

Dendrochronological Sourcing of Timbers from the Great Houses of Chaco Canyon

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October 1, 2013



Tom Swetnam



Chris Baisan



Jeff Dean



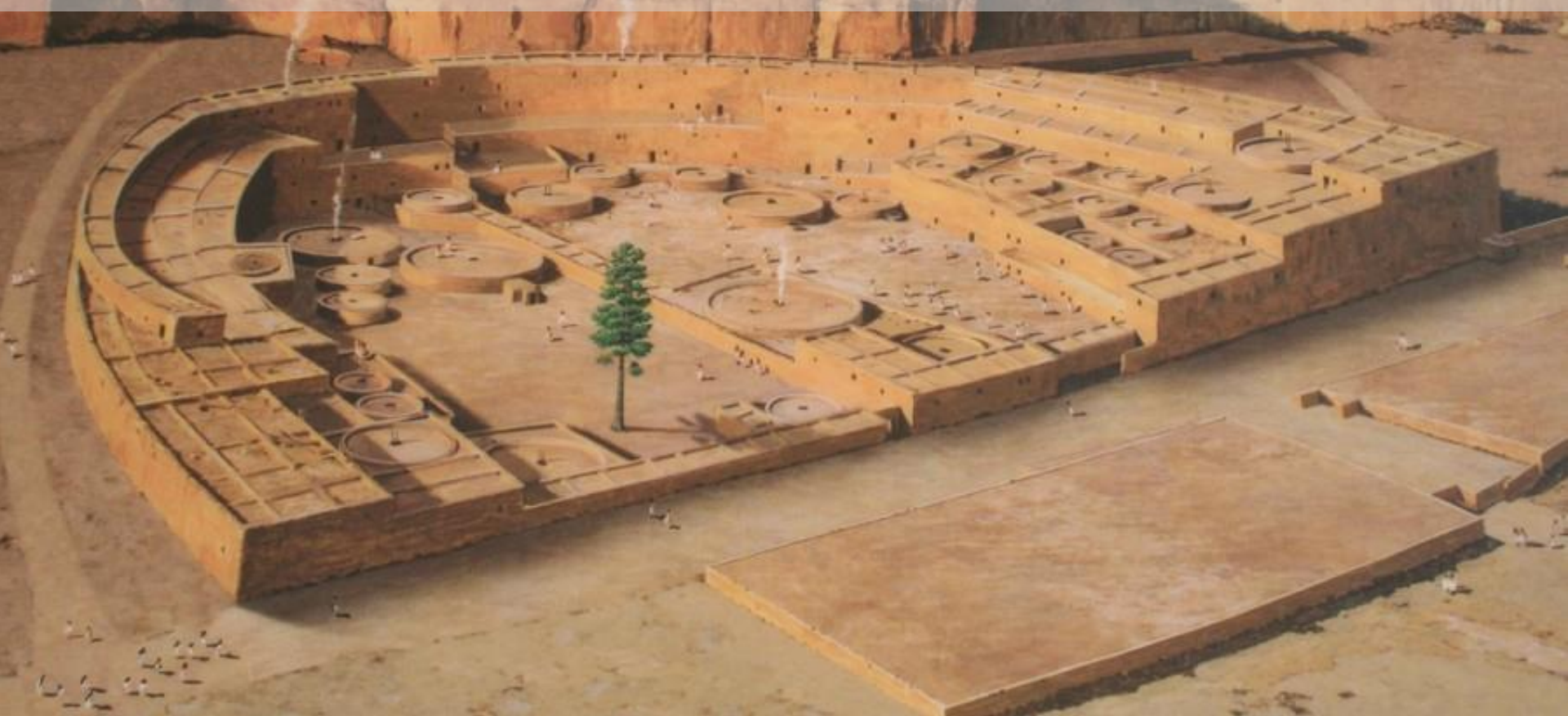
Western
National Parks
Association



Chaco Culture

National Historical Park
New Mexico

Unearthing the Story of JPB-99, The Plaza Tree of Pueblo Bonito



DISCOVERY OF THE PLAZA TREE

“Its decayed trunk lay on the last utilized pavement, and its great, snaglike roots preclude the possibility of its ever having been moved.”

- Judd 1954:3

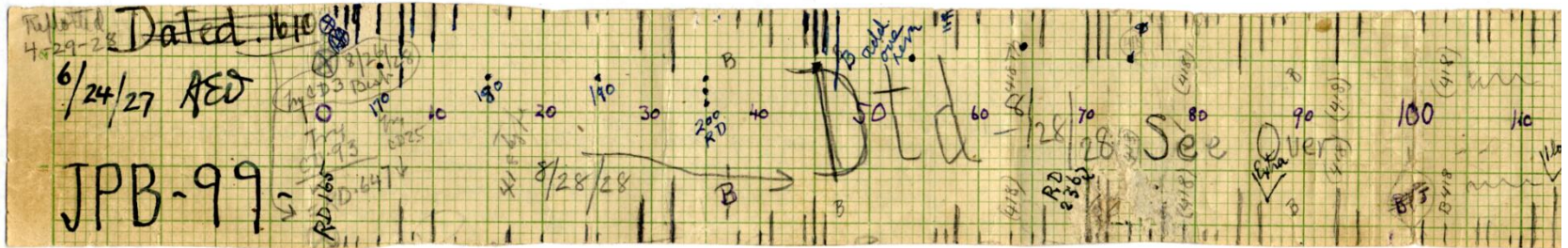


Photo by O.C. Havens, 1924. # 28416-A



TREE-RING DATING

- Performed by A.E. Douglass



- AD 730 – 981+vv



- Estimated death: ca. 1130*

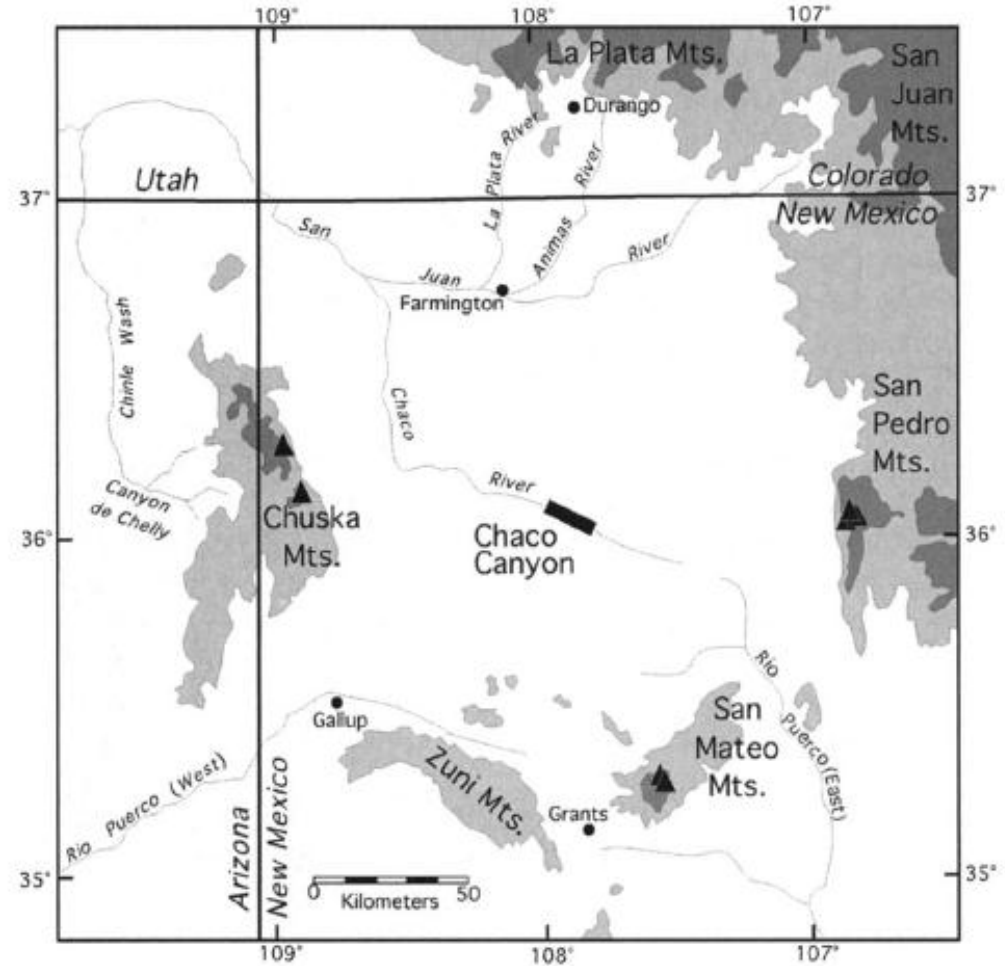
*Nash 1997, *Am. Ant.*

Interpretations of the Rooted Tree

- Evidence for a hypothetical Chaco forest (Judd and Douglass)
 - Along with modern ponderosa pines in Chaco
 - Explains the existence of so many timbers
- Gnomon “world tree”
 - Standing in the principal solar and lunar axes of the Chacoan world (Stein et al. 1997)
 - Important to interplay of sunlight and shadow in Pueblo Bonito architecture (Ashmore 2007)
- Wills (2012) dismisses these ideas, based on stratigraphic context of tree

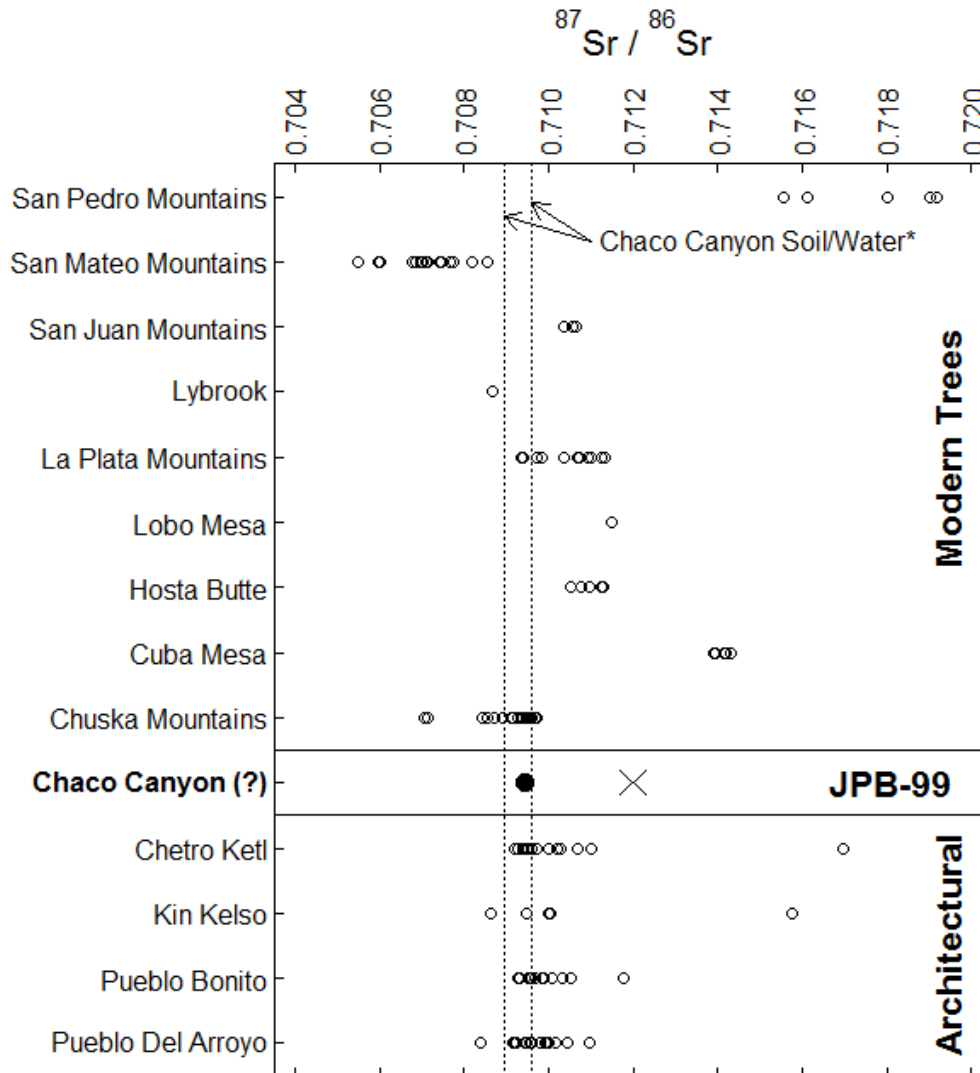
COULD IT HAVE BEEN MOVED?

