various dated masters (to determine a calendar year match). The 50-year ring groups in an individual sample are lagged a certain number of years (in this study a lag of 25 years was used) to provide an overlap of data within the groupings. The results are displayed in a series of ways, with Part 8 "Date Adjustment for Best Fit Matches for Counted or Unknown Series" composed of columns with the "best fit" being in column #1, the next "best fit" in column #2 and so on out 11 columns. The "add" number is the number to be added to the last year of growth (1000) to provide the year date of felling, while the "corr" number relates to how well the "add" meshes with the master. A correlation coefficient of .3281 is considered the threshold of significance for 50-year ring groups. Higher correlation values (preferably over .40) accompanying consistent "add" numbers in the first column usually reveal reliable results for longer-lived samples. It should be noted that samples exhibiting short ring counts (less than 60) are more prone to display spurious results. In the example below, consistent "add" numbers with strong correlations appearing in the first column for samples DLBH-07 and 08 reveal each samples' true date of felling (1000+784 and 782 = 1784 and 1782 respectively). Sample DLBH-09 does not show consistently strong correlation with any particular date. Note that the lag used in this example is 10 years.

SERIES	COUNTED SEGMENT	ADD # 1	CORR	ADD # 2	CORR	ADD # 3	CORR	ADD # 4	CORR	ADD # 5	CORR	ADD # 6	CORR	ADD # 7	CORR	ADD # 8	CORR	ADD # 9	CORR	ADD #10	CORR
DLBH-07	937- 986	784	.51	712	.47	729	.37	713	.37	847	.33	846	.31	728	.30	813	.29	800	.29	763	.28
DLBH-07	947- 996	784	.54	712	.45	760	.33	816	.31	729	.31	800	.29	713	.29	671	.29	847	.26	808	.25
DLBH-07	951-1000	784	.41	760	.35	712	.35	661	.31	787	.30	800	.29	774	.29	729	.27	808	.26	832	.25
DLBH-08	929- 978	782	.44	746	.42	793	.33	760	.32	705	.32	840	.31	858	.30	689	.30	824	.28	685	.26
DLBH-08	939- 988	782	.61	746	.37	689	.34	840	.30	725	.29	708	.27	723	.27	806	.27	684	.25	724	.25
DLBH-08	949- 998	782	.69	669	.47	840	.41	722	.32	806	.28	708	.27	700	.26	683	.25	723	.25	720	.24
DLBH-08	951-1000	782	.69	669	.38	840	.38	722	.34	757	.29	700	.28	730	.25	659	.24	838	.23	723	.23
DLBH-09	932- 981	713	.52	785	.35	848	.35	744	.35	729	.32	863	.31	846	.28	849	.26	693	.26	714	.25
DLBH-09	942- 991	846	.38	713	.36	785	.33	848	.33	729	.29	727	.29	790	.29	693	.28	761	.28	705	.27
DLBH-09	951-1000	799	.43	783	.39	731	.30	689	.30	808	.29	767	.27	756	.26	790	.25	814	.24	846	.24

Once samples from a site are firmly dated and grouped into a site master, Part 2 "Correlations with Master Series of all Segments as Dated and Measured" and Part 3 "Segments Correlating Low, or Higher, at other than Dated Position" of COFECHA can be viewed to see how well each sample correlates with the others in the group and where weak areas within the ring counts are located for further scrutiny.

Results- See Figure 1
A total of twenty samples were taken from the frame that appears to be constructed with a mix of reused and site specific material. Species encountered included white oak, black ash, white pine, and spruce.

Oak
Of the twenty samples, ten were identified as white oak.
The first series of tests attempted to develop a floating oak site master to reveal the felling relationships between the samples. These tests met with some success as illustrated on Chart 1A where NJN-06 and 08 indicate being felled 5 years before NJN-09, NJN-02 and 11 have last year of growth rings 39 years earlier than NJN-09, while NJN-14 was felled 34 years earlier, and NJN-03 came down 40 years earlier. NJN-05, 10, and 13 do not align consistently throughout their growth with a consistent felling offset when compared to those samples that do align. On Chart 1B, Part 2 reveals how each samples 50-year ring groups correlate with each other where they overlap. While all align strongly in their later year ring-group overlaps, some weakness is noted in certain samples (NJN-02,03,11,14) in their earliest periods of growth. The better fits noted in Part 3 of Chart 1B for these samples do not reveal any glaring errors, suggesting that this weakness is not overly critical.
The next series of tests compared the oak samples to several regional oak masters. A test against an oak master known as Boston 01, developed by the Lamont-Doherty Tree-Ring Laboratory (LDTRL), reveals, as seen on Chart 2, NJN-03 aligning somewhat weakly, for most of its growth with 1687, NJN-06 and 08 aligning strongly with 1707 and NJN-09 showing strength for wanting to align with 1712 in its later years of growth. None of the other samples reveal significant alignments.
A test against oak master Boston 02, developed by the Oxford Dendrochronology Laboratory (ODL), illustrated on Chart 3, finds more samples aligning with specific dates. NJN-02 aligns well with 1673 as does NJN-11 in its last 85 years of growth, NJN-03 aligns strongly for most of its growth with 1672, NJN-06 and 08 once again align with 1707, as does NJN-09 aligning with 1712 throughout its growth. As well, NJN-10 aligns with 1631 in its last 80 years of growth, NJN-13 shows strength for 1611 during its last 75 years of growth, and NJN-14 associates with 1678 throughout its growth. It should be noted that the dates being proposed for NJN-02,03,06,08,09,11,14 are in agreement with the offsets seen in the floating oak master on Chart 1A. It is also worth pointing out that while sample NJN-03 aligned with 1687 for most of its growth when compared to Boston 01, a closer look at Chart 2, with Chart 3 results in hand, reveals the date 1672 appearing in columns 2 and 3 with correlation coefficients over the .3281 threshold in all but one 50-year ring group.
A third test against a North Shore oak master developed by the author which also includes some material from both Boston 01 and Boston 02, once again reveals similar results, as illustrated on Chart 4.
Working with the results of these various tests, certain of the samples were assigned calendar dates to create a Noyes house oak site master as seen on Charts 5A and B.

Black Ash
Four samples turned out to be black ash, a species that has very few dated masters.

As with the oak, these samples were tested against themselves in an attempt to create a floating master. Unfortunately no significant results could be determined. That said, one of the few dated masters (provisional) for the species comes from the North Shore, and when the samples are tested against it, several significant results are noted. Chart 6 reveals NJN-01 aligning throughout its growth with a date of 1707, the latter years of growth of NJN-07 align with 1712, and NJN-12 shows weak strength for possibly aligning with 1707 or 1708 throughout most of its growth. These early 18th century dates are in agreement with what some of the oak samples, namely NJN-06,08, and 09, are revealing. As well, a date of 1673 can be found lurking within the results of NJN-04, perhaps a coincidence but worthy of note as relates to the earliest oak in the previous tests.

White pine

Two samples, NJN-17 and 18, were identified as white pine and, when run against each other, reveal that both were felled the same year, as noted on the top of Chart 7. As with the black ash, there are only a few white pine masters available to work with. Luckily two are in the region with one being a site master from Newbury (ODL) and a regional southern Maine master developed by the author. Tests against both reveal the two samples align strongly with 1773, as seen on the lower portion of Chart 7. With such strong correlations, these samples were assigned this date and added to the material from the local site master to create a fledgling Newburyport area white pine master

Red Spruce

Four red spruce samples were tested against themselves in an attempt to create a floating master, but no conclusive results could be obtained.

Tests were then conducted using two regional spruce masters, one from the North Shore and the second from coastal Maine. In reality the North Shore spruce samples were almost certainly imported from Maine at the time of their use in North Shore buildings. Chart 8 illustrates the results of these two tests in which no one sample aligns throughout its growth with a specific date, although in several instances a date of 1773 is clearly being suggested with respectable correlation coefficients (NJN-15,20), especially in regards to NJN-20 for most of its growth.

