

DENDROCHRONOLOGY OF BRISTLECONE PINE

by

C. W. Ferguson, Principal Investigator

and

D. A. Graybill, Research Associate

Laboratory of Tree-Ring Research
University of Arizona
Tucson, Arizona 85721

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The work accomplished between May 1, 1981 and October 31, 1982 was for purposes of fulfilling Department of Energy contractual obligations (DE-AC02-81EV10680) and concurrently pursuing research activity funded by the Geology and Anthropology sections of The National Science Foundation (EAR-8018687 and EAR-8208715). A summary of this research was recently published in Radiocarbon (Ferguson and Graybill 1983). In most cases various facets of the work were related to projects sponsored by all agencies. Therefore the full range of activities during that period is described herein. The primary project goals were:

(1) To extend the bristlecone pine chronology from the White Mountains of California beyond 6700 B.C. and strengthen it by incorporating additional specimens.

(2) To develop bristlecone pine chronologies in new areas for applications in archaeology, isotopic studies, and other earth sciences.

(3) To furnish dendrochronologically dated wood to researchers engaged in the study of past variations in carbon isotopes and climate.

WHITE MOUNTAIN CHRONOLOGY DEVELOPMENT

Methuselah Walk Locality

Lat. 37°12'N., long. 118°10'W., el. 2900 m.

Field work led to the collection of 130 specimens. About 76% of these were small cross-sections taken in hopes of chronology extension. One series collected in 1981 that is about 500 years in length is over 10,000 radiocarbon years old (H. N. Michael, personal communication, 1982). It is one of three different series that date in the 2000 or so calendar years that lie just beyond the continuous chronology that reaches 6700 B.C. The remaining 24% of the collections were used to strengthen various intervals of the master chronology where specimen numbers were limited.

An updated version of the master chronology was developed. Its primary utility is for dating control. A magnetic tape with a copy of this was furnished to the Carbon Dioxide Information Center Library at Oak Ridge National Laboratory late in 1982.

GREAT BASIN CHRONOLOGY DEVELOPMENT

Indian Garden, Nevada

Lat. 39° N., long. 115°20' W., el. 2800 m.

This site in the White Pine Range of east-central Nevada was intensively collected in 1981 and subsequently processed. All data are bristlecone pine except four cores from limber pine.

Table 1. Tree-ring samples from Indian Garden, Nevada

	Cores	Cross sections
Collected	169	64
Dated	142	61
Measured	73	57

The final chronology is continuous from 3259 B.C.-A.D. 1980. This is the second longest chronology at the lower elevational range of the species and has several potential applications. First, some wood from the sections could be used for isotope studies that concern either paleoclimate or C-14 calibration. Second, the chronology can serve as a 5240 year control for dating tree-ring series derived from archaeological or geological contexts in the region.

Mt. Jefferson, Nevada

Collections were made in 1981 at two localities from living limber pine.

Mt. Jefferson West Lat. 38°47'30" N., long. 116°57'30" w., el. 3245 m

Mt. Jefferson East Lat. 38°46'30" N., long. 116°56' W., el. 3360 m

Table 2. Tree-ring series from Mt. Jefferson, Nevada

	East	West
Collected	34	12
Dated	28	12
Measured	22	12

The final averaged chronology for the two sites dates from A.D. 905-1981. It was developed for two purposes. First, to serve as a dating control for tree-ring series that might be obtained from archaeological excavations on the mountain by the American Museum of Natural History (under direction of D. H. Thomas). Second, to update and expand records of paleoclimatic variation at upper treeline for limber pine and for the region.

Mammoth Creek, Utah

Lat. 37°37'30" N., long. 112°40' W., el. 3620 m.

Final collections in 1982 supplemented earlier work here. Essentially all trees older than ca. 100 years have now been cored at this small site. All series are bristlecone pine.

