DENDROCHRONOLOGY IN OAXACA, MEXICO: A PRELIMINARY STUDY

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ABSTRACT

Dendrochronological research in the Mexican state of Oaxaca in 1970 proved negative due to complacent ring series. It is suggested that this is caused by a flexible growing season triggered only by the onset of the rains. Pine and fir were sampled from eleven sites. No old age trees were located and crossdating could not be accomplished.

INTRODUCTION

Dendrochronological research was carried out in the Mexican state of Oaxaca during March – June 1970 while the author was engaged in a project of archaeological investigations on the Oaxacan coast. This project was under the direction of Donald L. Brockington, Department of Anthropology, University of North Carolina, and was supported by National Science Foundation grant GS-2866. Although not relating directly to the archaeological work on the coast, the tree-ring investigations were also provided with financial support.

Except for some brief exploratory work done by Schulman in the Valley of Mexico early in the 1940's (Schulman 1944) and a small amount of recent sampling in Chiapas, no serious dendrochronological research has before been attempted in Mesoamerica. In that area Oaxaca stands out as a seemingly ideal location for tree-ring studies. The central valleys of the state are semiarid and enclosed by timbered ranges producing a situation not unlike areas in the North American Southwest where dendrochronology has been most successful.

The pre-Hispanic remains in Oaxaca are abundant and there is also a wealth of early Spanish architecture. These are excellent sources for extending a chronology back into time. The valleys are certainly dry enough to afford the necessary preservation of timbers and wood materials. All that is needed is for archaeologists to begin recognizing and collecting the tree-ring remains from their excavations. The sampling of colonial period buildings would hepefully bridge any gap between a modern and an archaeological chronology. In short, Oaxaca appears on the surface to be one of the best suited areas in southern Mexico for tree-ring research. If tree-ring dating does have a future in Mesoamerica, all logic would seem to demand that it succeed in Oaxaca.

DESCRIPTION

Oaxaca is the next to southernmost state in Mexico (Fig. 1). Except for a narrow coastal strip along the Pacific Ocean and the southern half of the Isthmus of Tehuantepec it lies almost entirely in the highlands. Two main mountain masses are located in the state. The smallest and most northern is the Sierra Madre de Oaxaca or Juarez which lies immediately north of the state capital. This range begins with the peak of Orizaba on the Puebla-Veracruz border and ends at the Isthmus of Tehuantepec. In Oaxaca it attains elevations in excess of 3400 meters. The Sierra Madre del Sur parallels the coast in the southern part of the state and forms a barrier between the coast and central valleys. These highlands have their origin in Jalisco and they too disappear at the Isthmus after rising to over 4000 meters in Oaxaca.

The two mountain chains contain almost all the timbered land in Oaxaca. There are a dozen or more species, and a number of varieties, of pine growing in the state and one, if not two, species of fir (*Abies* sp.). Pines predominate and can be found in virtually every habitat in the mountains and down to 500 meters in places on the coastal slope. The firs are scattered and confined to the most mesic environments of the upper elevations.

In Oaxaca, as in most of Mesoamerica, elevation determines the climate. The rainy season normally begins in May and lasts until October with the greatest amounts falling during the four summer months. Annual precipitation ranges from an average of 400 millimeters in the drier valleys to over 2000 millimeters on the mountaintops. Rather high temperature extremes occur during the dry months of December – April. Night time temperatures

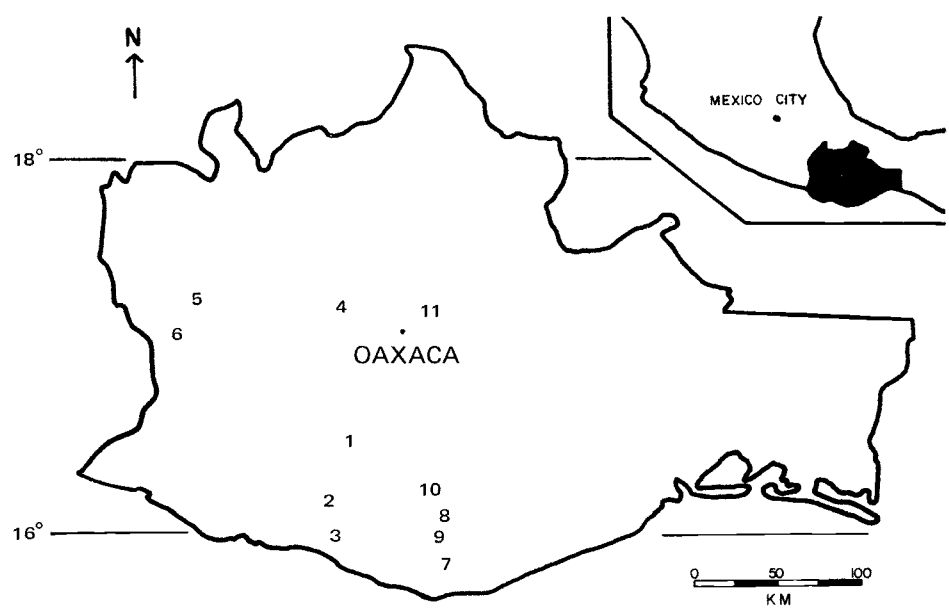

Figure 1. Location of sites sampled.

can drop to near freezing in the central valleys from December or February and well below that mark in the higher mountains. Frosts seldom occur below 1500 meters except in low areas affected by pronounced cold air drainage. Annual maximums are usually recorded in April or early May near the end of the dry season.