Discussion

While a relatively small structure, the Joseph Noyes house frame posed significant challenges due to the incorporation of clearly reused material, some quirky joinery where the entry bay frame joins the parlor/chamber bay at the plate level, and the use of softwood species in the entry bay frame but hardwood in the parlor/chamber bay.

A review of the results of the dendrochronology testing suggests the reused material comes from a structure(s) constructed in the 1670's that gets used in conjunction with material felled during the period 1707-1712 (three being critical posts) most likely related to the initial build of the house. One would expect this structure to have included an entry bay, as it currently has, but it is difficult to explain why it may have been removed in the 1770's when the softwood framing was felled that currently supports this section. It is possible the evidence of weathering on some of the framing located on the backside of the upper chamber indicates that the structure was in disrepair by the early 1770's. It is

worthy of note that one of the two samples taken from the removed leanto rafters currently stored in the basement also indicates a 1773 felling date, suggesting that perhaps the entry modifications were undertaken at the time of the leanto addition (though having only two samples from the leanto roof is certainly less than ideal, especially when only one dated, for conclusively dating any construction event). With this information in hand it would be well worth having an expert in early framing conduct a more detailed examination of the structure to get a better understanding of the joinery, and couple this with further documentary research around these dates to see if corroborating material can be located that would help to clarify the initial build and subsequent modifications.

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FIGURE 1

JOSEPH NOYES HOUSE, NEWBURYPORT, MASSACHUSETTS

RECORD ID	AGE	FYOG	LYOG	WANE	SPECIES	LOCATION
NJN-01	106	1602	1707	Y	FRNI	W.RAFTER,3RD FROM S.END
NJN-02	116	1558	1673	Y	QUAL	SW RAFTER
NJN-03	102	1571	1672*	Y	QUAL	E.SLOPE LOWER PURLIN,SE BAY
NJN-04	111	890	1000	y	FRNI	E.SLOPE 1STRAFTER FROM S.END
NJN-05	69	932	1000	Y**	QUAL	E.RAFTER,2ND FROM S.END
NJN-06	75	1633	1707	Y	QUAL	NW CHIMNEY POST
NJN-07	121	880	1000	Y	FRNI	E-W CENTER ATTIC TIE BEAM
NJN-08	93	1615	1707	Y	QUAL	NE CHIMNEY POST
NJN-09	107	1606	1712	Y	QUAL	SW CORNER POST
NJN-10	131	870	1000*	Y	QUAL	PARLOR,W.WALL CEILING GIRT
NJN-11	136	1538	1673w	Y	QUAL	PARLOR SUMMER BEAM
NJN-12	129	872	1000	Y	FRNI	PARLOR CHIMNEY GIRT
NJN-13	126	875	1000	Y?	QUAL	PARLOR, E.WALL CEILING GIRT
NJN-14	112	1567	1678	Y	QUAL	PARLOR HEARTH LINTEL
NJN-15	118	1656	1773W	Y	PCRU	SE CORNER POST
NJN-16	68	933	1000	Y	PCRU	N.END WALL,2ND FLOOR GIRT
NJN-17	64	1710	1773	Y	PIST	N.END WALL ATTIC TIE GIRT
NJN-18	76	1698	1773	Y	PIST	NW CORNER POST
NJN-19	97	904	1000	Y	PCRU	LEANTO RAFTER IN BASEMENT
NJN-20	112	1662	1773	Y	PCRU	LEANTO RAFTER IN BASEMENT

FYOG = FIRST YEAR OF GROWTH, AS MEASURED
LYOG = LAST YEAR OF GROWTH, AS MEASURED
QUAL = WHITE OAK
PCRU = RED SPRUCE
PIST = WHITE PINE
FRNI = BLACK ASH
* = PARTIAL LAST RING, NOT MEASURED.TREE FELLED THE FOLLOWING SPRING
Y** = FIRST 40+ RINGS FROM WANE VERY TIGHT, NOT MEASURED.
w = WEAK

CHART 1A

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES — Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN OAK VS NJN OAK ALIGNED
50-YEAR SEGMENTS LAGGED 25 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-02	885- 934	-39 .73	50 .35	-40 .33	-38 .31	8 .27	52 .26	39 .24	11 .23	-48 .22	-11 .21	-51 .20
NJN-02	910- 959	-39 .77	-66 .43	-67 .37	7 .33	-65 .29	39 .26	-22 .26	40 .24	-17 .24	5 .23	28 .23
NJN-02	935- 984	-39 .62	7 .31	-15 .30	3 .27	-93 .26	-17 .23	5 .22	16 .22	-61 .21	-35 .21	-85 .21
NJN-02	951-1000	-39 .65	-85 .32	-4 .32	-74 .30	-110 .29	-109 .29	-5 .26	-19 .24	-93 .24	-17 .23	-61 .23
NJN-03	899- 948	-40 .66	-67 .42	6 .36	-65 .33	21 .32	-42 .30	18 .26	-41 .25	-53 .25	50 .23	8 .23
NJN-03	924- 973	-40 .62	-75 .34	25 .26	26 .25	-76 .25	-8 .21	5 .20	-25 .20	27 .19	-86 .18	-9 .17
NJN-03	949- 998	-40 .70	-86 .44	-103 .40	-5 .34	-72 .31	-116 .30	-37 .26	-113 .23	-69 .22	-25 .21	-57 .20
NJN-03	951-1000	-40 .71	-86 .42	-103 .41	-5 .38	-72 .31	-116 .29	-37 .26	-57 .22	-19 .22	-113 .20	-75 .19
NJN-05	932- 981	-101 .40	-102 .37	-46 .33	-26 .32	4 .31	-93 .28	-22 .28	-74 .28	-7 .23	-31 .22	-104 .22
NJN-05	951-1000	-46 .43	-26 .35	-101 .33	-102 .32	-11 .22	-31 .21	-92 .21	-12 .21	-73 .20	-30 .19	-65 .19
NJN-06	926- 975	-5 .76	-61 .30	-48 .30	17 .29	-79 .24	-63 .22	0 .20	-80 .19	-20 .19	-44 .19	19 .18
NJN-06	951-1000	-5 .83	-96 .32	-37 .31	-72 .29	-108 .28	-82 .26	-110 .24	-121 .24	-71 .23	-4 .23	-60 .21
NJN-08	908- 957	-5 .79	15 .34	32 .25	-53 .24	10 .23	-51 .22	-7 .21	-46 .21	30 .21	-61 .20	-14 .20
NJN-08	933- 982	-5 .86	-81 .40	-51 .32	-25 .23	-80 .23	-27 .21	-61 .20	10 .20	17 .18	-28 .18	-72 .17
NJN-08	951-1000	-5 .84	-110 .31	-121 .28	-27 .26	-62 .25	-28 .25	-72 .24	-40 .22	-6 .21	-51 .21	-75 .20
NJN-09	894- 943	0 .73	22 .28	35 .25	-41 .25	17 .24	-5 .22	57 .22	-50 .19	-26 .18	42 .18	-63 .18
NJN-09	919- 968	0 .77	-76 .40	20 .26	-63 .25	-22 .25	-20 .22	-1 .22	-74 .21	-35 .20	32 .19	22 .19
NJN-09	944- 993	0 .72	-76 .42	-22 .36	-37 .34	-93 .34	-35 .31	-57 .25	-96 .25	-106 .24	-20 .24	-1 .23
NJN-09	951-1000	0 .74	-22 .37	-93 .35	-57 .34	-37 .32	-35 .29	-96 .28	-1 .27	-76 .24	-125 .23	-13 .22
NJN-10	870- 919	-41 .38	58 .36	-27 .34	75 .31	73 .27	19 .27	0 .25	-39 .24	53 .23	-40 .22	5 .20
NJN-10	895- 944	-54 .40	-40 .39	35 .38	50 .33	-41 .29	-6 .29	49 .28	-68 .25	-66 .23	27 .22	15 .22
NJN-10	920- 969	-48 .35	-81 .34	-53 .32	-55 .31	7 .24	-50 .23	-33 .23	-80 .22	8 .22	-36 .21	-78 .21
NJN-10	945- 994	-48 .40	-13 .29	-36 .29	-85 .28	-108 .28	-83 .28	-81 .27	-112 .25	-89 .25	-116 .25	-98 .22
NJN-10	951-1000	-81 .37	-36 .33	-16 .31	-2 .24	-25 .24	-13 .23	-116 .23	-48 .23	-53 .20	-107 .18	-46 .18
NJN-11	865- 914	-39 .75	-12 .43	24 .31	-11 .27	44 .27	79 .26	-37 .25	37 .23	69 .21	-9 .21	34 .20
NJN-11	890- 939	-39 .60	57 .34	37 .34	-59 .31	59 .27	17 .25	-12 .24	-19 .23	2 .23	24 .22	-47 .21
NJN-11	915- 964	-39 .75	-58 .30	-83 .26	14 .25	-25 .24	22 .24	11 .21	2 .21	7 .20	-4 .19	-35 .18
NJN-11	940- 989	-39 .59	-78 .37	-35 .36	-32 .34	-112 .31	2 .30	-110 .27	4 .24	-85 .24	3 .22	-7 .21
NJN-11	951-1000	-39 .58	-78 .30	-79 .29	-7 .22	-16 .21	-110 .20	-64 .19	-105 .19	-112 .19	-71 .18	-52 .18
NJN-13	875- 924	41 .40	-20 .36	28 .31	63 .28	-31 .28	-13 .26	21 .24	-45 .24	60 .23	19 .22	43 .21
NJN-13	900- 949	-46 .48	-44 .35	-39 .33	0 .33	21 .29	-5 .22	32 .22	-71 .22	28 .21	41 .20	-73 .19
NJN-13	925- 974	-26 .33	-72 .29	-70 .26	-5 .24	-74 .24	0 .23	-52 .22	-46 .20	10 .20	-80 .19	-73 .19
NJN-13	950- 999	-101 .42	-100 .42	-74 .34	-30 .32	-26 .32	-4 .28	-5 .24	-52 .21	-48 .20	-72 .20	-3 .20
NJN-13	951-1000	-101 .45	-100 .43	-74 .34	-30 .33	-26 .32	-4 .28	-5 .26	-72 .22	-52 .21	-48 .20	-3 .20
NJN-14	889- 938	-34 .54	-8 .45	-35 .33	-37 .30	-36 .30	37 .30	-19 .27	57 .27	42 .27	-48 .26	-38 .24
NJN-14	914- 963	-34 .54	-8 .32	-17 .24	-30 .23	9 .22	-2 .21	-56 .21	7 .20	-65 .19	-39 .18	20 .16
NJN-14	939- 988	-34 .66	-78 .29	-110 .25	-80 .24	-2 .24	-105 .23	-69 .23	-64 .22	-108 .21	-11 .20	-54 .19
NJN-14	951-1000	-34 .70	-69 .43	-108 .26	-105 .25	-78 .25	-54 .24	-11 .23	-88 .22	-2 .22	-97 .21	-110 .21