- Betancourt et al. 1986, *Amer. Antiq.*
- English et al. 2001, *PNAS*
- Reynolds et al. 2005, *J. Arch. Sci.*



Map: English et al. 2001, *PNAS*

STRONTIUM SIGNATURE OF JPB-99



Reynolds et al.
2005, *J. Arch Sci*
*Benson et al.
2003, *PNAS*



Search for Field Notes



West Court - 1 ^{Field notes of 1923-1927} condensed & clarified. 1924.

Only entrance to PB is in SE corner of West Ct., betw. Rs. 137 & 140. Originally open & 7'10" w. This passage was later barred by a single cross-wall 26" th., built without founda. on a 4" sand layer 15" below last utilized Court level. East side of Court from East Gate to

Judd – Douglass Letters

June 11, 1924.

Dr. A. E. Douglass,
University of Arizona,
Tucson, Arizona.

My dear Dr. Douglass:

At this time I am expressing to you a box containing five new beam sections from Pueblo Bonito and Pueblo del Arroyo. You will be especially interested in section 99, cut from near the roots of a large and partially decayed log found in the west court of Bonito. It lay very close to the surface and from the root stumps led me, at first, to believe the tree had grown where it fell. But failure to find any trace of decayed roots forced me to abandon this possibility. The unwieldy butt would have made it impossible to carry the 20 foot log any great distance, at any rate. I shall be much interested to learn from your examination whether the rings add anything to what we have heretofore obtained in Chaco Canyon.

Our work for the season is well under way and we hope to send you a goodly series of beam sections. In mid-September I shall spend a couple of days in Tucson. At that time we should review our plans for the future of the beam studies.

Cordially and sincerely yours,

Judd – Douglass Letters

del Arroyo. You will be especially interested in section 99, cut from near the roots of a large and partially decayed log found in the west court of Bonito. It lay very close to the surface and from the root stumps led me, at first, to believe the tree had grown where it fell. But failure to find any trace of decayed roots forced me to abandon this possibility. The unwieldy butt would have made it impossible to carry the 20 foot log any great distance, at any rate. I shall be much interested to learn from your examination whether the rings add anything to what we have heretofore obtained in Chaco Canyon.

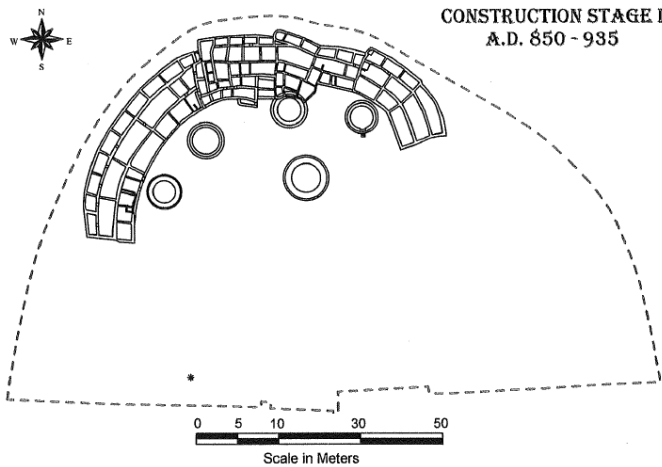
The Backstory

- After persistent reminders, Douglass finally examines JPB-99 in June, 1927
- Dating is confirmed the following year, August, 1928
- Summer of 1929:
 - Final beam expedition, Judd and Douglass together for most of summer
 - Had to explain the existence of the tree, and the thousands of timbers in the great houses
- Douglass first to publish description of the tree:
 - “... as a living tree it unquestionably stood *somewhere near*” the south wall of Pueblo Bonito (Douglass 1935:47)

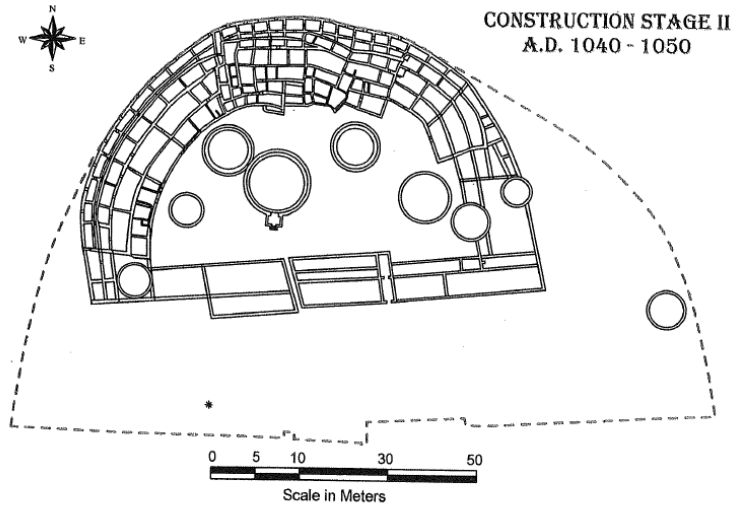
Tree-Ring Growth and Climate Response of JPB-99

...

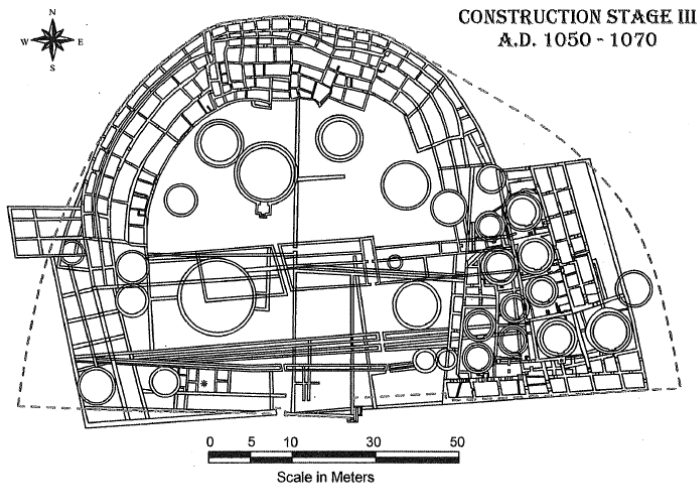
CONSTRUCTION STAGES OF PUEBLO BONITO



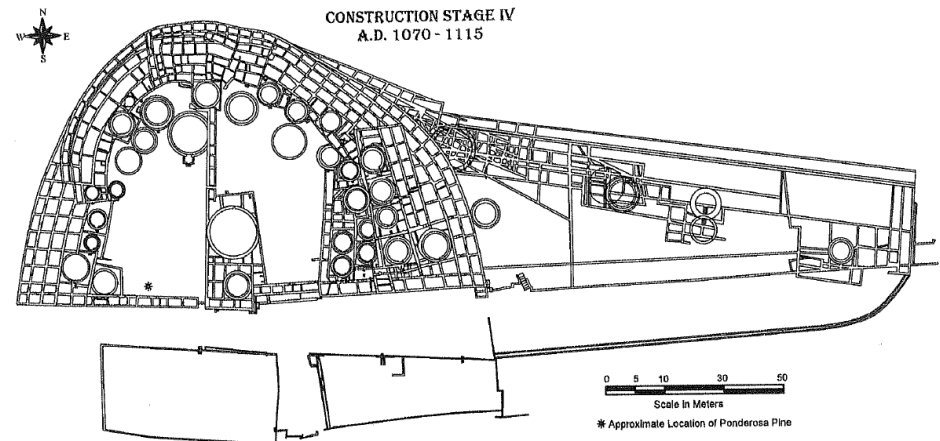
* Approximate Location of Ponderosa Pine



* Approximate Location of Ponderosa Pine



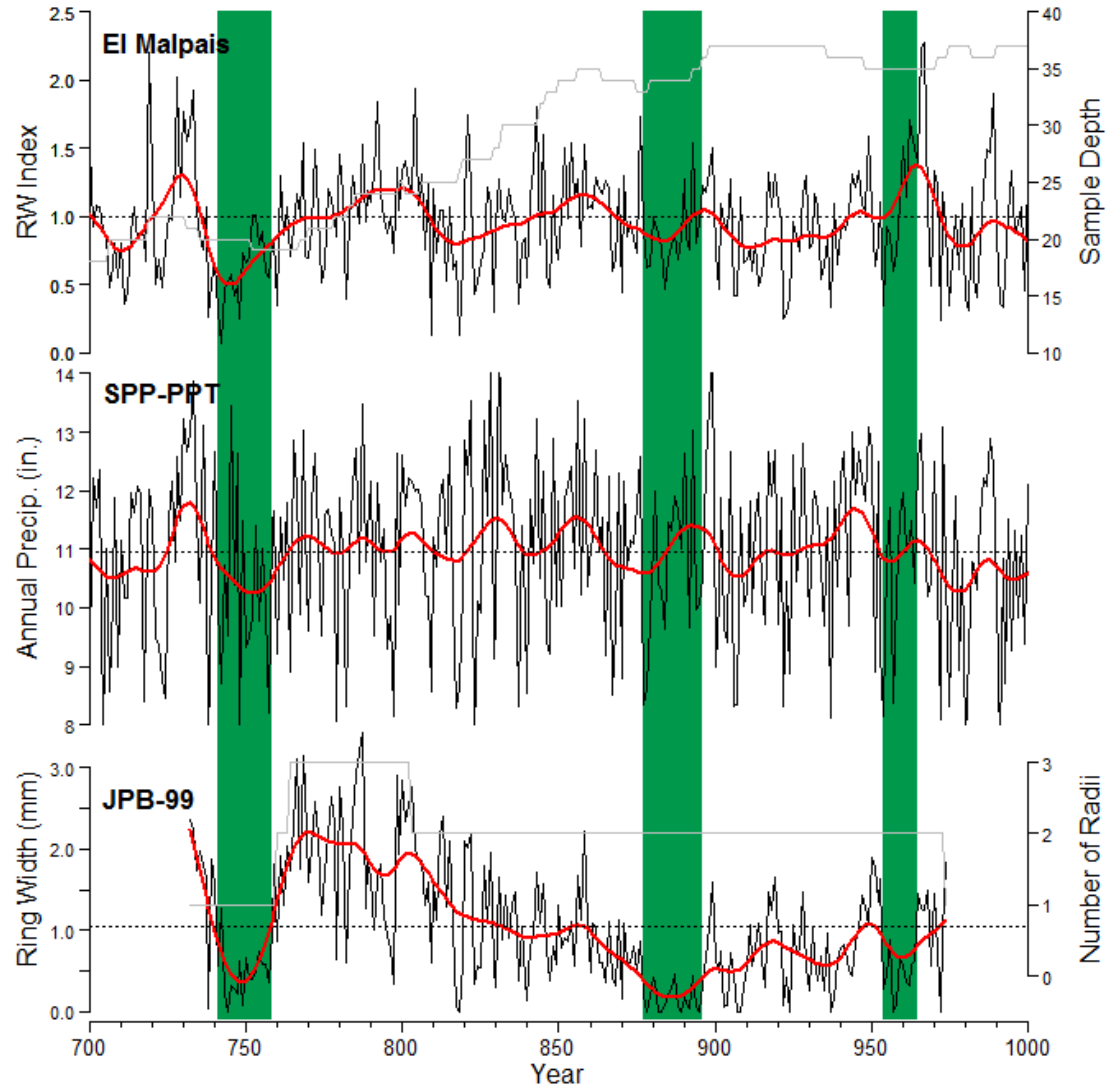
* Approximate Location of Ponderosa Pine