Table 3. Tree-ring series from Mammoth Creek, Utah

	No. of cores
Collected	66
Dated	61
Measured	58

The final chronology spans the period of A.D. 747-1981. It is currently in use as a control in attempts to date tree-ring series from Fremont Virgin Branch Anasazi sites in southwest Utah. It will also potentially be useful in long-term paleoclimatic studies of the region.

Miscellaneous sites

Four other sites were investigated in 1982 for their potential.

Table 4. Miscellaneous site data

	Cores Collected	Cores Dated	Cores Measured	Date Span
Bryce Point, Utah Lat. 37°36' N., 112°10'W., el. 2500 m.	27	11	0	A.D.1303-1982
Badger Creek, Utah Lat. 37°36'30" N., 112°17'30"W. el. 2635 m.	37	17	11	A.D.1226-1982
Twisted Forest, Utah Lat. 37°41'N., long. 112°52'W. el. 3050 m.	37	29	29	A.D. 311-1980
Highland Peak, Nevada Lat. 37°54'N., long. 114°35'W. el. 2750 m.	21	21	21	A.D.1347-1980

No further work is planned at the Bryce Point, Badger Creek and Twisted Forest sites. The chronologies can serve as controls for dating other tree-ring series but are not suitable for paleoclimatic analysis. The Highland Peak site can serve for chronology control and paleoclimatic analysis.

ISOTOPIC RESEARCH

Radiocarbon Studies

Dendrochronologically dated samples of bristlecone pine have provided the primary basis for calibration of the radiocarbon time scale (Klein, Lerman, Damon, and Ralph 1982). One current need is to complete the calibration from 5400 B.C. back to ca. 6600 B.C., the earliest period that wood is available for destructive analysis. We have been providing samples to several radiocarbon laboratories for this purpose and for

investigation of anomalies in other time periods. Appendix 1 summarizes all dated samples sent to the different laboratories during the period of 5/1/82 to 10/31/82.

Isotopic Ratios

Dated sections of wood have been processed and sent to Minze Stuiver at the University of Washington for study of past isotopic variation. The samples are summarized in Appendix 3.

Tandem Accelerator Mass Spectrometer (TAMS)

The current project has provided duplicate samples of dated wood to the TAMS facilities at Arizona and Oxford, England so that a direct interlaboratory comparison of dating results can be made. Appendix 2 summarizes the samples that have been supplied to those facilities.

References

Ferguson, C. W. and D. A. Graybill

1983 Dendrochronology of Bristlecone Pine: A Progress Report.
Radiocarbon 25(2)287-88.

Klein, Jeffrey, J. C. Lerman, P. E. Damon, and E. K. Ralph

1982 Calibration of Radiocarbon Dates: Tables based on the
Consensus Data of The Workshop on Calibrating The
Radiocarbon Time Scale. Radiocarbon 24(2)103-50.