Present forest conditions in Oaxaca are nowhere near their natural state – in fact this may have been the case for quite some time. The Mesoamerican practice of clearing land for agricultural fields by cutting down the vegetation and then burning it is widespread in Oaxaca. Untold areas of forest have been altered or destroyed and this is still an ongoing process today. A scarcity of old age trees results and single age stands have been produced where trees have been allowed to grow back. This serves only to compound the problems of the dendrochronologist.

METHODS

As a preliminary study, it was hoped that a modern chronology from living trees could be established for the area. This chronology would then form the basis for any future dendrochronological work in Oaxaca. Chronology building is dependent on some degree of sensitivity in the trees and in the existence of crossdating – at least among trees growing in the same site. These are the minimum requirements for establishing a valid and workable chronology. The author also endeavored to sample and identify a variety of coniferous species from as broad an environmental and distributional range as possible.

The major consideration in choosing which trees to sample was to select those which were the oldest and would thus exhibit the longest annual ring record and those specimens which were growing in sites that would cause them to be extra sensitive to the environmental conditions affecting growth. A tree from such a site should have annual rings of varying thicknesses which when analyzed would reveal a pattern from which a chronology is derived. If the thickness of the rings does not vary significantly from one to another then no chronology is possible – all one can then do is determine the age of the tree.

Trees were sampled from eleven different sites ranging in elevation from 550 meters to 2700 meters. Three species of pine were cored; *Pinus ayacahuite, Pinus rudis,* and *Pinus pseudostrobus.* The few fir that were sampled were all apparently *Abies hickeli* (Martinez 1945).

RESULTS

The results of the study were negative. The longest core obtained using a sixteen-inch Swedish increment borer showed only 165 years and less than one-sixth of the total sample exhibited length in excess of 100 years! All but five of the cores are hopelessly complacent – that is, there is not sufficient variability in the width of the rings to differentiate them on that basis. The five specimens that are workable demonstrate almost no degree of crossdating. Not even satisfactory crossdating was apparent among trees growing in a similar site only a few meters apart.

DISCUSSION

These are the problems that currently stand in the way of fruitful dendrochronological studies. Most serious is the underlying obstacle of complacency. Even if old age trees were located it would be to no avail if they were not sensitive. Why the lack of sensitivity? There are several possible explanations. It can be argued that the sample was too small and that we simply failed to find sensitive sites. Part way through the study, as the absence of sensitivity became known, efforts were concentrated on locating the most sensitive sites. Sometimes trees were cored that had no chance of showing respectable age, all in an effort to obtain some kind of meaningful record. These attempts also failed.

At this point some observations on the precipitation in Oaxaca are useful. Meteorological records are available for fifteen locations in the state. Records for the city of Oaxaca begin sporadically in 1914, those for the remainder of the stations begin in 1961 or 1962. The published data ends at 1967 so except for the Oaxaca station we must be content with only seven years of weather records. Using such short-term information to support broad scale arguments is indeed dangerous but it is essentially all the hard data that is available, unrepresentative as it may be. In any event, only two locations in Oaxaca report precipitation for any of the years 1961 – 1967 to be fifty percent or more below "normal". Moreover, when talking to the natives about the climate one almost never hears of a dry year. It is the wet years that stick in their memory. Any dryness is only remembered as the rains beginning late. This might imply then that there is not any marked variability in the yearly rainfall in Oaxaca. Considering the nature and extent of the evidence this is at best a very tentative proposal. But the indications are unmistakable and if precipitation is the critical factor affecting ring thickness then this would in some respect explain the uniform growth from year to year.

Farther north tree growth is severely limited by temperatures below freezing. In Oaxaca below freezing temporatures are confined to the months of December – February and are of short duration. Whereas in northern Mexico trees grow only during the warm months when temperatures are most favorable to growth, those in Oaxaca are not so confined since temperatures unfavorable to growth are restricted in their occurrence. Oaxacan conifers may be adapted to such an extent that the onset of their growing season is contingent only upon the beginning of the rains – whether in May as expected or later in the summer. The onset of the rains trigger the growing season. If the rains do not start in May, growth is delayed. Without the threat of freezing temperatures in the fall the trees are able to continue growing right on through the rainy season and even into November. In this way, if the precipitation was late in coming, the trees could make up for it by growing later into the year. A uniform ring series would be the result. Our work in 1970 does seem to support one aspect of this suggestion. Of the samples taken before May 8 only one shows new growth for the year. All our samples taken after June 1 exhibit that year's growth. In 1970 the rains began on schedule, in May.

CONCLUSIONS

It should be reiterated that this was only a preliminary investigation. More work is definitely needed. The explanations suggested should be examined critically. Dendrographs could be used to accurately define the growing season in relation to the beginning of the rains. It could then be seen if growth is determined by the timing of the rains or if it occurs during a set period irrespective of the start of the wet season. A thorough search for sensitive trees should also be made. If sensitive specimens could be located then the major difficulty would be overcome. These problems must first be solved before dendroclimatology or tree-ring dating have a chance of succeeding in Oaxaca.

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