* Approximate Location of Ponderosa Pine

Stein et al. 2003

GROWTH SIGNATURE OF JPB-99

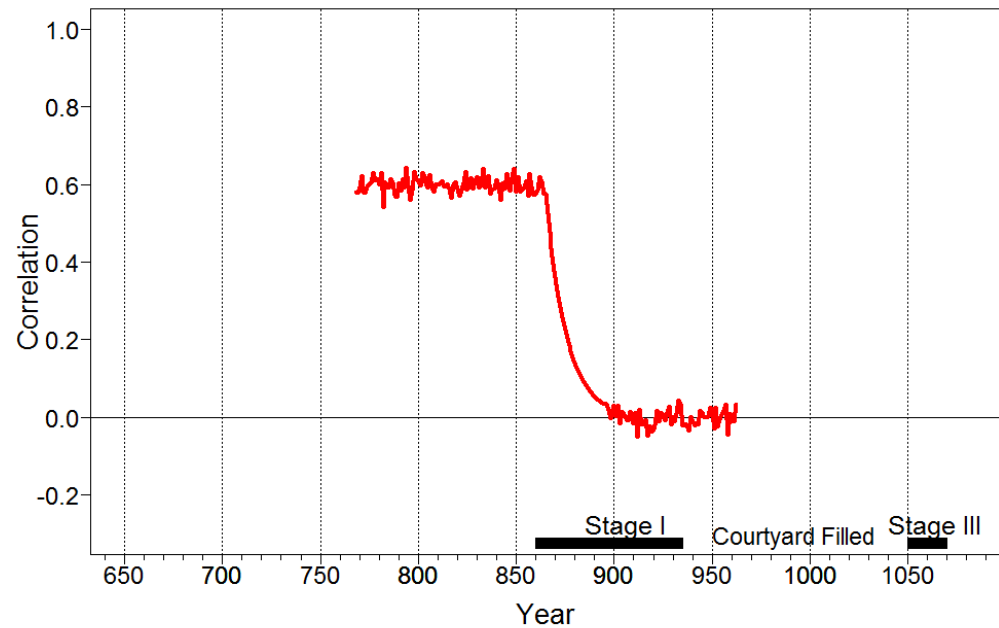


COMPARISON TO SIMILAR TREES



CORRELATION TO REGIONAL CHRONOLOGIES

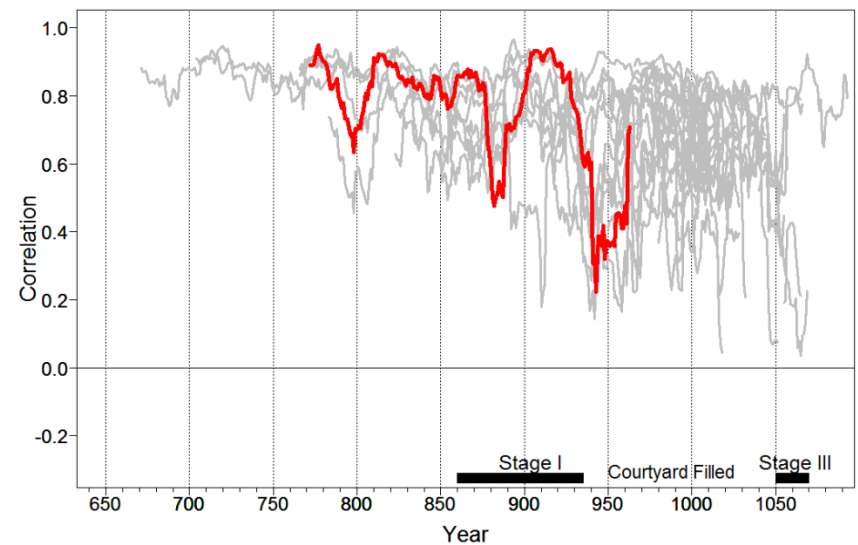
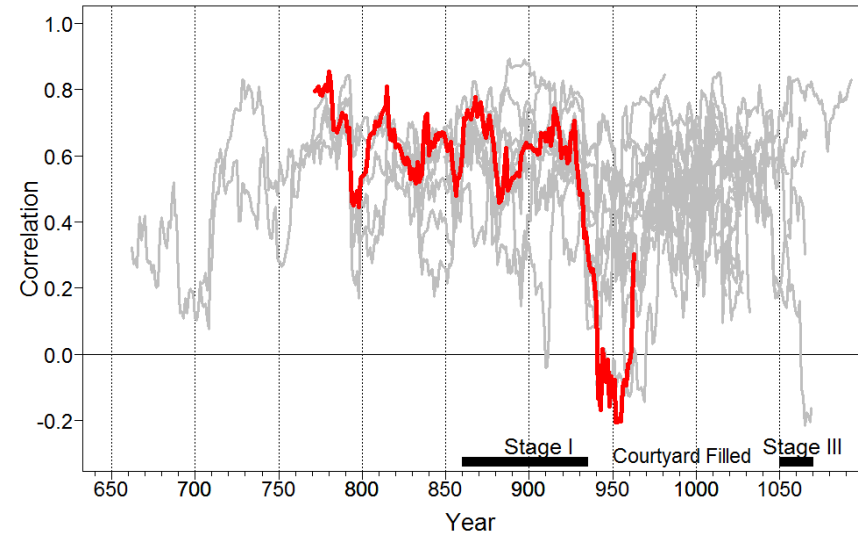
- An expectation:
 - Drop in correlation around time of intensified construction
 - Could be related to human impacts



*Stahle et al. 2009, *J. Clim.*

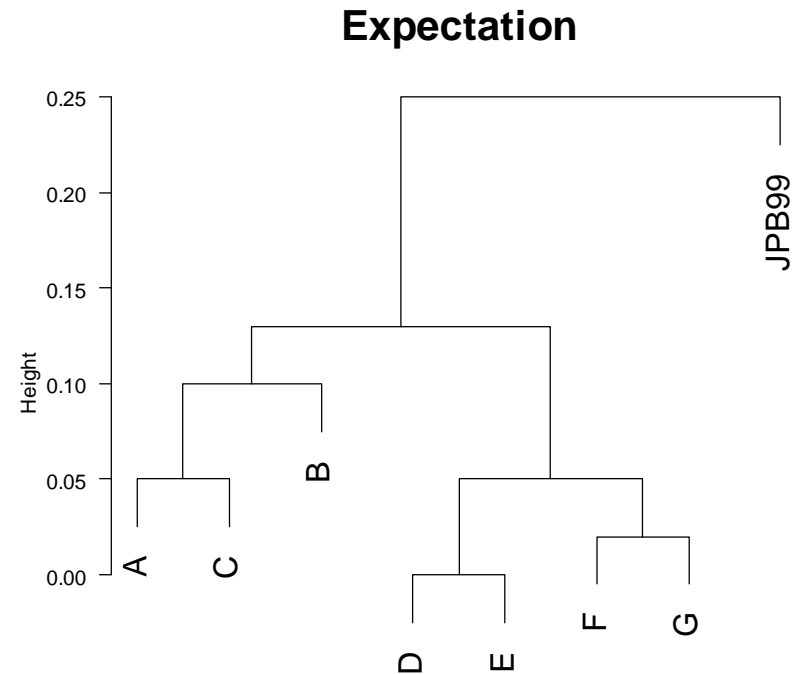
CORRELATION TO REGIONAL CHRONOLOGIES

- Reduction in correlation
- Also shown by several other pieces



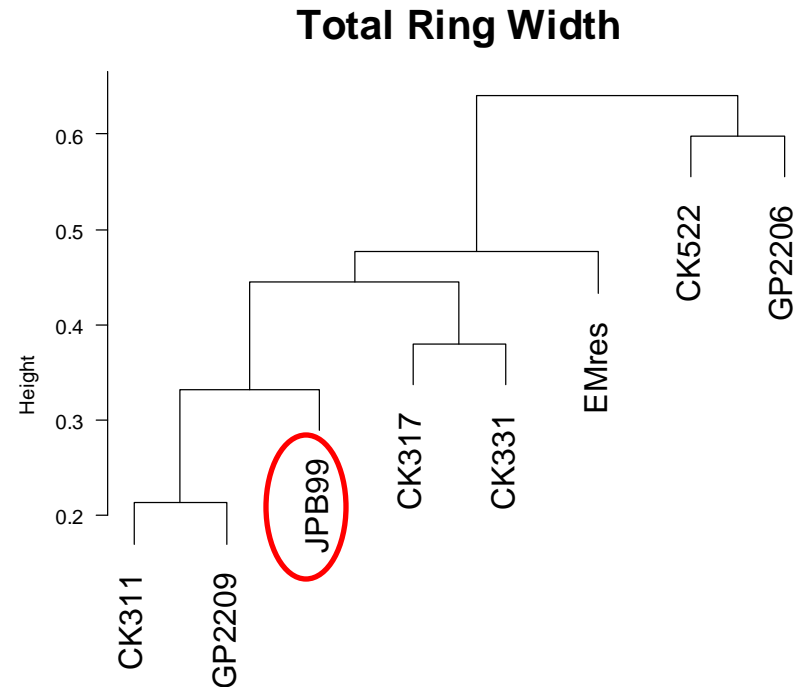
IS JPB-99 REALLY DIFFERENT?

- Cluster Analysis
 - Pairwise comparisons of the common period
 - Grouping based on common signals
- Proximity = Similarity



IS JPB-99 REALLY DIFFERENT?

