THE LETHAL DECLINE OF MESQUITE ON THE CASA GRANDE NATIONAL MONUMENT

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A visitor's first impression of the Casa Grande National Monument is one of taking a trip back through time to the late 14th century when the Great House was occupied by hardy Pueblo people. From a 20th-century viewpoint, a visitor can identify with the hardships endured by these farming people in this harsh environment.[2]

As one begins to view this environment he sees a typical desert area encircled by irrigated agricultural land. Yet, something is strikingly different. The area is littered with large deformed stumps of dead mesquite trees (*Prosopis velutina* Woot.). It is commonly asserted that these trees died in the early 1940s because the water table dropped due to increased irrigational demands. But no one truly knows just what caused the death of these trees.

This study is an attempt to determine what factor or factors may have been responsible for the massive lethal decline of the mesquite trees.

Casa Grande National Monument is situated 1.5 miles south of the Gila River and approximately 50 miles west of its junction with the Salt River. Located on an old floodplain, the monument comprises 480 acres of land 2 miles north of Coolidge, Pinal County, Arizona.

The area became a national monument in 1918. It was fenced on the north and east in 1931 and along the south and west boundaries in 1934. This restricted the trespass of people, livestock, and wildlife. To this day, the monument remains completely fenced and protected against all unauthorized trespass.

Dead mesquite trees are the rule throughout the area, with the exception of a few live ones in depressed locations.

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Methods

In an endeavor to determine the age and year of death, 10 cross-sectional specimens were cut from various mesquite trees on the monument. These specimens were then sanded and polished to a high sheen and viewed under a variable 7-75 power stereoscopic

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[2]For a complete history of the Casa Grande Ruins and National Monument see Kiva, February 1962, Vol. 27, No. 3.

microscope. An attempt was made to count and measure the annual radial growth rings along a radius of each specimen.

Of the ten specimens cut, three proved to be satisfactory dendrochronological material. The data obtained from these specimens were plotted as a line graph, using years and width of annual rings as axes (Fig. 1).

The data obtained from the dendrochronological specimens indicate the age of these trees to be 137, 110, and 111 years respectively. All three specimens exhibited series of alternate good and bad growth years. However, attempts to correlate these with precipitation data or to crossdate between specimens proved ineffective. This may have been due to the accidental inclusion of false growth rings with the valid annual rings. Mesquite tree sections are extremely difficult to work with because of the diffuse porous nature of the wood and the faint lines of compressed terminal tissue found at the end of each growing season (Ferguson and Wright, 1962).

In a personal interview with Dr. C. W. Ferguson of the Tree Ring Laboratory, Tucson, Arizona, the dendrochronological methods used in this study were validated. Dr. Ferguson observed the specimens involved and found the age determination of the trees valid within reasonable accuracy.

Climate

U.S. Weather Bureau summaries and monument reports were surveyed for data involving precipitation and temperature. Heaviest

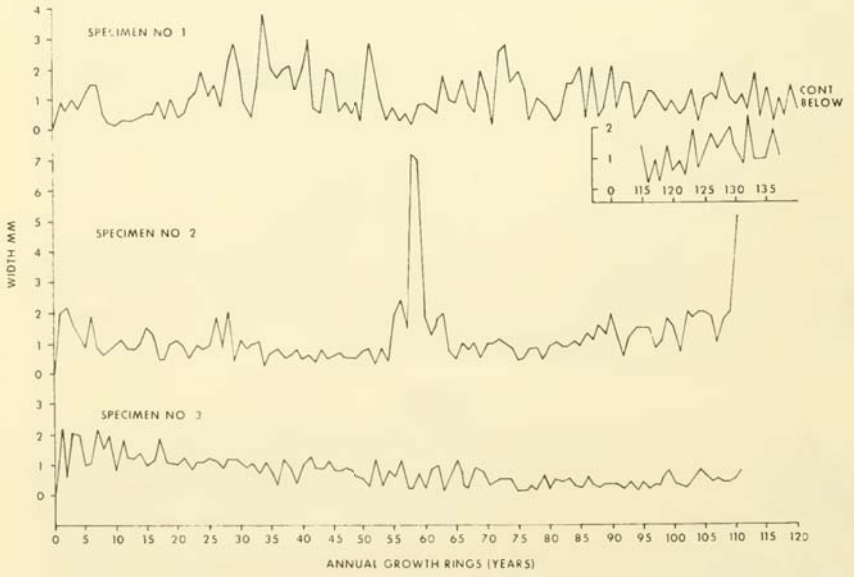

Fig. 1. Width (in mm) of annual growth rings by years for the three specimens studied.

