An Exploratory Investigation of the Pit Props at Joggins, Nova Scotia

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Abstract

An exploratory study of the pit props at Joggins Fossil Cliffs in Joggins, Nova Scotia was conducted on November 18th, 2008. This study is a preliminary investigation to understand when the various mines at the site were in production. Seventeen samples were collected from two levels on the cliff by the Mount Allison Dendrochronology (MAD) Lab. Samples were processed and cross-dated to a regional master chronology of red spruce (*Picea rubens*). The age of the samples divided into two groups a lower and an upper sampling site. The lower samples cut dates were from ~1866/69 while the upper samples were aged from 1874-75. A general trend of younger pit prop wood as one moves up the cliff face is apparent. These dates would suggest that the pit props appear to be of British origin. Further sampling and analysis would help to explain the duration and breadth of mining activity at the entire exposure. Further sampling would also deepen the regional red spruce master chronology.

Introduction

The Joggins Fossil Cliffs have long been the wonderment of visitors to the site. The cliffs are composed of sedimentary layers of Pennsylvanian strata, with the layers denoting periods of warm-wet and cool-dry conditions. Interspersed with these coal seams are fossils such as trees, ferns, amphibians and reptiles from the Paleozoic. In 2008, the fossil cliffs were given the status of a UNESCO World Heritage Site due to being the world's best Pennsylvanian outcropping.

The cliffs were first noted in the 1640's for their exposed coal deposits. The seams were a source of coal for Acadian settlers and then decades later mined for British interests. When exactly each of the sites along the cliffs was mined, is still unknown. Mining in this region began in 1686 but after the deportation of the Acadians in 1755, mining activity was halted by the British until the 1840's. Due to these activities along the cliffs there are remnant mining structures (shafts, beams, and planks) actively being eroded from the cliffs. As the erosion continues, the wood exposed along the cliff face, falls on the beach, and is transported away with the strong tides.

To begin to understand the mining history of this area a dendrochronological investigation into the age of the timber structures was initiated in November, 2008. In this exploratory study we hoped to address if it was possible to detect when each adit was worked, and by doing so, help determine who was conducting the mining. This undertaking was conducted with the assistance of Dr. Howard Falcon-Lang and Dr. Martin Gibling.

Methods

Joggins is located along the Bay of Fundy in Nova Scotia, southwest of Amherst (Lat.45^{o} 42' 21.6" N, Long. 64^{o} 26' 37.2" W). Samples were taken from exposed mining shafts along the cliffs, at a location where the coal seams met the beach (Figure 1). The cliffs are approximately 75 m tall at that location, and the sampling occurred at the base of one of the coal outcroppings where a small stream exits the base of the cliff at an old mine entrance.

Samples consisted of beams of the exposed mining shafts and roof planks. A saw was used to collect 17 samples by cutting off discs from the exposed beams. Two upright logs were sampled at the base of the seam where it intersected the beach (labeled "Mine Shaft" in Figure 2) as well as a cluster of beams ~5m above this base (labeled Lower in Figure 2). A third collection area was ~20m above the beach along the coal seam. Samples were labeled with the MAD Lab code 08BBD000 and location and condition of each sample was noted.

In the lab samples were sanded with progressively finer sanding paper (80-400grit) to bring out the cellular structures and annual rings of the wood. Rings were counted and measured along two paths from the pith (middle) of each disc sample using a Velmex measuring system with an accuracy of 0.001mm. Measurement paths were run through the most structurally sound portions of the sample.