- JPB-99 clusters with other samples
- And it's relatively removed from El Malpais
 - Different climate signal



Summary of JPB-99

- Could JPB-99 have been moved?
 - It's plausible: Large trees were carried to Chaco
- Is JPB-99 really different?
 - No, it shares growth patterns with other trees
- BUT: there's more work to be done...

Where did the tree grow?

...

If we can know that, where did all of the
beams grow?

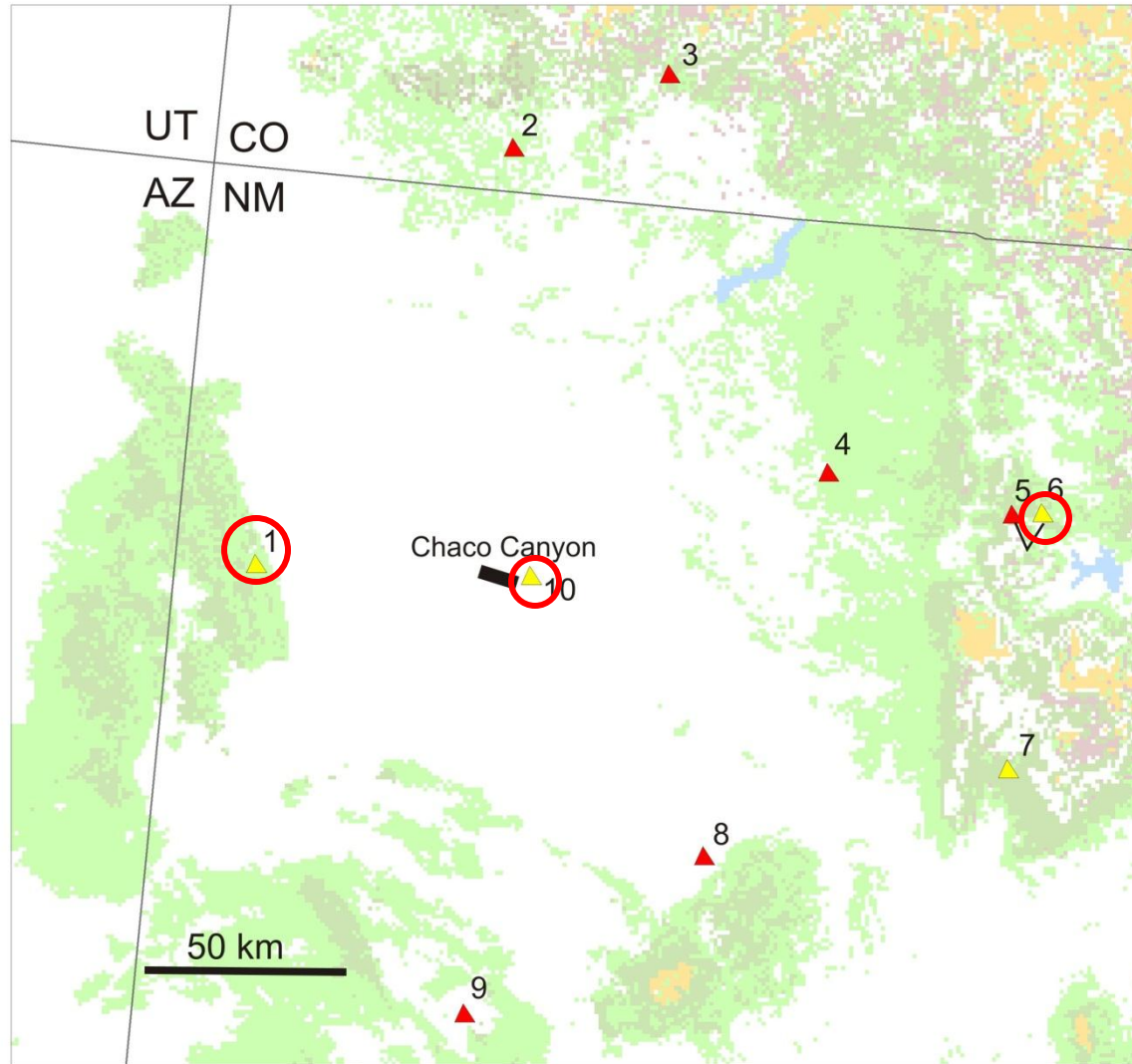
Dendrochronological Sourcing of Timbers from the Great Houses of Chaco Canyon



Study Objectives

- Decipher where timber was harvested
 - Relative importance of each region
- Scale of timber harvesting
 - Stands to whole mountains ranges
- Forest characteristics
 - Densities
 - Growth rates
 - Disturbance patterns

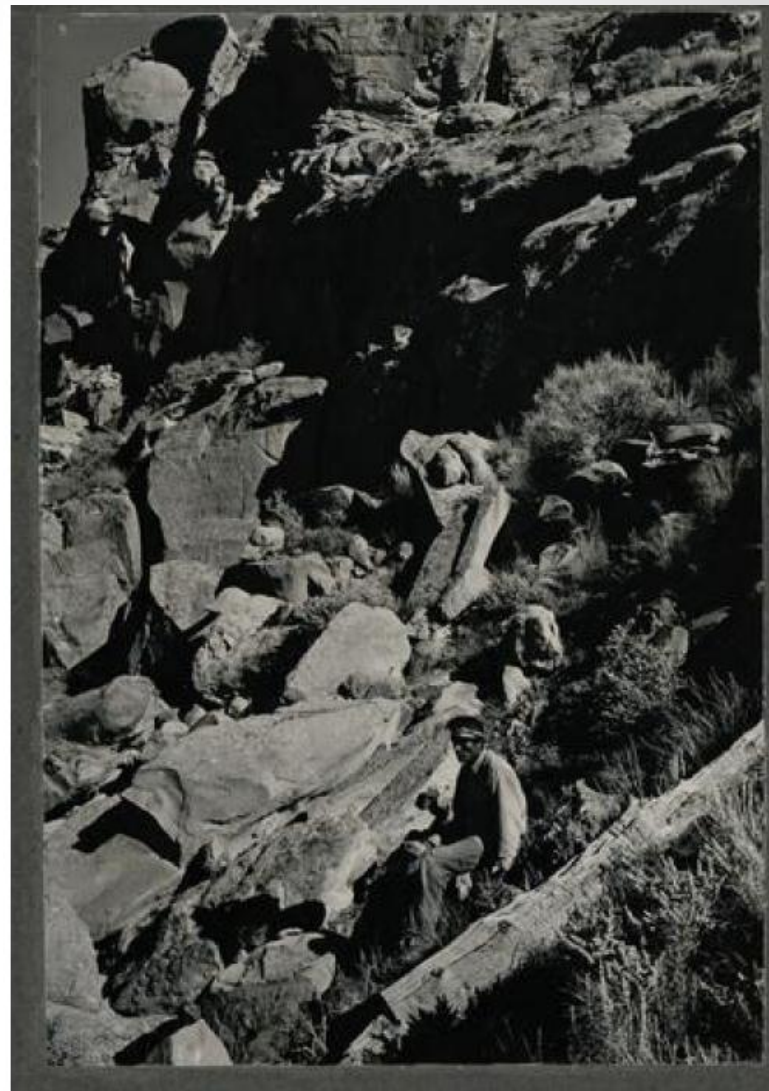
Chaco Woodshed Chronology Network





**Young rock pine (died 1926) on cliff S.E. of Pueblo Bonito.
One of last survivors. Pueblo Alto on right skyline.
#39577-A. Photos by N. M. Judd, 1926.
NAA judd_ngs_0022
National Anthropological Archives
NGS 39577-A**

CLOSE X

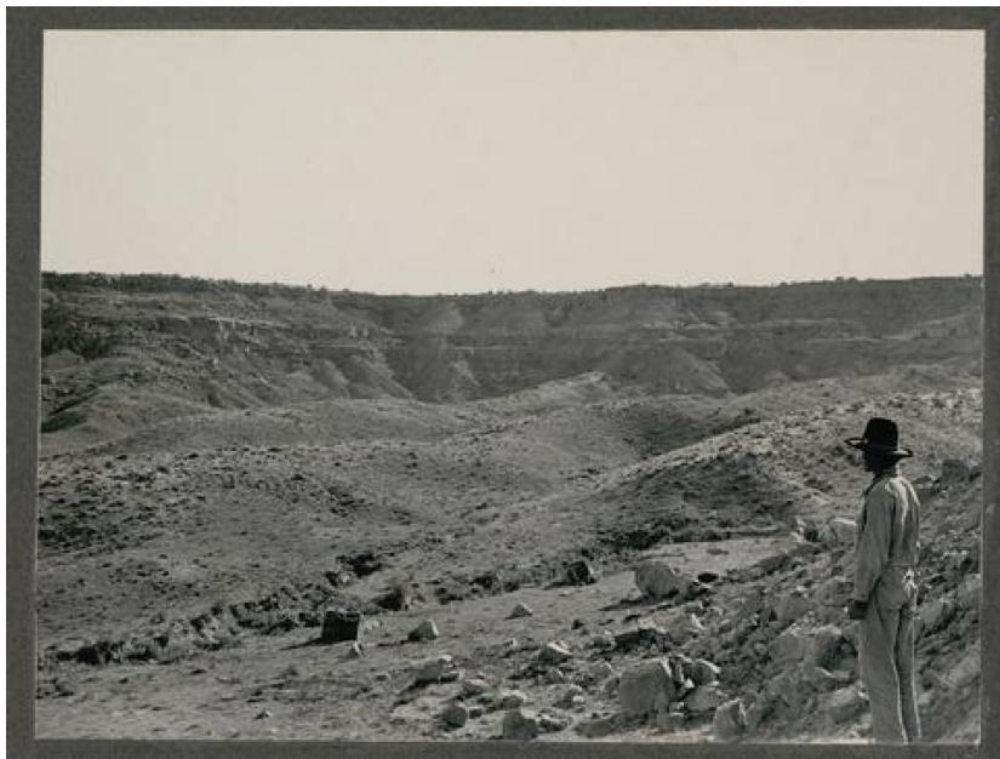


**Old pine log on slope at head of S. Fork
of Chaco Canyon, S.E. of Pueblo Bonito.
#39598-A. Photos by N. M. Judd, 1926.
NAA judd_ngs_0036
National Anthropological Archives
NGS 39598-A**

CLOSE X

Search for Wood in Chaco Canyon





South branch of Chaco Canyon, Wirito's Rincon, (S.E. of Pueblo Bonito). Dead pines were found of the slopes at left center. #39564-A. Photos by N. M. Judd, 1926.