CHART 1B

PART 2: CORRELATIONS WITH NJN OAK FLOATING MASTER SERIES OF ALL SEGMENTS AS DATED AND MEASURED

32-YEAR CUBIC SPLINE FILTER; CORRELATIONS OF 50-YEAR SEGMENTS LAGGED 25 YEARS

FLAGS: __A = CORRELATION UNDER 0.3281; __B = CORRELATION HIGHER AT OTHER POSITION

0SEQ	SERIES	INTERVAL	825 850 875 900 925 950 975 1000 1025 1050 1075 1100 1125 1150 1175 1200 1225 1250 1275 1300	FLAGS/ TOTAL
			874 899 924 949 974 999 1024 1049 1074 1099 1124 1149 1174 1199 1224 1249 1274 1299 1324 1349	
1	NJN-02	846- 961	.35 .35 .49 .46 .49 = =	1/ 5
+			___B	
2	NJN-03	859- 960	= .29 .42 .47 .58 = =	1/ 4
+			___B	
3	NJN-06	921- 995	= = = .55 .52 .59 =	0/ 3
+				
4	NJN-08	903- 995	= = = .68 .72 .67 =	0/ 3
+				
5	NJN-09	894- 995	= = .56 .63 .57 .52 =	0/ 4
+				
6	NJN-11	846- 961	.19 .18 .58 .46 .47 = =	2/ 5
+			___B ___B	
7	NJN-14	855- 966	= .23 .19 .45 .60 = =	2/ 4
+			___B ___B	

PART 3: SEGMENTS CORRELATING LOW, OR HIGHER AT OTHER THAN DATED POSITION Tucson-Mendoza-Hamburg-Lamont ProgLib

CORRELATIONS OF 50-YEAR SEGMENTS
FROM TEN YEARS EARLIER (-10) TO TEN YEARS LATER (+10) THAN DATED

SERIES	SEGMENT	HIGH	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
NJN-02	846- 895		.26	.23	-.13	.09	-.29	.05	-.28	.09	.05	.30	.35	.36	.18	-.07	.00	-.30	-.23	-.20	.07	-.11	-.30
+		1											___	<___>									
NJN-03	859- 908		.02	-.13	-.27	-.30	-.10	-.03	-.09	-.04	.27	.31	.29	-.02	.08	.14	.04	.16	-.12	.17	-.24	-.24	-.18
+		-1									<___>		___										
NJN-11	846- 895		.08	.07	.08	-.11	-.24	-.16	-.23	-.21	-.18	-.03	.19	.20	.09	.03	-.10	.13	-.03	-.08	-.04	-.04	.03
+		1											___	<___>									
NJN-11	850- 899		.07	.03	.09	-.12	-.19	-.21	-.13	-.25	-.09	-.03	.18	.18	.05	.02	-.06	.18	.05	.09	.01	.01	.01
+		5											___					<___>					
NJN-14	855- 904		.20	-.17	-.29	.06	-.16	.05	.33	.34	.24	.31	.23	.09	.11	-.39	.08	-.40	-.11	-.19	-.36	.11	-.18
+		-3								<___>			___										
NJN-14	875- 924		-.06	-.06	-.09	.16	-.15	.07	.03	.21	-.12	-.19	.19	-.08	.27	-.21	.21	-.08	-.21	.06	-.09	.18	.08
+		2											___		<___>								