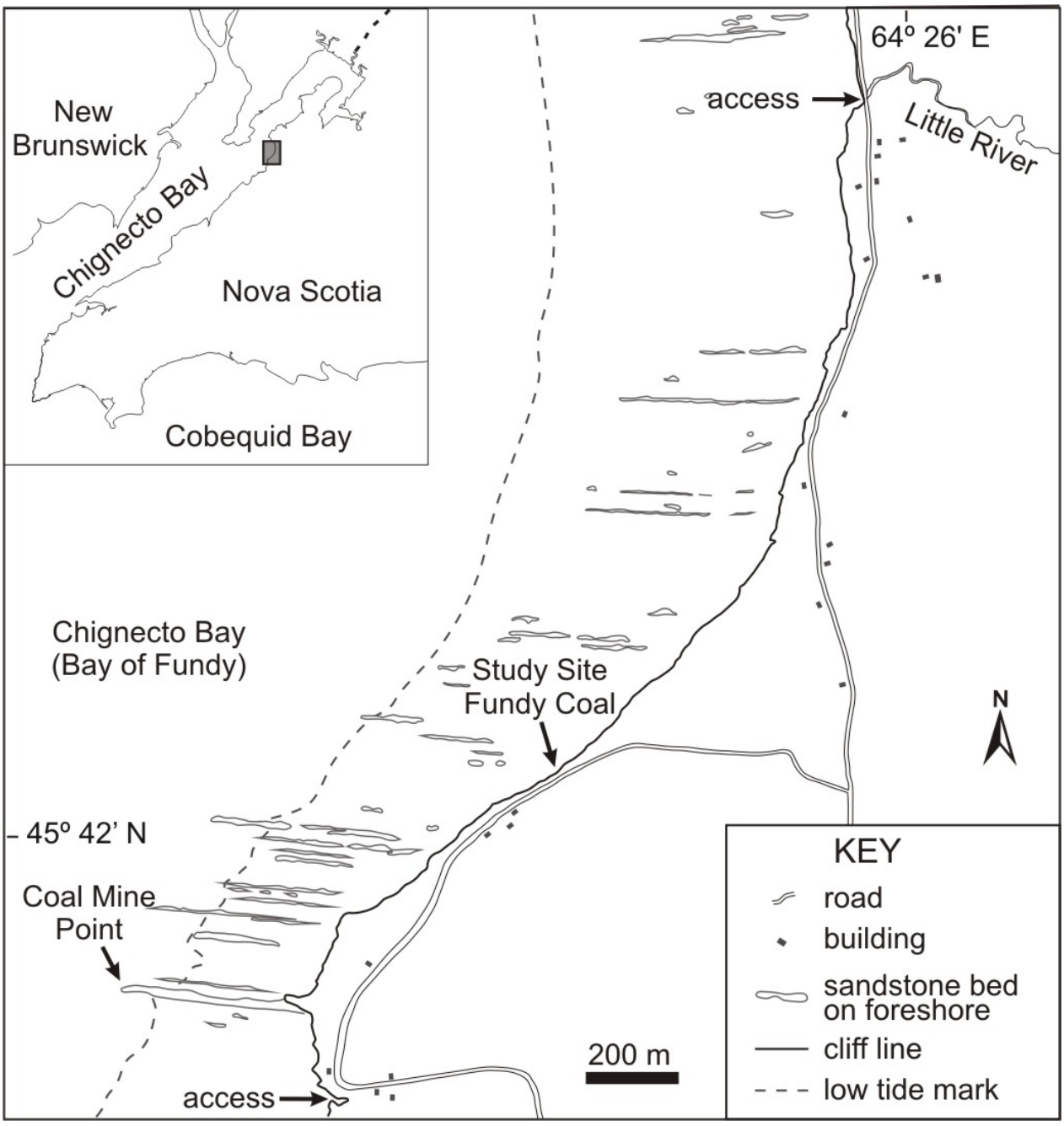

Figure 1 – A map of the Joggins Fossil Cliffs (Lat.45^{o} 42' 21.6", Long. 64^{o} 26' 37.2") with the Fundy Coal Seam study site located just north of Coal Mine Point.