precipitation usually falls during July and August when moist tropical air from the Gulf of Mexico covers the state. Thunderstorms are common in evenings at the monument during these months. The monument also receives some precipitation during the winter when middle latitude storms move far enough south to affect central Arizona. Annual precipitation totals ranged from a high of 19.22 inches in 1941 to a low of 3.56 inches in 1956. Other high precipitation years include 16.08 inches in 1914, 13.17 inches in 1912, 12.11 inches in 1915, 10.29 inches in 1936, and 10.01 inches in 1932. Low precipitation years include 4.63 inches in 1939, 5.84 inches in 1943, 6.14 inches in 1935, and 6.95 inches in 1938 (Fig. 2). The station at the monument was closed from August 1916 to August 1931, and no data are available for those years (Institute of Atmospheric Physics, University of Arizona, 1960).

Average yearly temperatures at the monument varied from 66.8 F to 71.6 F during the period from 1909 through 1959 except for the years 1916 to 1930, when the station was closed (Institute of Atmospheric Physics, University of Arizona, 1960).

Infestations

Possible natural enemies of mesquite were researched along with monument records and photographs. These included insects, parasites, and diseases common to mesquite in central and southern Arizona.

No evidence of infestation by insects or disease prior to the death of the trees was found. The only diseases reported to occur in mesquite in Arizona are leaf rust (*Revenelia arizonica* Ell. and Ev.) and leaf blight (*Sclerophysnium aureum* Heald and Lewis).

The mistletoe infestation was first officially noted in 1936, but the photographs of 1878 and 1930 (Fig. 3 and 4) show heavy infestation. Mistletoe is parasitic, sapping nutrients and valuable water from the host. This parasitism may have severely weakened the mesquite trees, prohibiting their adaptation to a changing environment.

The following excerpts taken from the Southwestern Monuments Monthly Reports, referring to a mistletoe infestation of the mesquite trees on the monument, indicate the awareness of the parasite:

> An infestation has been noticed on some of our mesquite trees. The Naturalist Division informs me that it is not unusual and should be investigated by a forester. Is such an expert available? (SWM, January 1936)
>
> Mr. Yeager inspected the mesquite infestation and told us that it needed considerable attention. It will need additional funds to cope with the situation, the urgency of which I cannot overemphasize. The infestation is spreading rapidly and will result in the loss of all of our mesquite trees if remedial measures are not taken very soon. Mr. Yeager will return with another expert on the 29th and we can then determine just how much money will be needed. I hope that you can make the Great White Father see the necessity for immediate action. (SWM, September 1936)