CHART 2

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN OAK VS BOSTON 01 1530-1785
50-YEAR SEGMENTS LAGGED 25 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-02	885- 934	649 .41	762 .36	763 .36	799 .33	665 .29	764 .29	719 .29	815 .28	706 .28	674 .27	653 .27
NJN-02	910- 959	736 .33	680 .32	812 .31	662 .29	649 .28	804 .26	671 .26	689 .25	774 .25	751 .23	647 .22
NJN-02	935- 984	693 .32	638 .31	791 .31	731 .29	680 .28	596 .28	743 .28	604 .26	745 .26	694 .26	772 .25
NJN-02	951-1000	673 .46	731 .42	638 .38	757 .33	695 .31	745 .31	592 .30	693 .30	735 .29	694 .28	584 .28
NJN-03	899- 948	648 .52	672 .46	785 .42	714 .35	765 .33	718 .31	733 .30	639 .28	837 .27	747 .27	749 .26
NJN-03	924- 973	687 .32	644 .31	790 .31	656 .30	672 .29	806 .29	754 .26	661 .25	739 .25	718 .25	809 .25
NJN-03	949- 998	687 .48	759 .40	672 .39	590 .33	667 .33	707 .32	670 .31	629 .28	627 .28	774 .26	644 .26
NJN-03	951-1000	687 .43	672 .41	759 .39	707 .34	590 .33	670 .32	774 .29	602 .29	627 .29	656 .29	658 .29
NJN-05	932- 981	764 .35	655 .33	627 .32	647 .28	760 .28	762 .27	611 .26	638 .26	681 .25	752 .25	748 .24
NJN-05	951-1000	592 .39	604 .36	701 .34	605 .30	638 .29	770 .27	779 .27	718 .26	647 .25	666 .25	717 .24
NJN-06	926- 975	707 .55	679 .33	637 .26	710 .26	727 .26	627 .25	651 .24	791 .24	746 .23	805 .23	613 .23
NJN-06	951-1000	707 .67	594 .44	745 .37	708 .37	783 .33	673 .32	780 .29	759 .28	729 .26	743 .25	696 .25
NJN-08	908- 957	707 .54	722 .34	650 .33	727 .30	763 .29	820 .28	765 .28	679 .27	693 .27	664 .27	794 .26
NJN-08	933- 982	707 .68	722 .32	679 .30	759 .30	664 .29	626 .28	794 .27	607 .25	742 .25	662 .25	706 .24
NJN-08	951-1000	707 .67	626 .41	779 .38	594 .31	745 .28	673 .28	637 .26	664 .23	693 .23	741 .23	769 .22
NJN-09	894- 943	664 .40	825 .39	777 .38	684 .34	640 .33	799 .31	727 .30	742 .29	706 .29	715 .28	816 .27
NJN-09	919- 968	711 .40	712 .36	651 .35	697 .34	747 .34	764 .31	664 .30	816 .29	618 .29	727 .27	634 .27
NJN-09	944- 993	712 .51	711 .37	746 .36	733 .35	675 .34	678 .33	677 .31	734 .27	697 .26	690 .26	785 .26
NJN-09	951-1000	712 .56	678 .36	677 .36	711 .36	595 .35	619 .34	733 .33	746 .32	785 .31	675 .31	597 .30
NJN-10	870- 919	787 .48	800 .39	785 .39	717 .33	729 .33	674 .32	731 .31	843 .31	773 .30	742 .29	747 .29
NJN-10	895- 944	648 .56	747 .44	785 .36	799 .35	762 .31	748 .30	691 .28	800 .28	820 .26	797 .25	763 .25
NJN-10	920- 969	648 .38	801 .34	624 .33	720 .30	662 .25	790 .22	760 .21	637 .21	705 .20	759 .19	718 .19
NJN-10	945- 994	755 .38	720 .35	636 .31	606 .31	625 .29	585 .28	729 .28	671 .28	718 .25	687 .24	749 .23
NJN-10	951-1000	606 .34	749 .33	755 .32	631 .30	662 .29	763 .28	687 .28	729 .27	614 .26	651 .23	676 .22
NJN-11	865- 914	676 .40	708 .39	791 .34	744 .32	863 .30	735 .28	843 .28	717 .27	719 .26	756 .26	842 .26
NJN-11	890- 939	654 .43	708 .42	791 .41	771 .41	735 .33	832 .32	781 .30	678 .29	769 .28	666 .25	842 .25
NJN-11	915- 964	632 .38	729 .35	787 .35	771 .34	678 .32	821 .31	646 .30	749 .30	673 .29	810 .29	781 .29
NJN-11	940- 989	680 .37	634 .36	731 .36	764 .29	715 .28	766 .28	659 .28	716 .26	677 .26	752 .24	603 .23
NJN-11	951-1000	716 .39	579 .34	634 .33	731 .32	668 .30	715 .28	602 .28	735 .27	679 .26	680 .26	606 .24
NJN-13	875- 924	727 .62	772 .31	807 .28	694 .28	810 .28	785 .28	853 .27	685 .26	670 .26	692 .25	781 .25
NJN-13	900- 949	781 .31	714 .30	727 .29	801 .28	824 .28	692 .28	743 .28	748 .28	791 .27	795 .26	729 .26
NJN-13	925- 974	744 .40	686 .36	702 .34	605 .29	643 .27	791 .27	722 .26	613 .26	750 .26	631 .25	770 .25
NJN-13	950- 999	744 .29	686 .27	584 .25	775 .24	674 .24	784 .24	647 .24	701 .21	641 .21	588 .21	611 .21
NJN-13	951-1000	744 .29	686 .26	584 .24	674 .23	647 .23	784 .23	612 .22	672 .21	641 .21	775 .21	701 .20
NJN-14	889- 938	656 .43	769 .41	680 .38	817 .34	807 .30	693 .30	654 .27	655 .25	802 .25	709 .24	803 .24
NJN-14	914- 963	647 .50	817 .34	762 .33	788 .29	623 .28	721 .27	736 .27	632 .27	665 .25	704 .25	693 .25
NJN-14	939- 988	710 .33	678 .31	632 .30	608 .29	788 .27	782 .25	791 .24	630 .23	761 .21	774 .21	635 .21
NJN-14	951-1000	678 .36	608 .33	673 .33	584 .30	713 .26	757 .24	600 .23	730 .23	761 .23	693 .22	616 .22