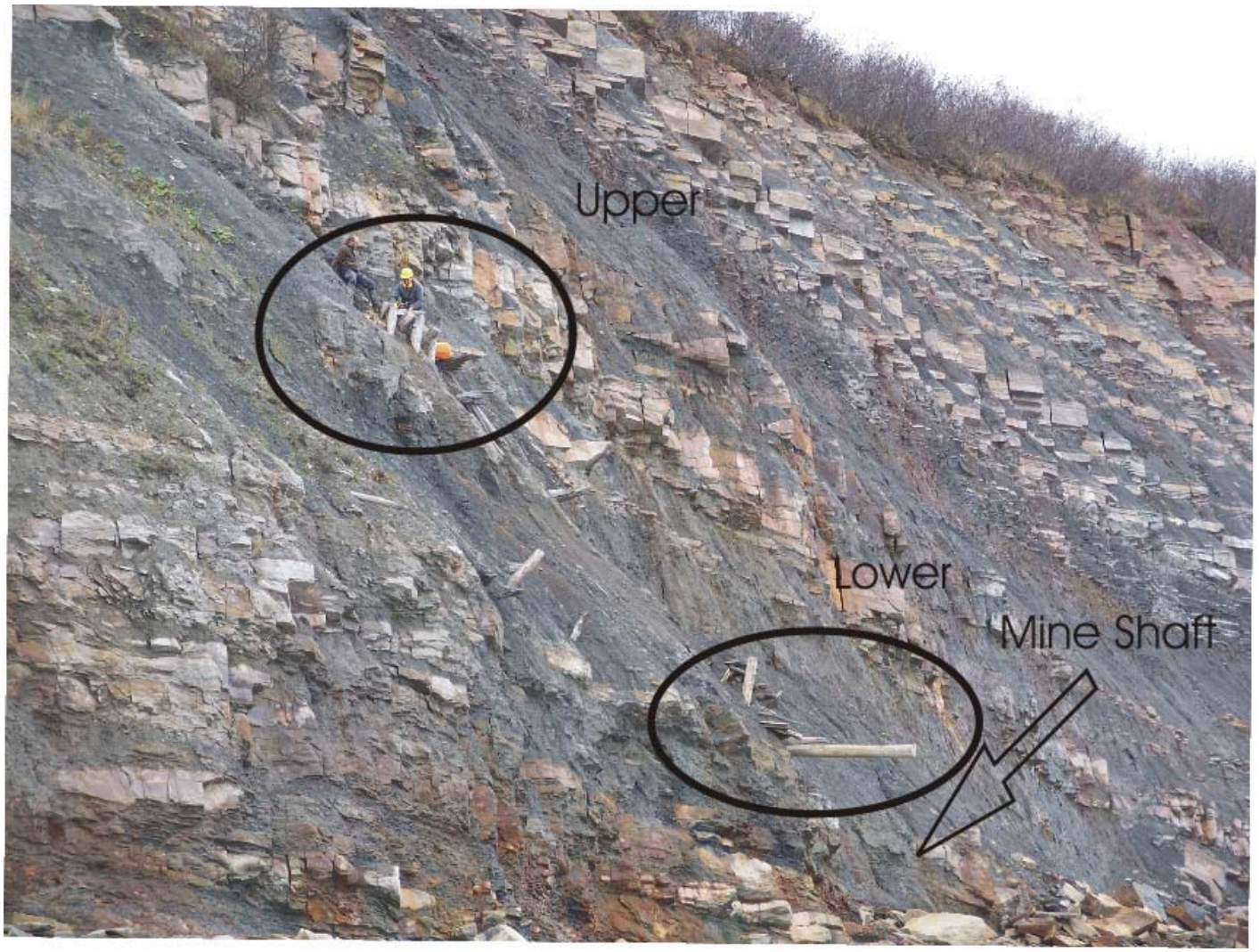

Figure 2 – The sampling locations “Mine Shaft”, “Lower” and “Upper” are illustrated in this image.

Time series of measurements from the pit prop samples were correlated to each other thereby creating floating chronologies (chronologies that are not attached to a specific period of time). The floating chronologies were then cross-dated to a previously establish master chronology that was locked in time from the area. Cross-dating is the practice of taking the pattern of growth from one sample and comparing it to that of another (Figure 3).