NAA judd_ngs_0021

National Anthropological Archives

NGS 39564-A

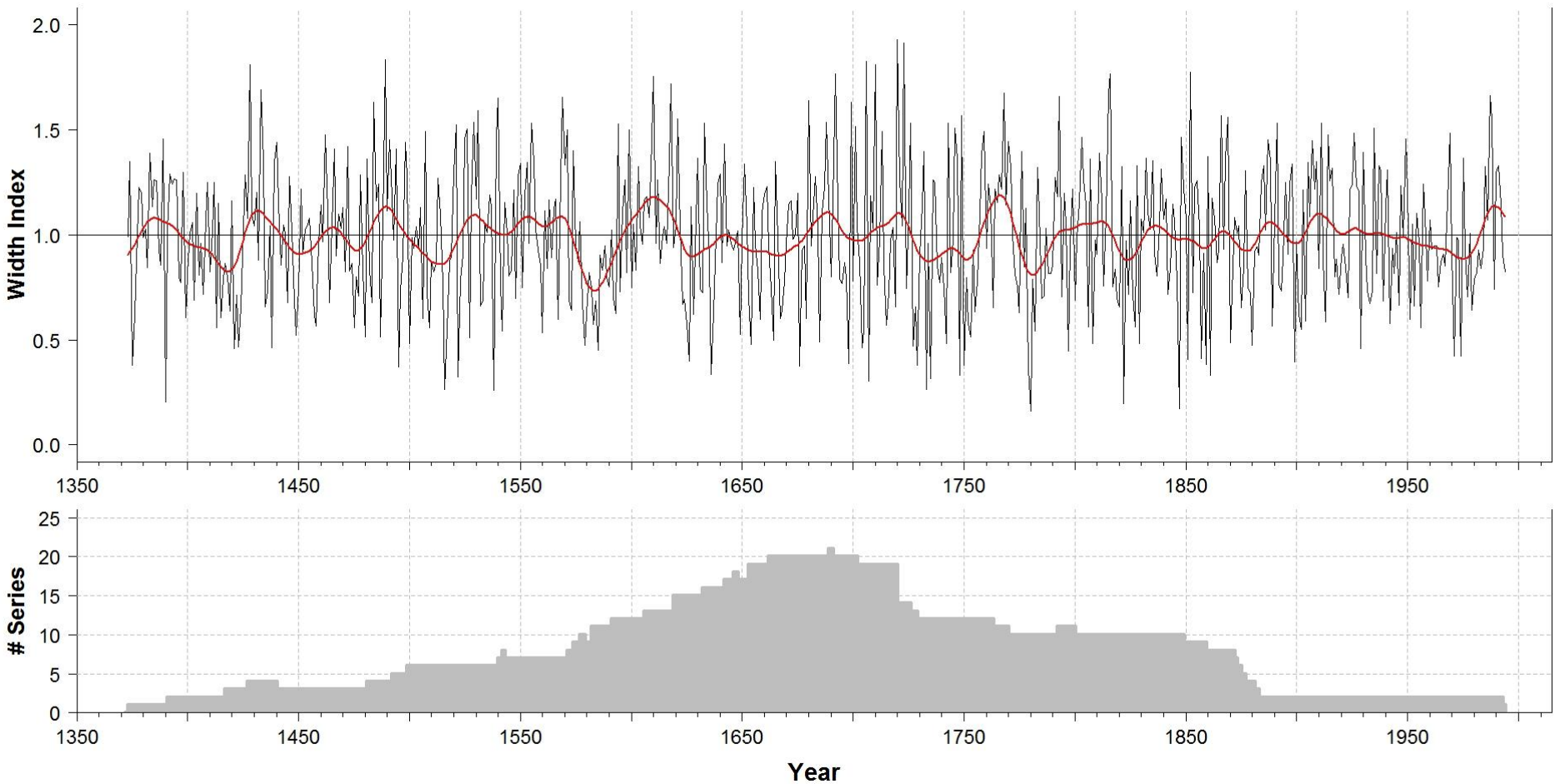
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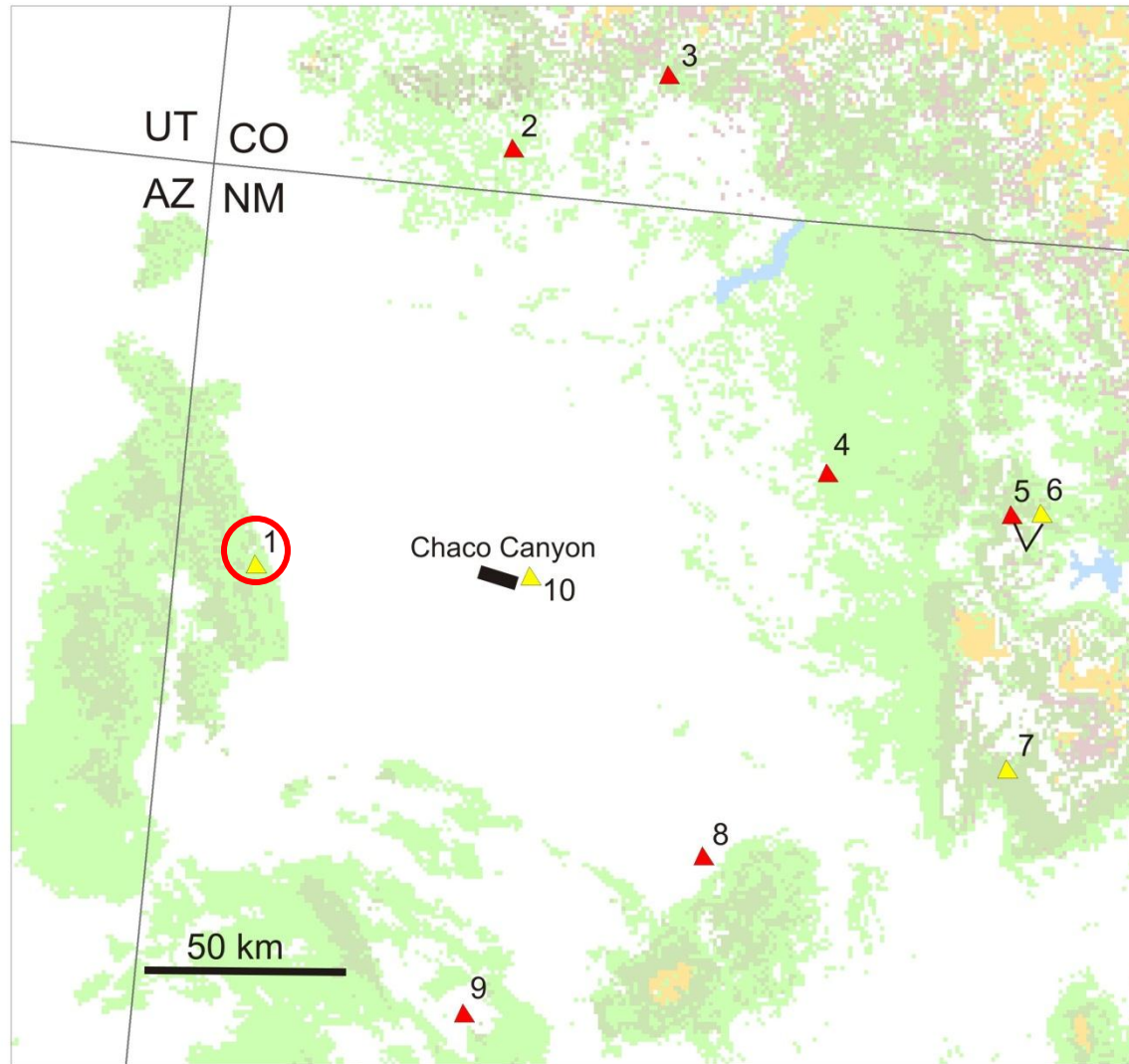