CHART 3

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES — Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN OAK VS BOSTON 02 1454-1769
50-YEAR SEGMENTS LAGGED 25 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-02	885- 934	673 .54	762 .34	788 .33	672 .32	620 .29	697 .29	804 .28	709 .27	764 .27	751 .26	789 .25
NJN-02	910- 959	673 .39	571 .33	568 .32	554 .29	623 .27	705 .26	785 .25	734 .25	647 .24	646 .24	804 .24
NJN-02	935- 984	673 .45	719 .37	584 .35	777 .28	566 .27	717 .26	665 .26	532 .26	603 .25	623 .25	654 .25
NJN-02	951-1000	673 .55	525 .38	603 .37	731 .37	757 .36	510 .35	584 .34	695 .34	528 .32	602 .30	513 .30
NJN-03	899- 948	677 .38	733 .34	672 .32	765 .31	604 .30	670 .29	616 .29	624 .27	718 .27	644 .26	770 .26
NJN-03	924- 973	672 .50	687 .31	636 .29	738 .28	707 .26	703 .25	737 .23	609 .23	770 .23	759 .23	596 .22
NJN-03	949- 998	672 .64	524 .36	759 .35	687 .34	707 .32	556 .31	527 .28	581 .28	692 .28	636 .26	767 .26
NJN-03	951-1000	672 .64	524 .37	707 .32	759 .32	527 .30	581 .30	556 .29	687 .29	692 .28	583 .27	767 .26
NJN-05	932- 981	611 .40	727 .35	764 .30	690 .29	686 .27	681 .26	638 .25	619 .25	772 .24	651 .23	545 .22
NJN-05	951-1000	572 .45	503 .40	666 .37	611 .35	537 .32	651 .32	701 .31	761 .30	647 .29	590 .27	705 .26
NJN-06	926- 975	707 .52	744 .40	729 .36	579 .30	616 .30	664 .30	791 .30	654 .29	581 .26	559 .25	594 .25
NJN-06	951-1000	707 .50	616 .43	527 .38	733 .35	640 .34	696 .31	566 .31	710 .30	581 .28	675 .26	578 .25
NJN-08	908- 957	707 .67	559 .39	727 .35	631 .34	722 .33	616 .30	657 .30	659 .29	579 .28	574 .28	611 .28
NJN-08	933- 982	707 .76	744 .39	631 .36	611 .34	613 .34	562 .30	561 .29	538 .28	589 .28	524 .28	576 .28
NJN-08	951-1000	707 .66	613 .32	642 .31	562 .30	640 .30	615 .29	614 .29	744 .28	765 .27	538 .26	589 .26
NJN-09	894- 943	712 .62	598 .44	638 .42	799 .40	564 .39	747 .33	727 .32	825 .31	616 .30	686 .28	586 .26
NJN-09	919- 968	712 .61	711 .40	616 .39	747 .37	549 .35	618 .33	564 .31	601 .29	734 .29	733 .28	594 .27
NJN-09	944- 993	712 .61	566 .43	619 .42	733 .38	581 .36	711 .35	675 .32	618 .31	636 .30	677 .30	641 .29
NJN-09	951-1000	712 .58	619 .50	509 .38	733 .38	507 .36	711 .35	566 .34	531 .32	690 .32	602 .31	754 .30
NJN-10	870- 919	787 .48	843 .48	785 .35	765 .32	698 .32	717 .31	617 .31	748 .30	674 .29	731 .28	733 .27
NJN-10	895- 944	747 .42	579 .36	763 .34	630 .34	799 .32	656 .31	608 .31	691 .30	785 .30	748 .29	671 .28
NJN-10	920- 969	631 .50	763 .36	629 .34	759 .33	798 .31	578 .31	557 .29	657 .28	720 .28	662 .28	630 .27
NJN-10	945- 994	631 .52	573 .35	516 .34	628 .33	626 .29	664 .29	754 .29	757 .27	729 .25	755 .24	720 .23
NJN-10	951-1000	631 .56	550 .36	768 .33	516 .33	548 .33	729 .30	666 .30	687 .29	763 .28	755 .28	573 .25
NJN-11	865- 914	630 .37	612 .35	811 .34	739 .30	700 .26	683 .24	674 .24	650 .24	701 .24	756 .23	681 .23
NJN-11	890- 939	566 .51	771 .41	600 .41	729 .32	807 .32	769 .30	805 .30	673 .30	714 .29	588 .28	791 .27
NJN-11	915- 964	673 .62	734 .45	787 .36	554 .34	584 .31	566 .30	632 .30	654 .29	590 .29	749 .28	719 .26
NJN-11	940- 989	673 .42	532 .40	760 .37	716 .33	677 .32	680 .32	584 .32	601 .31	585 .31	625 .29	586 .28
NJN-11	951-1000	673 .48	700 .47	716 .46	532 .33	585 .29	638 .28	606 .26	663 .25	598 .24	536 .23	735 .23
NJN-13	875- 924	705 .38	748 .34	644 .32	600 .32	624 .28	824 .26	677 .26	768 .25	753 .24	775 .24	681 .24
NJN-13	900- 949	768 .36	748 .34	692 .31	799 .30	690 .30	764 .30	612 .29	795 .27	611 .26	637 .26	733 .25
NJN-13	925- 974	611 .55	744 .44	770 .40	664 .35	782 .35	612 .32	686 .29	591 .29	766 .27	571 .26	780 .25
NJN-13	950- 999	611 .43	686 .43	612 .38	744 .35	538 .34	614 .33	564 .31	541 .31	708 .26	591 .26	638 .25
NJN-13	951-1000	611 .43	686 .40	612 .38	744 .35	538 .34	614 .33	541 .33	564 .32	561 .26	591 .26	708 .26
NJN-14	889- 938	678 .59	623 .50	604 .40	769 .38	568 .37	585 .36	791 .36	654 .34	676 .34	704 .31	677 .31
NJN-14	914- 963	678 .45	710 .34	630 .33	695 .32	656 .32	704 .29	541 .28	556 .28	647 .27	559 .26	747 .26
NJN-14	939- 988	678 .47	774 .36	710 .30	607 .30	584 .27	673 .25	700 .25	630 .24	690 .23	757 .22	624 .22
NJN-14	951-1000	678 .55	643 .47	607 .38	584 .34	757 .32	529 .30	560 .29	700 .26	648 .25	510 .24	731 .24

CHART 4

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES — Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN OAK VS NORTH SHORE OAK MASTER 1495-1750
50-YEAR SEGMENTS LAGGED 25 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-02	885- 934	673 .54	762 .43	616 .38	645 .34	799 .34	764 .34	801 .32	763 .29	747 .27	670 .26	618 .26
NJN-02	910- 959	673 .48	690 .36	680 .30	591 .29	763 .28	645 .27	719 .27	632 .25	656 .24	772 .24	592 .24
NJN-02	935- 984	673 .49	675 .39	591 .35	743 .32	717 .29	694 .28	677 .27	756 .26	623 .25	651 .25	637 .24
NJN-02	951-1000	673 .55	708 .36	735 .32	629 .32	731 .31	694 .31	627 .30	693 .29	695 .27	603 .27	675 .26
NJN-03	899- 948	616 .39	644 .39	670 .38	604 .35	785 .31	733 .31	765 .30	671 .28	730 .27	656 .27	799 .27
NJN-03	924- 973	672 .52	609 .42	636 .34	610 .31	608 .28	739 .25	687 .24	776 .23	750 .23	583 .22	667 .22
NJN-03	949- 998	672 .61	687 .36	734 .34	609 .28	707 .28	581 .27	583 .27	597 .26	636 .26	750 .25	725 .24
NJN-03	951-1000	672 .62	734 .34	707 .32	687 .31	544 .30	609 .30	581 .29	583 .28	553 .27	750 .27	736 .26
NJN-05	932- 981	764 .40	619 .35	666 .30	762 .28	646 .28	748 .28	636 .27	727 .26	611 .25	686 .25	630 .24
NJN-05	951-1000	611 .46	666 .40	701 .36	557 .29	647 .29	547 .29	718 .27	683 .27	558 .25	663 .25	700 .22
NJN-06	926- 975	707 .65	604 .44	640 .34	654 .30	657 .29	621 .29	590 .28	729 .28	769 .26	581 .26	727 .26
NJN-06	951-1000	707 .67	745 .41	708 .39	616 .37	602 .36	640 .34	729 .30	657 .28	604 .24	578 .22	675 .22
NJN-08	908- 957	707 .71	657 .44	722 .40	659 .36	769 .32	742 .30	705 .29	727 .28	618 .26	785 .25	604 .25
NJN-08	933- 982	707 .75	576 .39	604 .34	705 .34	685 .34	579 .32	704 .32	722 .30	657 .30	581 .27	706 .27
NJN-08	951-1000	707 .71	685 .35	720 .33	745 .30	576 .29	637 .27	657 .26	640 .25	706 .25	642 .23	704 .23
NJN-09	894- 943	712 .58	638 .45	791 .32	608 .29	727 .27	686 .27	707 .27	769 .26	777 .24	671 .23	660 .23
NJN-09	919- 968	712 .62	690 .42	711 .38	747 .35	603 .30	581 .30	588 .30	672 .29	707 .27	694 .27	641 .27
NJN-09	944- 993	712 .60	690 .52	711 .45	675 .36	566 .35	677 .35	551 .32	692 .31	604 .31	746 .29	581 .29
NJN-09	951-1000	712 .61	690 .50	711 .49	551 .40	677 .35	675 .33	587 .27	732 .27	544 .26	733 .26	618 .26
NJN-10	870- 919	642 .48	800 .42	787 .42	644 .41	785 .40	748 .37	720 .30	765 .30	809 .29	631 .28	667 .28
NJN-10	895- 944	617 .44	747 .43	785 .39	631 .37	602 .35	762 .34	656 .33	799 .33	630 .32	748 .31	702 .30
NJN-10	920- 969	631 .48	720 .34	602 .33	601 .33	657 .32	600 .28	679 .28	760 .27	623 .26	662 .26	630 .24
NJN-10	945- 994	631 .46	623 .35	720 .32	573 .31	614 .30	664 .30	719 .29	703 .26	553 .25	626 .24	755 .23
NJN-10	951-1000	631 .56	740 .29	571 .28	596 .27	550 .26	614 .25	623 .24	703 .23	662 .23	696 .22	621 .22
NJN-11	865- 914	756 .33	650 .31	827 .30	644 .30	789 .29	700 .29	791 .29	739 .28	630 .28	683 .27	710 .26
NJN-11	890- 939	791 .35	729 .35	769 .35	673 .34	781 .31	623 .31	749 .27	610 .27	700 .26	699 .25	771 .25
NJN-11	915- 964	673 .63	783 .35	632 .32	595 .29	769 .28	734 .27	749 .26	663 .24	623 .24	767 .23	580 .22
NJN-11	940- 989	673 .53	573 .35	677 .33	634 .32	715 .31	731 .30	680 .30	599 .28	557 .27	714 .27	571 .27
NJN-11	951-1000	673 .51	716 .41	730 .33	557 .30	570 .27	715 .24	610 .24	680 .23	696 .23	623 .23	633 .23
NJN-13	875- 924	627 .29	748 .28	772 .28	755 .26	753 .26	781 .26	692 .26	740 .26	810 .25	638 .25	669 .24
NJN-13	900- 949	683 .42	690 .32	692 .31	799 .30	612 .29	640 .29	700 .27	781 .26	729 .25	652 .24	605 .23
NJN-13	925- 974	744 .40	611 .36	581 .30	686 .30	612 .30	664 .29	766 .27	604 .27	640 .27	682 .25	583 .23
NJN-13	950- 999	686 .37	611 .36	612 .36	578 .35	682 .29	721 .29	614 .27	638 .27	657 .26	737 .25	636 .25
NJN-13	951-1000	612 .37	686 .36	611 .36	578 .36	682 .29	737 .28	721 .27	614 .27	638 .27	657 .27	547 .26
NJN-14	889- 938	678 .47	704 .40	663 .40	749 .39	647 .37	769 .34	802 .32	606 .31	803 .31	701 .29	623 .29
NJN-14	914- 963	678 .45	656 .41	704 .38	618 .30	743 .27	673 .26	601 .26	710 .25	630 .25	615 .24	600 .23
NJN-14	939- 988	678 .45	710 .39	607 .35	656 .34	584 .33	731 .31	673 .27	591 .26	615 .25	744 .23	639 .23
NJN-14	951-1000	678 .50	607 .43	643 .37	584 .32	615 .32	658 .30	639 .28	710 .26	550 .26	656 .25	673 .24