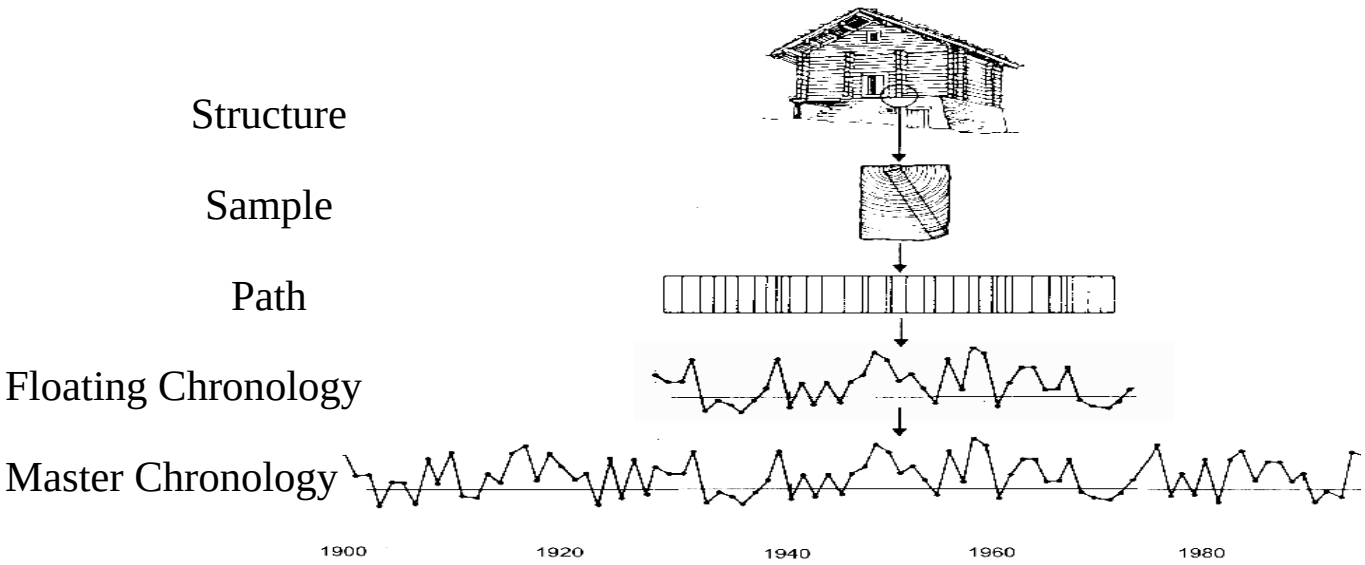

Figure 3 - Example of cross-dating by using patterns from a structure (floating chronology) compared to a master chronology.

To assist in the cross-dating procedure we used the statistical cross-dating program COFECHA (Holmes, 1986a). COFECHA uses correlation values to assist in accurately dating samples. Higher correlation values indicate that the floating chronology corresponds well to the master chronology. Lower correlation values can indicate a variety of things such as ecological or climatic variation from the norm or that the sample is inaccurately dated. Since field notes indicated that we had samples of two species present, the floating chronologies were run against both a red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) master chronology available from the MAD Lab Archive. This insured that the patterns found in the floating samples could be referenced to one of the two chronologies locked in time.

Each of the floating and master chronologies was standardized to have a mean of one by using a negative exponential curve in the program ARSTAN (Holmes,1986b). This standardization was completed to allow samples of different ages to be compared.

Results and Discussion

All 17 of the samples were able to be cross-dated. The correlation of the floating chronology from the samples is 0.366 (Table 1). The floating chronology correlates significantly to the master red spruce chronology (0.139 n=248 Figure 4a). The floating chronology locked into time from 1627 to 1875 against the master regional red spruce chronology. The red spruce master chronology is only slightly older than the Joggins samples, thus the addition of the Joggins samples to the master will increase the depth and reliability of the master chronology (Figure 4b).

The 17 samples fall into two distinct time periods 1868/1869 and 1875. These groupings are also divided by location (see Figure 2). The 1868/1869 samples were from the lower sites (mine shaft on the beach and the lower cluster; Table 1). The upper samples consistently had a cut dates around 1875. These results lead us to believe that the construction of the mine shaft

began in the lower portions in the late 1860s before coal extraction was initiated from the upper portions in 1875.

Table 1 – Sample identifier, location of samples, time span, number of years, overall correlation to the floating chronology against the master red spruce chronology and species.

Series #	First Year	Last Year	# of Years	Correlation	Species
08BDD01A	1800	1869	70	0.00	Fir?
08BDD01B	1800	1869	70	0.20	Fir?
08BDD02A	1810	1868	59	0.28	Spruce?
08BDD02B	1810	1868	59	0.33	Spruce?
08BDD03A	1741	1875	135	0.47	Spruce?
08BDD03B	1741	1874	134	0.44	Spruce?
08BDD04A	1647	1868	222	0.47	Spruce
08BDD04B	1647	1874	228	0.47	Spruce
08BDD05A	1645	1871	227	0.27	Spruce?
08BDD05B	1647	1870	224	0.40	Spruce?
08BDD06A	1760	1875	116	0.46	Spruce?
08BDD06B	1760	1872	113	0.56	Spruce?
08BDD07A	1740	1875	136	0.59	Spruce?
08BDD07B	1740	1875	136	0.45	Spruce?
08BDD08A	1752	1875	124	0.46	Spruce?
08BDD08B	1734	1855	122	0.34	Spruce?
08BDD09A	1748	1871	124	0.41	Spruce?
08BDD09B	1748	1865	118	0.41	Spruce?
08BDD10A	1627	1872	246	0.17	Spruce?
08BDD10B	1627	1828	202	0.01	Spruce?
08BDD11A	1768	1875	108	0.48	Spruce?
08BDD11B	1768	1875	108	0.59	Spruce?
08BDD12A	1755	1867	113	0.47	Spruce?
08BDD12B	1756	1866	111	0.41	Spruce?
08BDD13A	1734	1867	134	0.32	Spruce?
08BDD13B	1735	1867	133	0.41	Spruce?
08BDD14A	1746	1868	123	0.50	Spruce?
08BDD14B	1746	1867	122	0.36	Spruce?
08BDD15B	1832	1861	30	0.59	Spruce?
08BDD015	1833	1862	30	0.29	Spruce?
08BDD16A	1800	1869	70	0.19	Spruce
08BDD16B	1800	1870	71	-0.04	Spruce
08BDD17A	1821	1868	48	0.31	Spruce
08BDD17B	1821	1868	48	0.10	Spruce