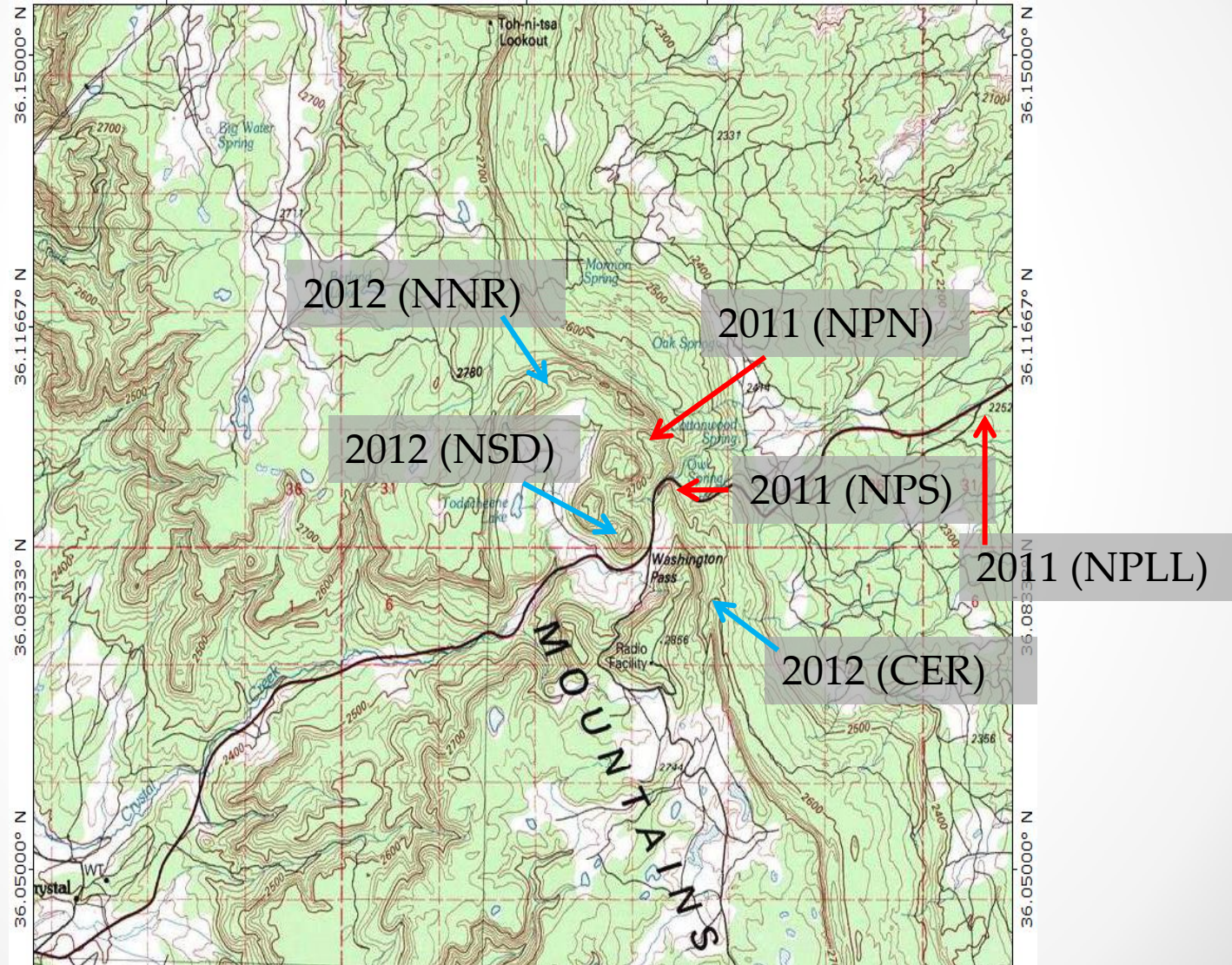
Chaco Canyon Ponderosa Chronology



Chaco Woodshed Chronology Network



Tree-Ring Sites in the Chuska Mountains



Building the Narbona Pass Chronology



NPS003: 1714-2010



NPS004: 1571-2010



NPS104: 1313-1584



NPS110: 1173-1441

Building the Narbona Pass Chronology



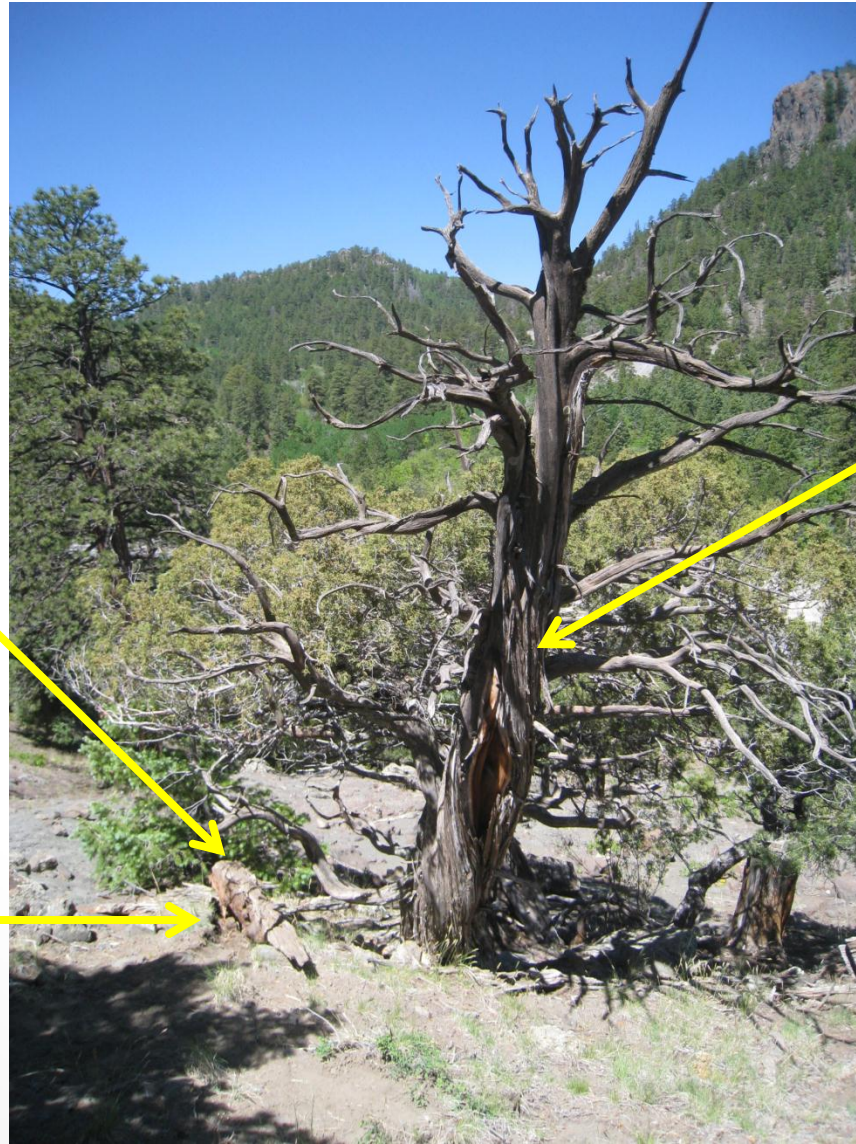
NPS115: 870-1090



NPS122: 897-1032

Surprises from Narbona Pass

NPS117: 850s-1045
PIED



NPS124: 1130s-1785
JUSC

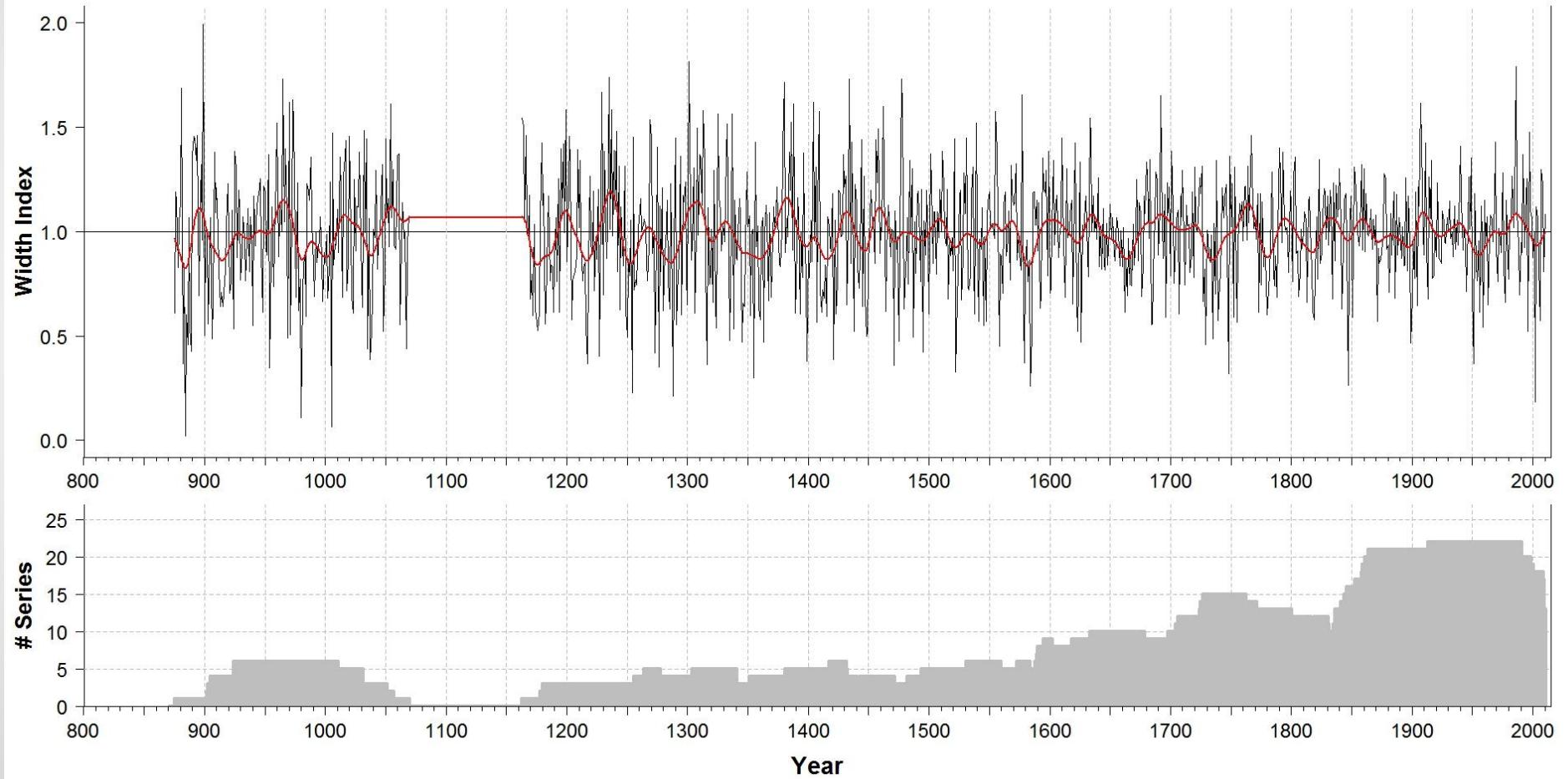
NPS118: 330s-660s
JUSC

Surprises from Narbona Pass