CHART 5A

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES — Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN OAK VS NJN OAK DATED
50-YEAR SEGMENTS LAGGED 25 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-02	885- 934	673 .73	762 .35	672 .33	674 .31	720 .27	764 .26	751 .24	723 .23	664 .22	701 .21	661 .20
NJN-02	910- 959	673 .77	646 .43	645 .37	719 .33	647 .29	751 .26	690 .26	752 .24	695 .24	717 .23	740 .23
NJN-02	935- 984	673 .62	719 .31	697 .30	715 .27	619 .26	695 .23	717 .22	728 .22	651 .21	677 .21	627 .21
NJN-02	951-1000	673 .65	627 .32	708 .32	638 .30	602 .29	603 .29	707 .26	693 .24	619 .24	695 .23	651 .23
NJN-03	899- 948	672 .66	645 .42	718 .36	647 .33	733 .32	670 .30	730 .26	671 .25	659 .25	762 .23	720 .23
NJN-03	924- 973	672 .62	637 .34	737 .26	738 .25	636 .25	704 .21	717 .20	687 .20	739 .19	626 .18	703 .17
NJN-03	949- 998	672 .70	626 .44	609 .40	707 .34	640 .31	596 .30	675 .26	599 .23	643 .22	687 .21	655 .20
NJN-03	951-1000	672 .71	626 .42	609 .41	707 .38	640 .31	596 .29	675 .26	693 .22	655 .22	599 .20	637 .19
NJN-05	932- 981	611 .40	610 .37	666 .33	686 .32	716 .31	619 .28	690 .28	638 .28	705 .23	681 .22	608 .22
NJN-05	951-1000	666 .43	686 .35	611 .33	610 .32	701 .22	681 .21	620 .21	700 .21	639 .20	682 .19	647 .19
NJN-06	926- 975	707 .76	651 .30	664 .30	729 .29	633 .24	649 .22	712 .20	632 .19	692 .19	668 .19	731 .18
NJN-06	951-1000	707 .83	616 .32	675 .31	640 .29	604 .28	630 .25	602 .24	591 .24	641 .23	708 .23	652 .21
NJN-08	908- 957	707 .79	727 .34	744 .25	659 .24	722 .23	661 .22	666 .21	705 .21	742 .21	698 .20	651 .20
NJN-08	933- 982	707 .86	631 .40	661 .32	687 .23	632 .23	685 .21	651 .20	722 .20	729 .18	684 .18	640 .17
NJN-08	951-1000	707 .84	602 .31	591 .28	685 .26	650 .25	684 .25	640 .24	672 .22	706 .21	661 .21	637 .20
NJN-09	894- 943	712 .73	734 .28	747 .26	671 .25	729 .24	707 .22	769 .22	662 .19	686 .18	649 .18	754 .18
NJN-09	919- 968	712 .77	636 .40	732 .26	649 .25	690 .25	692 .22	711 .22	638 .21	677 .20	744 .19	734 .19
NJN-09	944- 993	712 .72	636 .42	690 .36	675 .34	619 .34	677 .31	655 .25	616 .25	606 .24	692 .24	711 .23
NJN-09	951-1000	712 .74	690 .37	619 .35	655 .34	675 .32	677 .29	616 .28	711 .27	636 .24	587 .23	699 .22
NJN-10	870- 919	671 .38	770 .36	685 .34	787 .31	785 .27	731 .27	712 .25	673 .24	765 .23	672 .22	717 .20
NJN-10	895- 944	658 .40	672 .39	747 .38	762 .33	671 .29	706 .29	761 .28	644 .25	646 .23	739 .22	727 .22
NJN-10	920- 969	664 .35	631 .34	659 .32	657 .31	719 .24	662 .23	679 .23	632 .22	720 .22	676 .21	634 .21
NJN-10	945- 994	664 .40	699 .29	676 .29	627 .28	604 .28	629 .28	631 .27	600 .25	623 .25	596 .25	614 .22
NJN-10	951-1000	631 .37	676 .33	696 .31	710 .24	687 .24	699 .23	596 .23	664 .23	659 .20	605 .18	666 .18
NJN-11	865- 914	673 .75	700 .43	736 .31	701 .27	756 .27	791 .26	675 .25	749 .23	781 .21	703 .21	746 .20
NJN-11	890- 939	673 .60	769 .34	749 .34	653 .31	771 .27	729 .25	700 .24	693 .23	714 .23	736 .22	665 .21
NJN-11	915- 964	673 .75	654 .30	629 .26	726 .25	687 .24	734 .24	723 .21	714 .21	719 .20	708 .19	677 .18
NJN-11	940- 989	673 .59	634 .37	677 .36	680 .34	600 .31	714 .30	602 .27	716 .24	627 .24	715 .22	705 .21
NJN-11	951-1000	673 .58	634 .30	633 .29	705 .22	696 .21	602 .20	648 .19	607 .19	600 .19	641 .18	660 .18
NJN-13	875- 924	753 .40	692 .36	740 .31	775 .28	681 .28	699 .26	733 .24	667 .24	772 .23	731 .22	755 .21
NJN-13	900- 949	666 .48	668 .36	673 .33	712 .33	733 .29	707 .22	744 .22	641 .22	740 .21	753 .20	639 .19
NJN-13	925- 974	686 .33	640 .29	642 .26	707 .24	638 .24	712 .23	660 .22	666 .20	722 .20	632 .19	639 .19
NJN-13	950- 999	611 .42	612 .42	638 .34	682 .32	686 .32	708 .28	707 .24	660 .21	664 .20	640 .20	709 .20
NJN-13	951-1000	611 .45	612 .43	638 .34	682 .33	686 .32	708 .28	707 .26	640 .22	660 .21	664 .20	709 .20
NJN-14	889- 938	678 .54	704 .45	677 .33	675 .30	676 .30	749 .30	693 .27	769 .27	754 .27	664 .26	674 .24
NJN-14	914- 963	678 .54	704 .32	695 .24	682 .23	721 .22	710 .21	656 .21	719 .20	647 .19	673 .18	732 .16
NJN-14	939- 988	678 .66	634 .29	602 .25	632 .24	710 .24	607 .23	643 .23	648 .22	604 .21	701 .20	658 .19
NJN-14	951-1000	678 .70	643 .43	604 .26	607 .25	634 .25	658 .24	701 .23	624 .22	710 .22	615 .21	602 .21