Appendix 1. Samples provided for C-14 research

Dated wood provided to P. E. Damon, University of Arizona

Date range			Grams	Genus and Species
-6570	TO	-6560	1.0	PILO
-6460	TO	-6450	40.0	PILO
-6440	TO	-6430	40.0	PILO
-6410	TO	-6400	40.0	PILO
-6400	TO	-6390	40.0	PILO
-6390	TO	-6380	40.0	PILO
-6380	TO	-6370	40.0	PILO
-6370	TO	-6360	40.0	PILO
-6360	TO	-6350	40.0	PILO
-6350	TO	-6340	40.0	PILO
-6340	TO	-6330	40.0	PILO
-6330	TO	-6320	40.0	PILO
-6320	TO	-6310	40.0	PILO
-6310	TO	-6300	40.0	PILO
-6300	TO	-6290	40.0	PILO
-6290	TO	-6280	40.0	PILO
-6280	TO	-6270	40.0	PILO
-6270	TO	-6260	40.0	PILO
-6260	TO	-6250	40.0	PILO
-6250	TO	-6240	40.0	PILO
-6240	TO	-6230	40.0	PILO
-6230	TO	-6220	40.0	PILO
-6220	TO	-6210	40.0	PILO
-6210	TO	-6200	40.0	PILO
-5820	TO	-5810	41.0	PILO
-5810	TO	-5800	40.0	PILO
-5800	TO	-5790	40.0	PILO
-5790	TO	-5780	40.0	PILO
-5780	TO	-5770	40.0	PILO
-5770	TO	-5760	41.0	PILO
-5760	TO	-5750	40.0	PILO
-5750	TO	-5740	41.5	PILO
-5740	TO	-5730	40.0	PILO
-5730	TO	-5720	40.5	PILO
-5720	TO	-5710	40.0	PILO
-5710	TO	-5700	40.0	PILO
-5700	TO	-5690	40.0	PILO
-5690	TO	-5680	40.0	PILO
-5680	TO	-5670	40.5	PILO
-5670	TO	-5660	40.0	PILO
-5660	TO	-5650	40.0	PILO
-5650	TO	-5640	41.5	PILO
-5640	TO	-5630	40.0	PILO
-5630	TO	-5620	40.0	PILO
-5620	TO	-5610	40.0	PILO
-5610	TO	-5600	40.0	PILO
-5600	TO	-5590	40.5	PILO
-5590	TO	-5580	41.0	PILO
-5580	TO	-5570	41.0	PILO
-5570	TO	-5560	40.5	PILO
-5560	TO	-5550	40.5	PILO
-5550	TO	-5540	40.0	PILO

Appendix 1. (continued)

-5540	TO	-5530	40.5	PILO
-5530	TO	-5520	40.0	PILO
-5520	TO	-5510	40.0	PILO
-5510	TO	-5500	40.0	PILO
-5500	TO	-5490	40.5	PILO
-5490	TO	-5480	40.0	PILO
-5480	TO	-5470	40.0	PILO
-5470	TO	-5460	40.0	PILO
-5460	TO	-5450	40.0	PILO
-5450	TO	-5440	40.0	PILO
-5440	TO	-5430	40.0	PILO
-5430	TO	-5420	40.0	PILO
-5420	TO	-5410	40.0	PILO
-5410	TO	-5400	40.0	PILO
-5400	TO	-5390	40.0	PILO
-5390	TO	-5380	40.0	PILO
-5380	TO	-5370	40.0	PILO
-5370	TO	-5360	39.5	PILO
-5360	TO	-5350	40.0	PILO
-750	TO	-740	50.0	PILO
-750	TO	-740	50.0	PIMO
-660	TO	-650	50.0	PIMO
1835	TO	1855	27.0	PILO

Appendix 1. (continued)

Dated wood provided to M. Stuiver, University of Washington

Date range			Grams	Genus and Species
-5810	TO	-5800	75.0	PILO
-5800	TO	-5790	75.0	PILO
-5790	TO	-5780	75.0	PILO
-5780	TO	-5770	72.5	PILO
-5770	TO	-5760	75.0	PILO
-5770	TO	-5760	75.5	PILO
-5760	TO	-5750	20.0	PILO
-5760	TO	-5750	50.5	PILO
-5750	TO	-5740	50.0	PILO
-5750	TO	-5740	20.5	PILO
-5740	TO	-5730	20.0	PILO
-5740	TO	-5730	51.5	PILO
-5730	TO	-5720	76.0	PILO
-5720	TO	-5710	50.0	PILO
-5720	TO	-5710	67.5	PILO
-5720	TO	-5710	11.0	PILO
-5710	TO	-5700	75.0	PILO
-5700	TO	-5690	75.0	PILO
-5690	TO	-5680	75.5	PILO
-5630	TO	-5620	75.0	PILO
-5620	TO	-5610	75.0	PILO

Appendix 1. (continued)