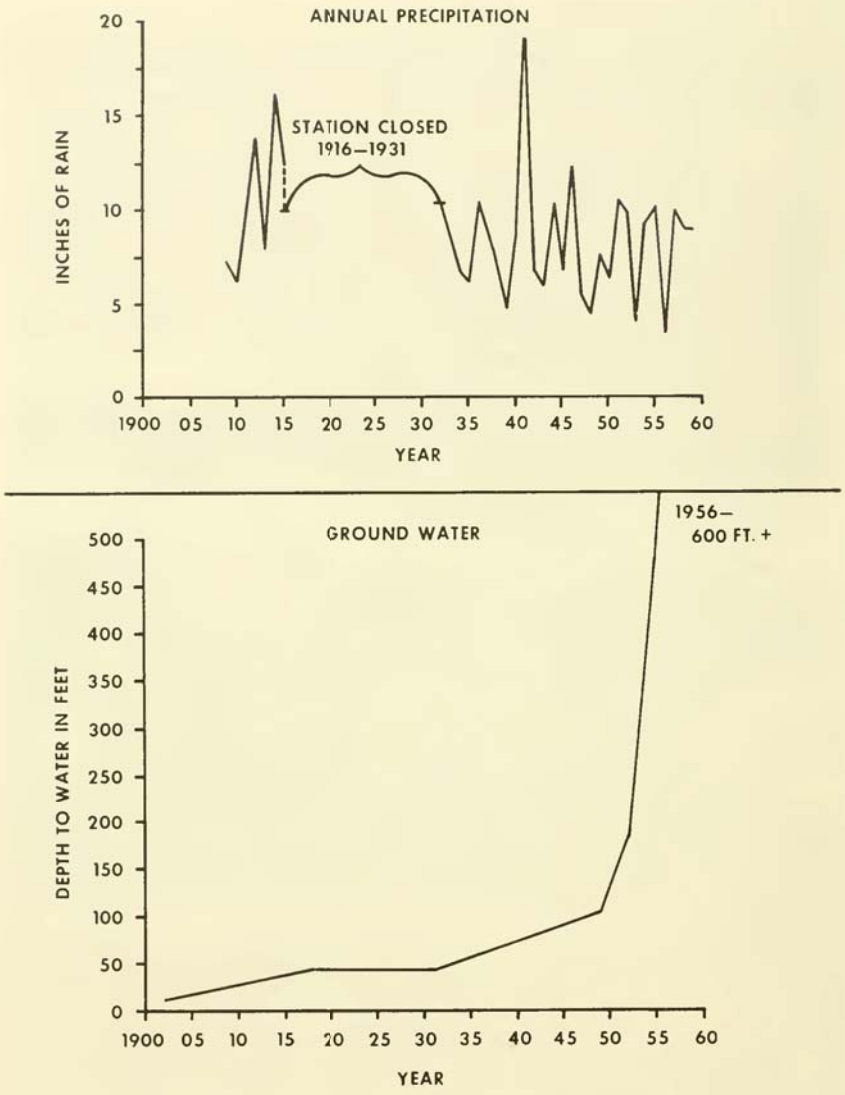

FIG. 2. Annual precipitation and depth of groundwater by years at Casa Grande National Monument.

Naturalist Natt Dodge notes:

When I came to Casa Grande National Monument in the fall of 1937, Monument personnel told visitors who asked that the mesquites were dying because of a lowering of the underground water table. This was borne out of the Monument water well going dry and having to be

FIG. 3. Appearance of Casa Grande Ruins in 1878. (Dark growth on trees is mistletoe.) (Courtesy National Park Service.)

deepened. However, an infestation of mistletoe was believed to be partially responsible.

GROUNDWATER

Available recorded water table data of the Arizona State Land Department, U.S. Geological Survey, and Casa Grande National Monument were researched and compared. In addition, a local well driller was interviewed about current conditions and substrate material.

The groundwater table adjacent to the Casa Grande National Monument declined from a depth of 44 ft in 1923 to approximately 100 ft in 1952 and approximately 150 ft by 1960 (U.S. Geological Survey data, Fig. 2). The monument is located in sections 9 and 16 of township 5 south, range 8 east, and the well site mentioned above is on section 17 of township 5 south, range 8 east, of the Gila and Salt River Meridian.

According to monument well records, the water table data are as follows:

1902 - First well dug on area; water standing at 10-16 ft (Monthly Report, September 1918).

1918 - New well dug; water level reached at 42′6″ (Monthly Report, October 1918).

1931 - Well drilled on area; water level 42′6″ from surface, 186′5″ pipe in hole (Log of well, old file no. 660-05.8).

FIG. 4. Aerial photograph, 1930, showing Casa Grande in relation to adjacent prehistoric ruins. (Courtesy National Park Service.)

1949 - Depth to water in monument well, 102′ (Letter to Hayden from director, 16 February 1956).

1952 - Water in well at depth of 180′ yielding 14 gallons per minute. Reservoir insufficient to supply needs of monument. Water piped to area from town of Coolidge (Letter of Hayden from director, 16 February 1956).

Mr. Dale Blakeman, a local well driller in Coolidge, Arizona, drilled a new well adjacent to the monument (1969). He reported that as he drilled, he passed through 30 ft of alluvial fill followed by 100 ft of large, rounded river boulders and a clay shale composite thereafter. He found no water at 130 ft plus.

Water table data tend to support the theory that it was a factor leading to the death of the mesquite trees. Root system development of mesquite trees varies. On deep soils with adequate moisture, a strong tap root tends to develop. But, on upland slopes where soils are more shallow and moisture seldom penetrates deeply, the tap root is small and lateral roots may reach out in all directions for 50 ft or more just beneath the surface (Parker and Martin, 1952). Phillips (1963) reports finding mesquite roots growing 175 ft below the ground surface.

The ability of mesquite to modify its root system is unknown. However, when the water table on the monument dropped 34 ft from 1902 to 1923, the mesquites were able to survive. It is possible that the maximum limits of extension or modification of the root system had been reached. Between 1931 and 1949 the water table

declined another 60 ft and the trees died. Possibly, the roots could not penetrate the extremely thick layer of boulders that Mr. Blakeman referred to; or it may be that the boulders could not retain enough moisture to support the advancing roots.

Discussion

Incomplete data and records were a constant source of problems during this study. It appeared as though persons recording data or observations took much for granted.

With the severe climate at the monument, all environmental factors become more critical. A few dry years could add considerable stress to a weakened tree. Insects, usually taking advantage of disadvantaged individuals, could find the mesquite trees ideal forage material, further compounding the problem. In addition, opportunistic leaf and root diseases could take advantage.

The cause of the lethal decline of mesquite trees on the monument appears to involve a number of factors, each contributing to the end result. Decline of the water table and mistletoe infestation may be the major contributors with age of trees, insect infestation, and natural successional process as secondary factors.

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