CHART 5B

PART 2: CORRELATIONS WITH NJN OAK MASTER SERIES OF ALL SEGMENTS AS DATED AND MEASURED

32-YEAR CUBIC SPLINE FILTER; CORRELATIONS OF 50-YEAR SEGMENTS LAGGED 25 YEARS

FLAGS: __A = CORRELATION UNDER 0.3281; __B = CORRELATION HIGHER AT OTHER POSITION

ØSEQ	SERIES	INTERVAL	1525 1550	1575	1600	1625	1650	1675	1700	1725	1750	1775	1800	1825	1850	1875	1900	1925	1950	1975	2000	FLAGS/ TOTAL
			1574 1599	1624	1649	1674	1699	1724	1749	1774	1799	1824	1849	1874	1899	1924	1949	1974	1999	2024	2049	
1	NJN-02	1558-1673	=	.35	.31	.44	.49	=	=													
+				__B	__A																	2/ 4
2	NJN-03	1571-1672	=	.29	.32	.41	.58	=	=													
+				__B	__A																	2/ 4
3	NJN-06	1633-1707	=	=	=	=	.55	.51	.59													
+																						0/ 3
4	NJN-08	1615-1707	=	=	=	.68	.73	.67	.67													
+																						0/ 4
5	NJN-09	1606-1707	=	=	=	.56	.71	.52	.53													
+																						0/ 4
6	NJN-11	1558-1673	=	.19	.28	.65	.47	=	=													
+				__B	__B																	2/ 4
7	NJN-14	1567-1678	=	.23	.12	.41	.60	.60	=													
+				__B	__B																	2/ 5

PART 3: SEGMENTS CORRELATING LOW, OR HIGHER AT OTHER THAN DATED POSITION Tucson-Mendoza-Hamburg-Lamont ProgLib

CORRELATIONS OF 50-YEAR SEGMENTS
FROM TEN YEARS EARLIER (-10) TO TEN YEARS LATER (+10) THAN DATED

SERIES	SEGMENT	HIGH	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
NJN-02	1558-1607		.26	.23	-.13	.09	-.29	.05	-.28	.09	.05	.30	.35	.36	.18	-.07	.00	-.30	-.23	-.20	.07	-.11	-.30
+		1											__	<__>									
NJN-02	1575-1624		-.15	-.07	-.01	.08	-.11	-.02	-.06	.03	.19	.08	.31	.05	.20	-.07	.00	-.07	-.22	.11	-.12	.09	-.13
+		0											<__>										
NJN-03	1571-1620		.02	-.13	-.27	-.30	-.10	-.03	-.09	-.04	.27	.31	.29	-.02	.08	.14	.04	.16	-.12	.17	-.24	-.24	-.18
+		-1									<__>	__											
NJN-03	1575-1624		-.13	-.08	-.15	-.13	.00	-.11	-.20	-.27	.15	.24	.32	-.01	.16	.05	.07	.13	-.04	.06	-.06	-.17	-.03
+		0											<__>										
NJN-11	1558-1607		.08	.07	.08	-.11	-.24	-.16	-.23	-.21	-.18	-.03	.19	.20	.09	.03	-.10	.13	-.03	-.08	-.04	-.04	.03
+		1											__	<__>									
NJN-11	1575-1624		-.17	.08	.00	.07	.04	.01	.10	-.09	.09	-.06	.28	.00	-.04	-.27	-.10	.09	.00	.30	-.10	.09	-.01
+		7											__							<__>			
NJN-14	1567-1616		.20	-.17	-.29	.06	-.16	.05	.33	.34	.24	.31	.23	.09	.11	-.39	.08	-.40	-.11	-.19	-.36	.11	-.18
+		-3								<__>			__										
NJN-14	1575-1624		-.30	-.30	-.14	.28	.04	.10	.19	.20	.04	.12	.12	.13	.34	-.26	.26	-.25	-.14	-.19	-.36	.25	.05
+		2											__		<__>								

CHART 6

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES — Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN BLACK ASH VS NORTH SHORE PROVISIONAL BLACK ASH MASTER 1549-1712
50-YEAR SEGMENTS LAGGED 25 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-01	895- 944	707 .43	660 .41	770 .35	753 .34	697 .28	680 .27	633 .25	729 .23	687 .23	754 .23	662 .22
NJN-01	920- 969	707 .58	753 .37	638 .35	687 .31	646 .30	668 .30	620 .30	737 .27	688 .26	716 .24	750 .23
NJN-01	945- 994	707 .40	675 .39	716 .38	598 .29	709 .28	620 .28	668 .26	647 .24	730 .24	588 .23	648 .22
NJN-01	951-1000	707 .40	675 .38	716 .36	668 .35	598 .34	588 .30	636 .25	646 .25	709 .22	620 .22	619 .20
NJN-04	890- 939	638 .36	650 .28	728 .27	679 .27	741 .26	727 .25	758 .25	778 .25	637 .23	651 .23	663 .22
NJN-04	915- 964	615 .50	695 .34	663 .32	673 .32	732 .31	736 .26	727 .24	758 .23	693 .23	692 .21	624 .21
NJN-04	940- 989	710 .43	673 .41	653 .25	727 .25	663 .24	586 .24	616 .23	730 .23	621 .22	690 .22	643 .22
NJN-04	951-1000	673 .46	586 .32	710 .31	641 .29	690 .25	704 .23	661 .23	616 .22	653 .22	619 .22	651 .21
NJN-07	880- 929	727 .35	764 .32	781 .31	647 .30	692 .30	722 .28	649 .26	793 .26	761 .26	672 .25	721 .25
NJN-07	905- 954	754 .32	692 .31	764 .30	671 .30	636 .28	643 .27	712 .26	699 .26	649 .26	753 .26	727 .25
NJN-07	930- 979	712 .44	713 .32	663 .31	614 .29	649 .28	623 .27	643 .26	671 .23	641 .23	735 .23	734 .22
NJN-07	951-1000	712 .48	695 .35	714 .31	713 .29	601 .28	649 .28	691 .26	671 .24	641 .24	602 .24	663 .24
NJN-12	872- 921	657 .33	681 .30	768 .28	678 .27	707 .25	718 .25	777 .24	708 .24	679 .24	654 .23	788 .21
NJN-12	897- 946	707 .34	678 .33	654 .29	672 .28	731 .28	697 .27	766 .27	749 .24	712 .24	630 .23	632 .23
NJN-12	922- 971	707 .38	724 .34	672 .32	653 .32	725 .31	635 .31	697 .28	748 .28	699 .27	745 .27	611 .23
NJN-12	947- 996	708 .46	707 .35	725 .34	691 .32	722 .29	706 .29	724 .27	654 .25	635 .25	580 .25	642 .23
NJN-12	951-1000	708 .44	707 .37	691 .36	642 .30	615 .27	595 .27	635 .26	654 .23	676 .22	724 .21	706 .19

CHART 7

PART 2: CORRELATIONS WITH NJN WHITE PINE MASTER SERIES OF ALL SEGMENTS AS DATED AND MEASURED

32-YEAR CUBIC SPLINE FILTER; CORRELATIONS OF 50-YEAR SEGMENTS LAGGED 25 YEARS

FLAGS: __A = CORRELATION UNDER 0.3281; __B = CORRELATION HIGHER AT OTHER POSITION

ØSEQ	SERIES	INTERVAL		900	925	950	975	1000	1025	1050	1075	1100	1125	1150	1175	1200	1225	1250	1275	1300	1325	1350	1375	FLAGS/ TOTAL
				949	974	999	1024	1049	1074	1099	1124	1149	1174	1199	1224	1249	1274	1299	1324	1349	1374	1399	1424	
1	NJN-17	937-1000	=	.76	.75	.73																		
+																								0/ 3
2	NJN-18	937-1000	=	.76	.75	.73																		
+																								0/ 3