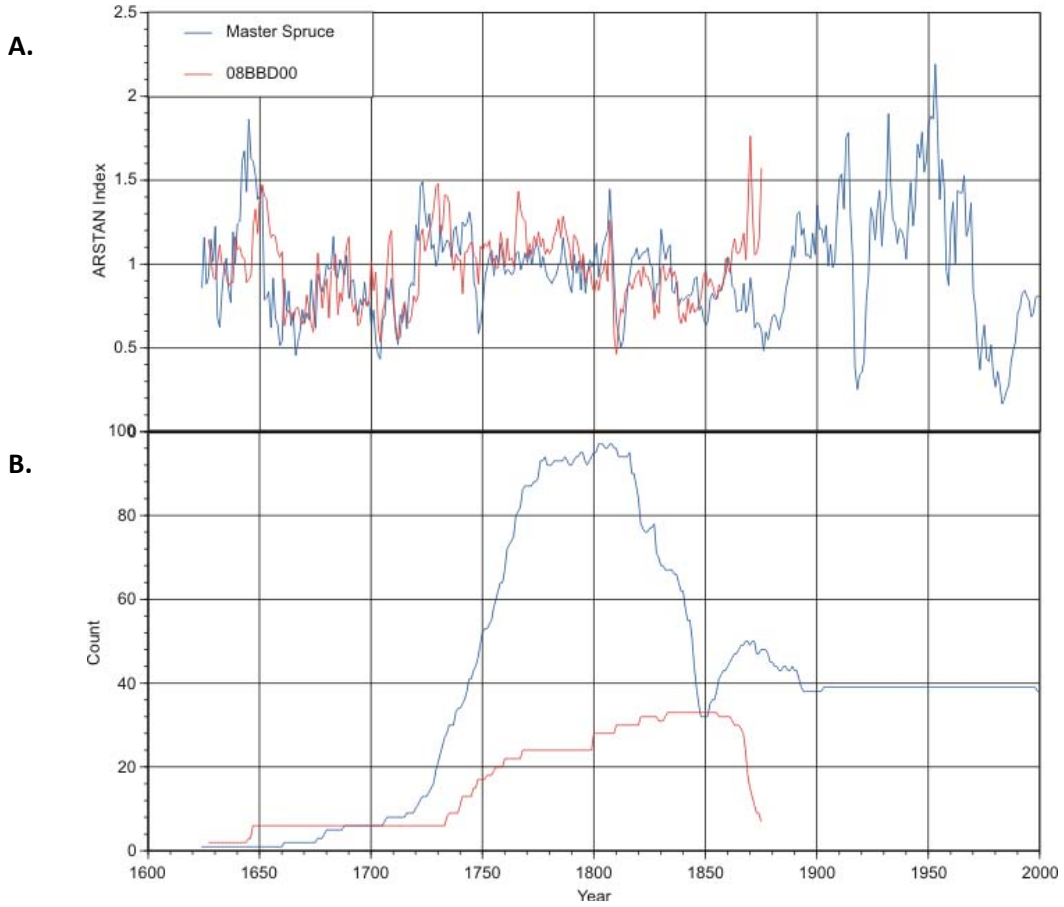

Figure 4A - The standardized master red spruce chronology and the 08BBD000 chronology. 4B - Sample length and depth for both the master and Joggins chronologies.

Conclusions

The Joggins fossil cliffs were mined progressively over time. The pit props that were examined in this investigation are associated with mining activity at the lower and mine shaft sites from 1868/69. The mining activity was also found to occur above these locations on the same coal seam at the upper location 7 years later. Due to the age of the trees in these clusters of pit props, the pit props are therefore associated with British controlled mining activity.

In addition to revealing when mining practices took place at these specific locations of the Joggins cliffs, this study has added to the red spruce master chronology sampling depth, by specifically adding to the number of trees in the 1600s. This addition will help strengthen the master red spruce chronology during the earlier years and will aid in cross-dating older structures in the future.

This was only an exploratory study into the mining activity at the Joggins fossil cliffs. We now know that this type of sampling methodology works well, and that additional sampling will continue to help reveal the timing of mining activities at Joggins at the specific locations across the cliffs. The potential also exists of discovering activities related to the early Acadian workings along the cliffs.

References

Holmes, R.L. (1986a). Users manual for program COFECHA. In *Tree-ring chronologies of western North America: California, eastern Oregon, and northern Great Basin* (eds R.L. Holmes, R.K. Adams & H.C. Fritts), pp. 41-49. Laboratory of Tree-Ring Research, University of Arizona, Tucson.

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