Dated wood provided to H. N. Michael and E. K. Ralph,

University of Pennsylvania

Date range			Grams	Genus and Species
-6410	TO	-6400	20.0	PILO
-6400	TO	-6390	20.0	PILO
-6390	TO	-6380	20.0	PILO
-6380	TO	-6370	20.0	PILO
-6370	TO	-6360	20.0	PILO
-6360	TO	-6350	20.0	PILO
-5810	TO	-5800	25.0	PILO
-5800	TO	-5790	26.0	PILO
-5790	TO	-5780	25.0	PILO
-5780	TO	-5770	26.5	PILO
-5770	TO	-5760	25.0	PILO
-5760	TO	-5750	28.0	PILO
-5750	TO	-5740	25.0	PILO
-5740	TO	-5730	25.5	PILO
-5730	TO	-5720	25.0	PILO
-5720	TO	-5710	25.0	PILO
-5710	TO	-5700	25.0	PILO
-5700	TO	-5690	25.0	PILO
-5670	TO	-5660	25.0	PILO
-5650	TO	-5640	25.0	PILO
-5570	TO	-5560	25.0	PILO

Appendix 1. (continued)

Dated wood provided to H. E. Seuss at La Jolla, California

Date range			Grams	Genus and Species
-5284	TO	-5273	30.5	PILO
-5263	TO	-5253	23.5	PILO
-5253	TO	-5243	23.5	PILO
-5243	TO	-5233	24.5	PILO
-5233	TO	-5223	30.5	PILO
-5223	TO	-5213	23.5	PILO
-5193	TO	-5181	22.5	PILO
-5181	TO	-5171	20.5	PILO

Dated wood provided to J. C. Vogel, Pretoria, South Africa

Date range			Grams	Genus and Species
-2950	TO	-2945	5.5	PILO
-2950	TO	-2945	17.0	PILO
-2945	TO	-2940	25.5	PILO
-2945	TO	-2940	6.5	PILO
-2840	TO	-2830	32.0	PILO
-2840	TO	-2835	6.5	PILO
-2835	TO	-2830	7.0	PILO

Appendix 2: Samples provided for TAMS research

Dated wood provided to D. Donahue, University of Arizona

Date range			Grams	Genus and Species
-6570	TO	-6560	1.0	PILO
-5051	TO	-5047	2.0	PILO
-4000	TO	-3990	2.0	PILO
-3010	TO	-3000	2.0	PILO
-1980	TO	-1970	2.0	PILO
-1000	TO	-990	2.0	PILO
00	TO	10	2.0	PILO
280	TO	290	2.0	PILO
480	TO	490	2.5	PILO
700	TO	710	2.5	PILO
890	TO	900	2.5	PILO
1000	TO	1010	2.0	PILO
1120	TO	1130	2.0	PILO
1880	TO	1885	2.0	PILO
1885	TO	1890	2.0	PILO

Dated wood provided to R. Gillespie, Oxford

Date range			Grams	Genus and Species
-5051	TO	-5047	2.0	PILO
-4000	TO	-3990	2.0	PILO
-3010	TO	-3000	2.0	PILO
-1980	TO	-1970	2.0	PILO
-1000	TO	-990	2.0	PILO
00	TO	10	2.0	PILO
1000	TO	1010	2.0	PILO
1885	TO	1890	2.0	PILO
1880	TO	1885	2.0	PILO

Appendix 3: Dated sections provided
to M. Stuiver, University of Washington

Date range	Genus and Species
-1670 to -590	PILO
-1670 to -590	PILO
-170 to -58	PILO
-60 to 950	PILO
-58 to 360	PILO
200 to 1954	PILO

Notes on appendices

The dates below are given in terms of our computer-oriented time scale. The year '0' was added at the A.D./B.C. break in terms of the Christian calendar. The unsigned positive dates are equivalent to A.D. calendar dates.

Abbreviations:

PILO = Pinus longaeva = Great Basin bristlecone pine

PIMO = Pinus monophylla = Singleleaf pinon