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES — Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN WHITE PINE VS NJN WHITE PINE ALIGNED
50-YEAR SEGMENTS LAGGED 25 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-17	937- 986	0 .95	2 .17	7 .13	14 .09	-7 .08	9 .07	-2 .07	1 .03	-1 .02	11 .02	-8 .01
NJN-17	951-1000	0 .94	-14 .19	-16 .18	-23 .16	-13 .13	-24 .11	-1 .10	-7 .09	-15 .08	-17 .08	-25 .07
NJN-18	925- 974	0 .92	15 .26	13 .14	22 .13	14 .12	24 .10	23 .10	8 .09	16 .08	25 .06	20 .03
NJN-18	950- 999	0 .92	-2 .17	-9 .10	-19 .09	-22 .08	1 .07	-25 .06	-12 .04	-18 .04	-7 .04	-11 .03
NJN-18	951-1000	0 .92	-2 .14	-25 .10	-11 .10	-9 .07	-19 .07	-18 .05	-14 .04	-12 .03	-24 .03	-22 .03

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES — Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN WHITE PINE VS SOUTHERN MAINE WHITE PINE MASTER 1549-1819
50-YEAR SEGMENTS LAGGED 20 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-17	937- 986	773 .69	807 .42	643 .33	826 .31	728 .31	670 .30	696 .28	824 .28	703 .28	662 .27	802 .27
NJN-17	951-1000	773 .59	740 .29	672 .28	725 .28	759 .28	671 .28	694 .28	614 .24	673 .24	742 .23	775 .22
NJN-18	925- 974	773 .58	670 .42	820 .38	842 .33	786 .32	834 .28	788 .27	795 .26	626 .26	687 .25	824 .25
NJN-18	945- 994	773 .59	604 .33	754 .31	740 .29	643 .29	822 .29	660 .25	696 .25	711 .24	634 .24	771 .24
NJN-18	951-1000	773 .63	740 .32	643 .31	771 .29	673 .28	694 .28	754 .28	660 .27	795 .25	604 .23	611 .23

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES — Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN WHITE PINE VS SPENCER-PIERCE-LITTLE HOUSE WHITE PINE SITE MASTER 1644-1833
50-YEAR SEGMENTS LAGGED 25 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-17	937- 986	834 .42	735 .41	773 .40	722 .34	832 .32	806 .31	835 .31	775 .29	789 .26	760 .25	753 .24
NJN-17	951-1000	773 .44	735 .41	759 .34	722 .33	832 .29	753 .28	706 .25	702 .23	792 .21	746 .21	775 .21
NJN-18	925- 974	773 .40	797 .38	832 .30	858 .29	735 .26	753 .26	730 .26	807 .26	829 .24	820 .23	821 .22
NJN-18	950- 999	773 .51	832 .42	735 .32	834 .31	702 .28	821 .23	753 .22	807 .20	751 .20	729 .20	716 .19
NJN-18	951-1000	773 .51	832 .43	735 .34	702 .28	706 .27	753 .26	821 .24	812 .21	715 .20	759 .19	726 .19

CHART 8

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN SPRUCE VS COASTAL MAINE SPRUCE MASTER 1592-1879
50-YEAR SEGMENTS LAGGED 25 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-15	883- 932	906 .32	732 .32	844 .32	809 .30	794 .30	805 .29	743 .29	773 .28	904 .27	895 .26	930 .25
NJN-15	908- 957	685 .39	824 .37	773 .35	750 .29	781 .29	859 .28	811 .26	820 .26	904 .24	879 .24	892 .23
NJN-15	933- 982	773 .42	799 .38	712 .35	859 .33	885 .31	665 .30	735 .29	801 .24	761 .24	715 .23	857 .21
NJN-15	951-1000	799 .46	735 .45	773 .41	832 .38	722 .37	859 .37	760 .36	742 .33	834 .31	684 .30	801 .28
NJN-16	933- 982	872 .35	773 .34	832 .28	800 .27	835 .27	753 .27	841 .26	722 .25	681 .25	813 .25	881 .25
NJN-16	951-1000	722 .39	832 .38	830 .37	691 .32	819 .30	841 .28	834 .27	735 .27	733 .27	839 .27	760 .26
NJN-19	904- 953	811 .45	773 .38	810 .37	924 .33	888 .29	892 .28	705 .28	771 .27	850 .27	916 .23	791 .23
NJN-19	929- 978	665 .39	811 .38	715 .38	671 .34	810 .33	881 .32	863 .29	733 .27	824 .27	786 .26	892 .26
NJN-19	951-1000	805 .41	834 .29	647 .29	759 .28	741 .28	840 .27	818 .27	841 .27	766 .26	875 .25	856 .24
NJN-20	889- 938	898 .37	882 .35	881 .31	925 .31	853 .30	869 .28	883 .28	880 .27	786 .27	837 .26	705 .25
NJN-20	914- 963	773 .61	881 .36	909 .30	715 .29	758 .29	694 .29	883 .27	786 .27	865 .27	837 .25	839 .24
NJN-20	939- 988	773 .63	715 .38	758 .35	733 .33	797 .31	881 .30	841 .29	884 .27	854 .27	658 .26	757 .26
NJN-20	951-1000	773 .60	733 .32	704 .29	653 .26	841 .26	863 .26	717 .25	722 .24	712 .24	872 .23	832 .23

PART 8: DATE ADJUSTMENT FOR BEST MATCHES FOR COUNTED OR UNKNOWN SERIES Tucson-Mendoza-Hamburg-Lamont ProgLib

NJN SPRUCE VS NORTH SHORE SPRUCE MASTER 1536-1873
50-YEAR SEGMENTS LAGGED 25 YEARS

SERIES	COUNTED SEGMENT	CORR ADD # 1	CORR ADD # 2	CORR ADD # 3	CORR ADD # 4	CORR ADD # 5	CORR ADD # 6	CORR ADD # 7	CORR ADD # 8	CORR ADD # 9	CORR ADD #10	CORR ADD #11
NJN-15	883- 932	820 .41	653 .41	677 .40	732 .39	689 .38	704 .38	809 .34	665 .33	844 .32	856 .32	796 .30
NJN-15	908- 957	811 .34	820 .33	708 .31	722 .31	859 .31	720 .30	798 .28	786 .27	824 .26	894 .26	684 .25
NJN-15	933- 982	773 .43	684 .34	729 .30	627 .30	859 .30	722 .28	799 .28	660 .26	630 .25	811 .25	830 .24
NJN-15	951-1000	773 .52	799 .47	608 .33	760 .32	722 .31	812 .28	733 .27	656 .26	832 .26	660 .26	735 .26
NJN-16	933- 982	773 .41	610 .36	813 .33	800 .28	832 .27	753 .26	764 .25	641 .24	722 .24	891 .24	666 .24
NJN-16	951-1000	733 .49	832 .37	830 .36	590 .35	735 .33	760 .31	664 .29	744 .28	588 .28	722 .28	821 .28
NJN-19	904- 953	639 .47	811 .38	810 .35	906 .34	690 .34	771 .33	785 .30	880 .30	708 .28	694 .28	640 .27
NJN-19	929- 978	733 .45	811 .43	639 .36	690 .36	708 .35	613 .31	694 .29	823 .28	666 .28	640 .28	824 .27
NJN-19	951-1000	805 .42	779 .33	732 .33	757 .31	792 .31	834 .30	611 .29	759 .28	710 .27	630 .27	683 .27
NJN-20	889- 938	898 .41	707 .38	924 .31	869 .30	870 .29	880 .29	896 .28	708 .28	801 .27	834 .26	799 .26
NJN-20	914- 963	707 .46	773 .42	881 .40	677 .34	771 .34	681 .32	786 .30	747 .30	896 .30	666 .28	865 .27
NJN-20	939- 988	773 .54	626 .41	720 .38	733 .36	881 .36	758 .36	757 .35	771 .33	797 .31	680 .31	830 .30
NJN-20	951-1000	773 .58	733 .36	614 .31	795 .31	601 .30	830 .30	599 .30	722 .27	730 .26	717 .25	819 .24