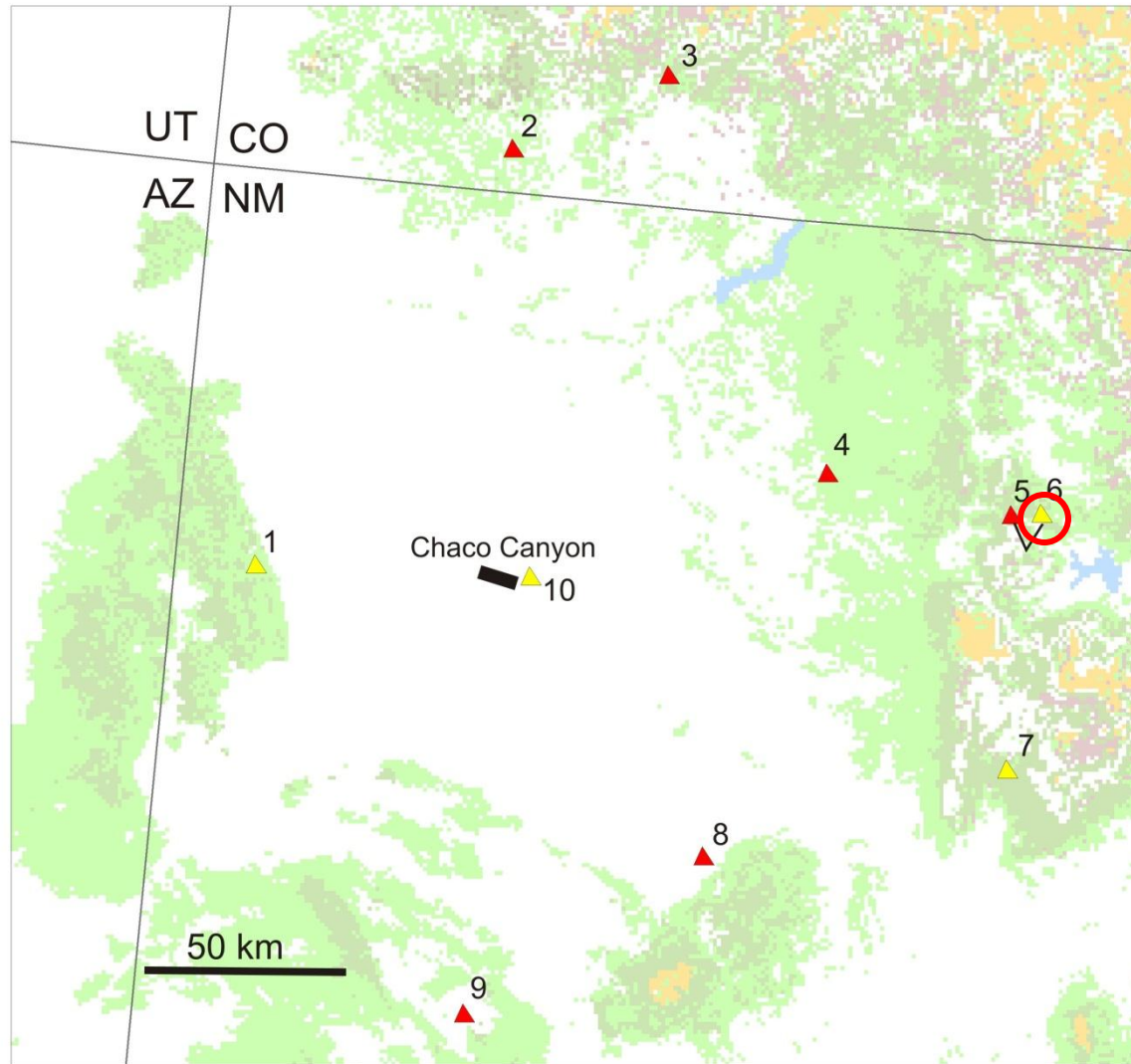


CER115: 70 BC – 267 AD
PIPO

Chuska Mountains



Chaco Woodshed Chronology Network



Mesa Alta





CDP-100: A.D. 819 - 1010

Mesa Alta Site



Building the Mesa Alta Chronology

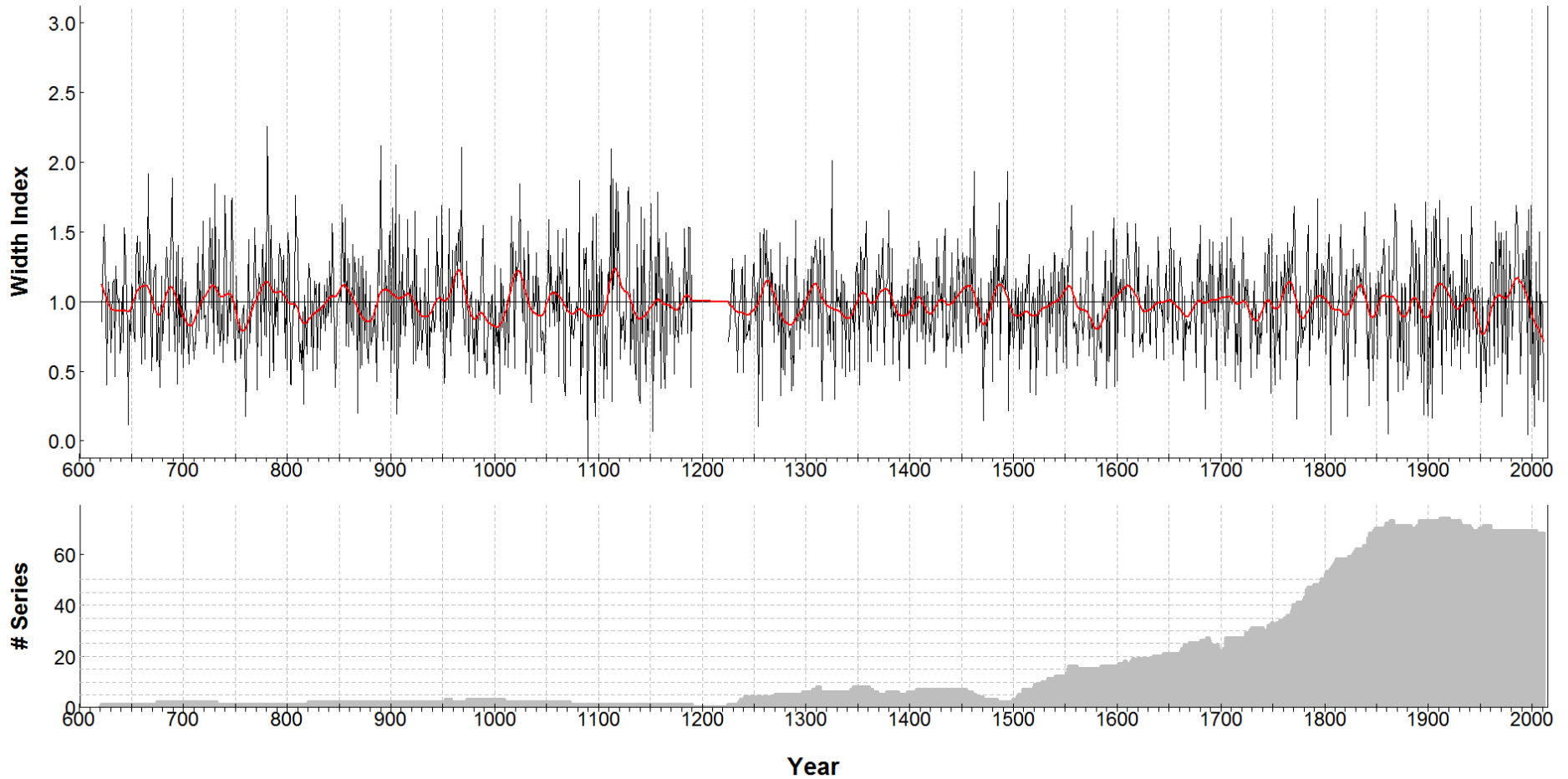


MDC106: A.D. 670 to 959

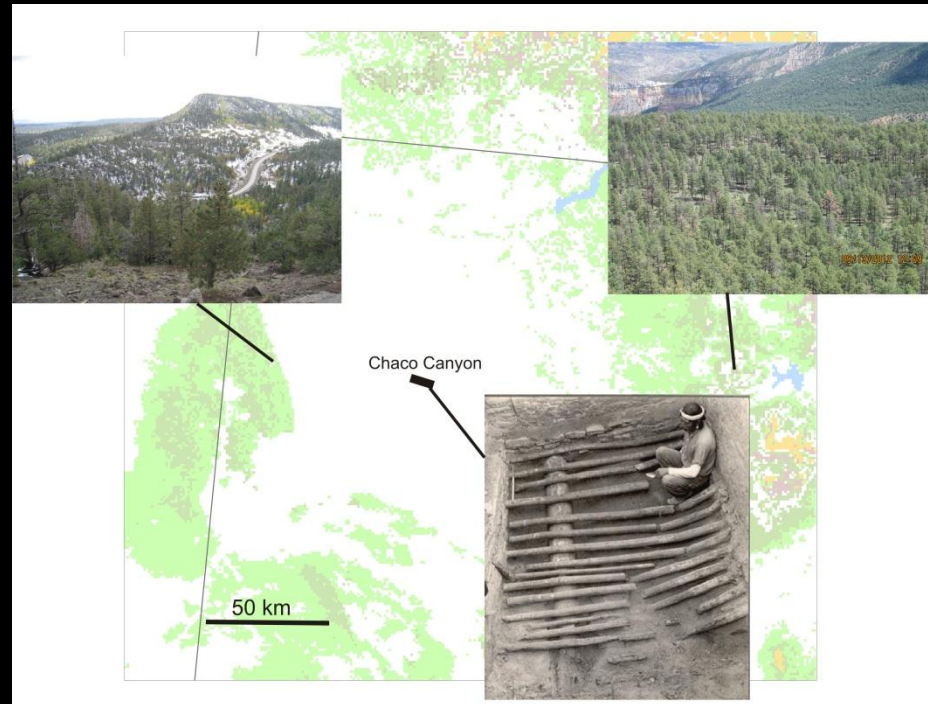


09/15/2012 11:03

Mesa Alta Chronology



A Test of Dendroprovenancing in the Southwest

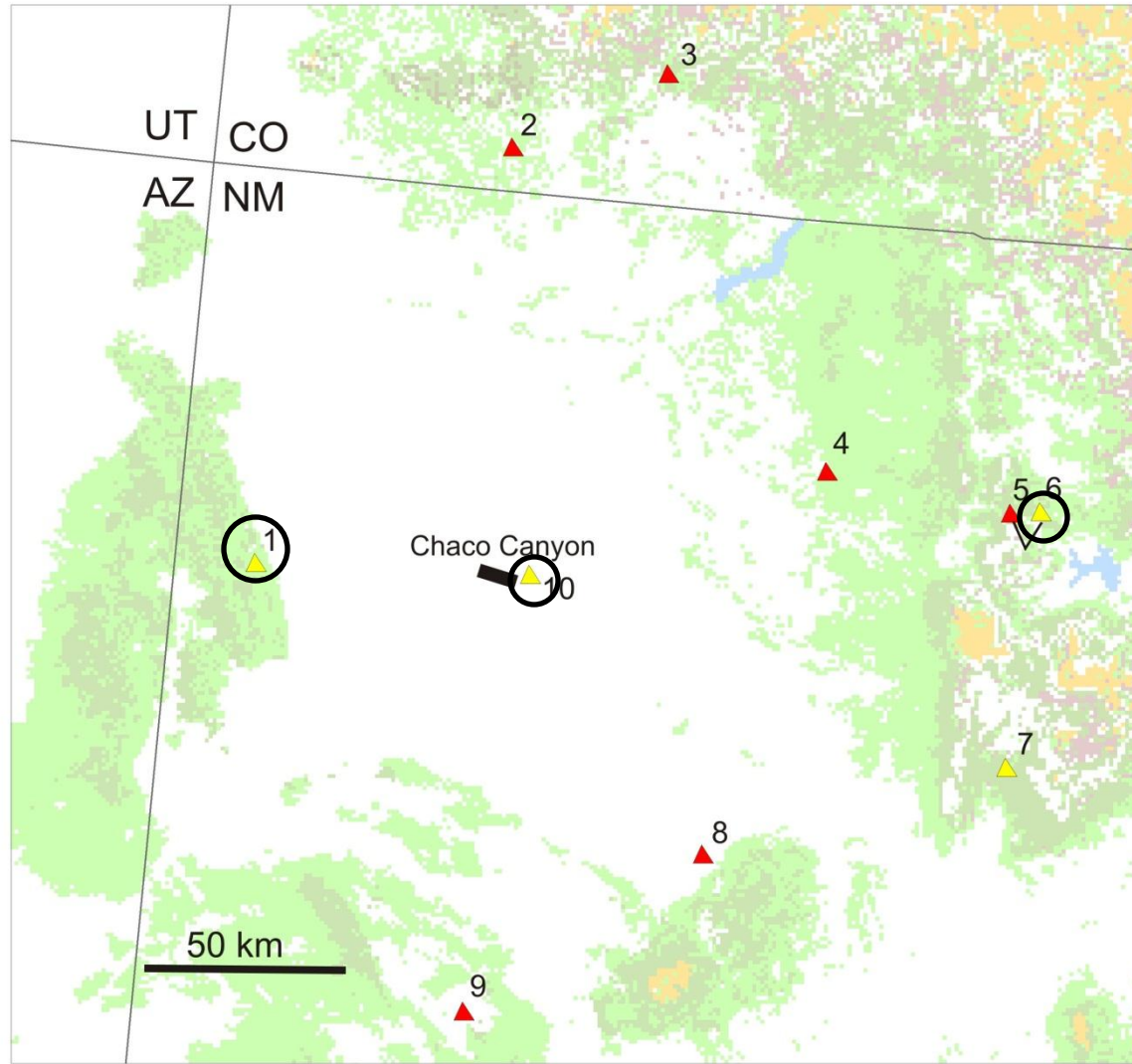


Christopher Guiterman, Thomas Swetnam, Jeffrey
Dean, Christopher Baisan, & Pearce Paul Creasman

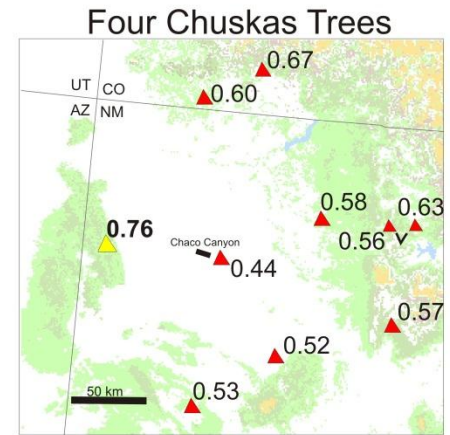
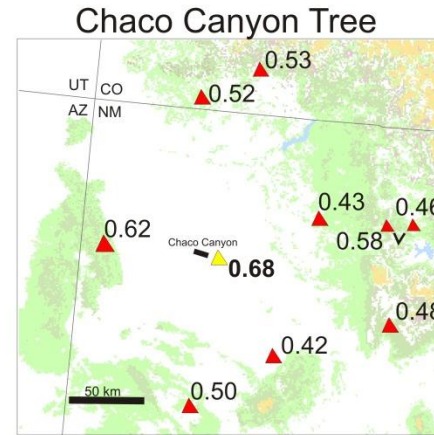
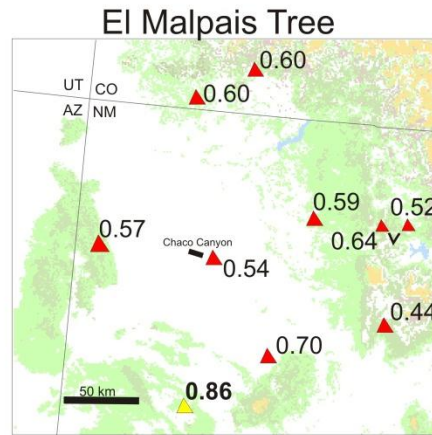
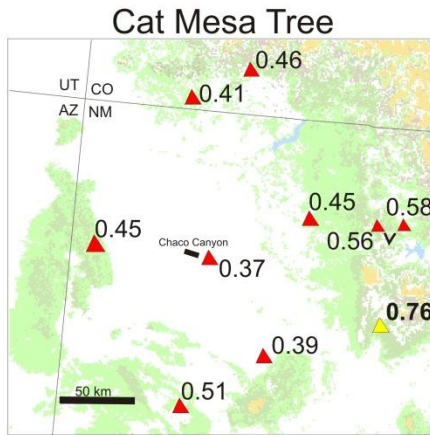
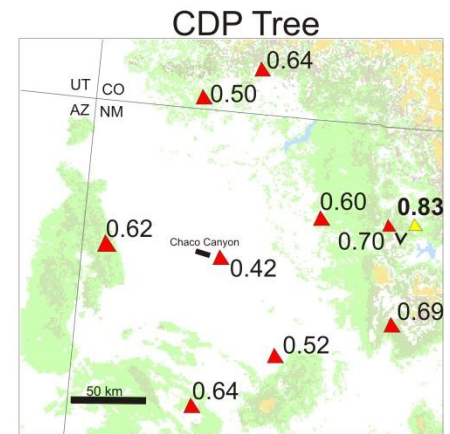
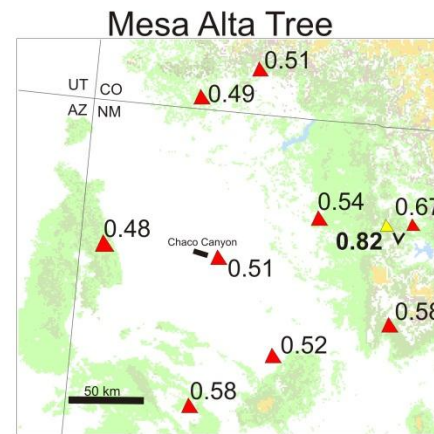
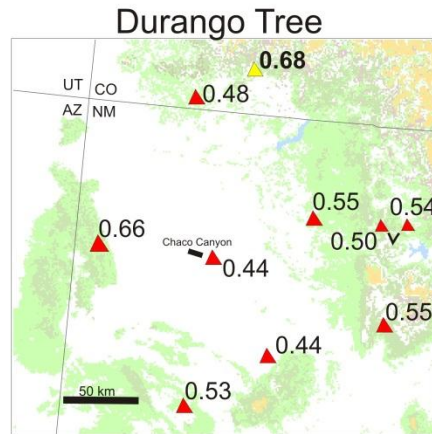
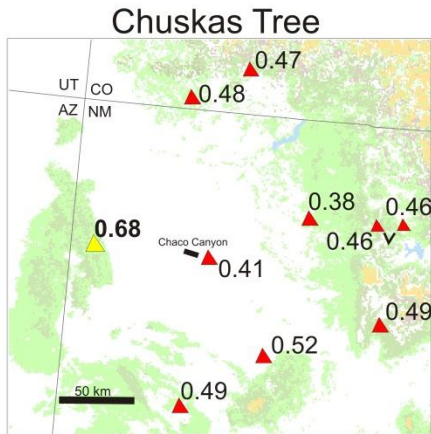
Laboratory of Tree-Ring Research

Earthweek 2013 - Tree-Ring Day, April 9, 2013

Chaco Woodshed Chronology Network



Experimental Dendroprovenance



Sourcing Archaeological Timbers

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Great House Tree-Ring Database

ChacoGreatHouses_LTRR_Database: Database (Access 2007 - 2010) - Microsoft Access

Table Tools: Filter, Sort & Filter, Records, Find, Text Formatting

ID	SiteFile	TRL_ID	NPS_ID	Species	SampleType	InnerDate	InnerDateTy	OuterDate	OuterDateTy	Provenance	Architectural type_unit	SampleYear	Excavator
1	Pueblo Bonito	PB-52		PP	XS	861 P		919 C		Pueblo Bonito	Room 320, W. wall, S. side,	1969	SWAC
2	Pueblo Bonito	PB-53		Populus	XS	894 P		917 vv		Pueblo Bonito	Room 320, W. wall, S. side,	1969	SWAC
3	Pueblo Bonito	PB-54		Populus	frag	900 FP		918 vv		Pueblo Bonito	Room 320, W. wall, S. side,	1969	SWAC
4	Pueblo Bonito	PB-55		Populus	frag	890 P		915 vv		Pueblo Bonito	Room 320, W. wall, S. side,		SWAC
5	Pueblo Bonito	PB-56		WF	1/2" core	960 FP		1047 vv		Pueblo Bonito		1979	TRL
6	Pueblo Bonito	PB-57		DF	1/2" core	998 P		1047 vv		Pueblo Bonito		1979	TRL
7	Pueblo Bonito	PB-58		DF	1/2" core	947 P		1040 vv		Pueblo Bonito		1979	TRL
8	Pueblo Bonito	PB-59 a, b		WF	Rot 1/2 XS	1008 P		1059 r		Pueblo Bonito	Room 335, E. wall, core bea	1979	Chaco Center
9	Pueblo Bonito	PB-60		DF	BE					Pueblo Bonito	Room 85, 1st story, E. wall,	1980	Chaco Center
10	Pueblo Bonito	PB-61		PP	XS					Pueblo Bonito	Room 85, 1st story, E. wall,	1980	Chaco Center
11	Pueblo Bonito	PB-62		Populus	1/2" core					Pueblo Bonito	Room 3b, 1st story, roof sec	1986	NPS
12	Pueblo Bonito	PB-63		DF	1/2" core					Pueblo Bonito	Room 3b, 1st story, roof sec	1986	NPS
13	Pueblo Bonito	PB-64		Populus	1/2" core					Pueblo Bonito	Room 3b, 1st story, roof sec	1986	NPS
14	Pueblo Bonito	PB-65		PP	1/2" core	809 P		860 v		Pueblo Bonito	Room 3b, 1st story, roof sec	1986	NPS
15	Pueblo Bonito	PB-66		JUN	1/2" core					Pueblo Bonito	Room 3b, 1st story, roof sec	1986	NPS
16	Pueblo Bonito	PB-67		PP	1/2" core	814 FP		860 v		Pueblo Bonito	Room 3b, 1st story, roof sec	1986	NPS
17	Pueblo Bonito	PB-68		Populus	1/2" core					Pueblo Bonito	Room 3b, 1st story, roof sec	1986	NPS
18	Pueblo Bonito	H-14 a-e		Pine	1/2 XS (5)					Pueblo Bonito		1919	EHM
19	Pueblo Bonito	H-15 a-d		PP	XS	890 P		1057 C		Pueblo Bonito	See AED's picture of H-15 ir	1919	EHM
20	Pueblo Bonito	H-16 a, b		Pine	XS	1031 P		1078 CL		Pueblo Bonito		1919	EHM
21	Pueblo Bonito	PB-1 a, b		PP	1/4 BE	841 P		1016 ++'		Pueblo Bonito	Wall under cliff behind Bor	1932	FMH
22	Pueblo Bonito	PB-2 a, b, c		PP	1/2 XS	890 P		1057 r		Pueblo Bonito	Wall under cliff behind Bor	1932	FMH
23	Pueblo Bonito	PB-3		PP	core	946 NP		1063 v		Pueblo Bonito	Wall under cliff behind Bor	1932	FMH
24	Pueblo Bonito	PB-4		PP	1" core	966 P		1038 +v'		Pueblo Bonito	Room 14b, ceiling	1929	Judd & Haur
25	Pueblo Bonito	PB-5		PP	1" core	997 P		1029 L		Pueblo Bonito	Room 14b, ceiling	1929	Judd & Haur
26	Pueblo Bonito	PB-6		WF	1" core					Pueblo Bonito	Room 299, ceiling	1929	Judd & Haur
27	Pueblo Bonito	PB-7		PP	1" core					Pueblo Bonito	Room 299, ceiling	1929	Judd & Haur
28	Pueblo Bonito	PB-8		PP	1/2 BE	987 P		1024 r		Pueblo Bonito	Room 100, ceiling	1929	Judd & Haur
29	Pueblo Bonito	PB-9		DF	1/2 BE	966 P		1042 rL		Pueblo Bonito	Room 100, ceiling	1929	Judd & Haur
30	Pueblo Bonito	PB-10								Pueblo Bonito	Room 100, ceiling	1929	Judd & Haur
31	Pueblo Bonito	PB-11		PP	XS					Pueblo Bonito	Room 104b, ceiling	1929	Judd & Haur
32	Pueblo Bonito	PB-12		PP	frag	857 FP		897 r		Pueblo Bonito	Room 97, NE wall	1929	Judd & Haur
33	Pueblo Bonito	PB-13		PP	1" core					Pueblo Bonito	Room 97, NE wall	1929	Judd & Haur
34	Pueblo Bonito	PB-14		PP	V-cut					Pueblo Bonito	Room 97, NE wall	1929	Judd & Haur
35	Pueblo Bonito	PB-15		PP	V-cut					Pueblo Bonito	Room 97, NE wall	1929	Judd & Haur
36	Pueblo Bonito	PB-16		PP	frag					Pueblo Bonito	Room 97, NE wall	1929	Judd & Haur
37	Pueblo Bonito	PB-17		Populus	1" core					Pueblo Bonito	Room 3b, ceiling	1929	Judd & Haur
38	Pueblo Bonito	PB-18		PP	1" core					Pueblo Bonito	Room 3b, ceiling	1929	Judd & Haur

Record: 1 of 6420

Next Steps

- Generate correlations of timbers to chronologies from the woodshed network
- Evaluate different statistical means of deciphering difference in the tree subpopulations
- Look for patterns of changing mean sensitivity and other indicators of environmental stress
 - Changing elevations, site qualities in timber selection through time

STAY TUNED!



Questions?

...