

Mesquite: A Multi-Purpose Species in Two Locations of San Luis Potosi, Mexico

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Abstract.—The mesquite woodland distributed in approximately 200,000 ha in Llanos de Angostura, and Pozo del Carmen, San Luis Potosi, represents a main source of firewood, construction material, honey, and forage for the rural people that inhabit part of the lowlands of the hydrological region RH26 and RH37. Firewood collection in this region averages 142 m³/week. Most of this wood is used by brick makers to fuel the kilns, and for domestic purposes (i.e., cooking and heating). Mesquite pod yields fluctuate by year. A three-year study, sampling pod production in two native stands located in Llanos de Angostura having 75 trees ha⁻¹ (29 trees less than 15 cm and 46 trees greater than 15 cm in basal diameter) and Pozos del Carmen, with 450 trees ha⁻¹ greater than 15 cm in basal diameter, indicated an annual pod yield of 500 to 900 kg ha⁻¹. Livestock industry is the major consumer of mesquite pods as forage and occasionally local people consume it boiled or grilled as candies. The mesquite gum as a substitute of the Arabic gum represents a potential economical income for the rural people of this region. Even though mesquite gum is generally produced under abnormal conditions (i.e., very dry episodes) the region has the potential to produce at least 10 metric tons of gum per year. A long-term management strategy of the mesquite woodlands in San Luis Potosi is necessary to establish silvicultural management techniques based on structure of the vegetation, pod production, and rates of growth. Currently, a project is being carried out to develop techniques for reforestation of mesquite in semiarid areas, and carry out thinnings of suppressed trees, and branch pruning on native young stands to evaluate its behavior in growth. Mesquite woodlands in San Luis Potosi continue to be destroyed and more careful management needs to be done to ensure future production and watershed protection of this resource.

Introduction

The management of watershed resources to produce more than one product or amenity is a common practice in many of the Mexican basins. The state of San Luis Potosi, located in central Mexico is bisected by two large hydrological regions RH37 (35 167 km²) and RH26 (27 140 km²), each one encompassed by several watersheds embedded in dominant semi-arid to semi-humid conditions.

Rural populations living in some of the watersheds depend upon a variety of resources that are produced in upland and lowland areas. However, intensive livestock

grazing, changes in land use, wood harvesting, and over-exploitation of underground water for irrigation purposes are leading to their degradation.

The mesquite woodland is one of the dominant vegetation types in these watersheds and has been intensively used during the last hundred years (Rzedowski 1966). Changes in land use have traditionally impacted native mesquite woodland stands mainly through the complete removal of vegetation for rain-fed and irrigated agricultural lands. Some mesquite woodland relicts currently covering an area of 50,000 ha in the region are highly disturbed, and they are intensively used by rural people as a source of firewood, furniture wood, timber, forage, and nectar for honey bees.

The integration of watershed management with multiple use of mesquite woodlands in San Luis Potosi demands a careful evaluation of the capability of mesquite trees to provide the amenities at the rate currently demanded by local people

Methodology

The study area is located in the watershed "Rio Verde 26CH" (21° 25'-22° 42'N; 99° 15'-100° 46'W) covering a total area of 9189 km² (figure 1). Northern, eastern, and western sections of this watershed are bordered by watersheds belonging to hydrological region RH37. Environmental conditions of this watershed are highly variable. The upper section of the watershed is characterized by semiarid conditions, vegetation is dominated by desert shrublands, grasslands, and mesquite woodlands; total annual precipitation ranges between 300 to 400 mm and precipitation increases to 500 mm at the northern and central portion of the watershed where mesquite density increases.

Two sites located in watershed 26CH were selected for this study, "Llanos de Angostura", Rioverde (22° 03' 53" N, 100° 01' 19" W, 1051 m elevation), and "Pozo del Carmen", Armadillo de los Infante (22° 19' 30"N, 100, 36' 18"W, 1590 m elevation). Structure of vegetation and gum production were obtained using plots of 4 x 30 m laid along a line transect and a point-centered quarter method. Each single mesquite tree was measured to get diameter at

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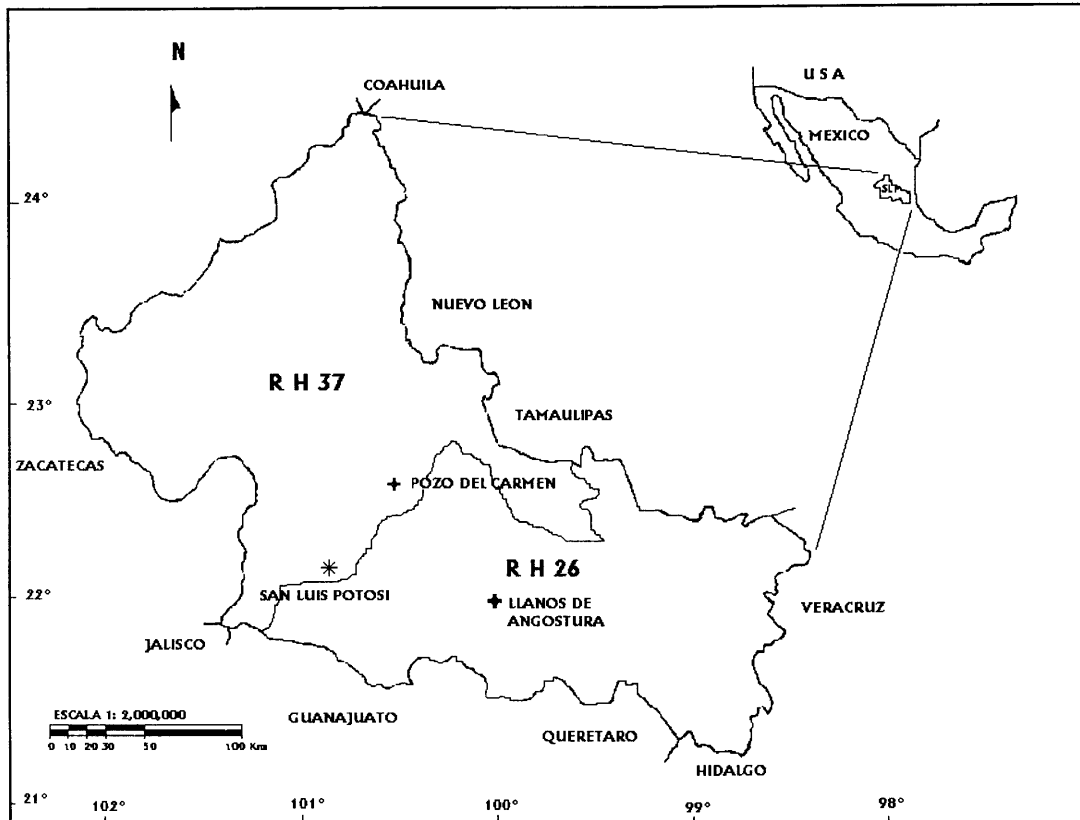


Figure 1. Location of studied mesquite woodland stands in San Luis Potosi, Mexico.

root collar, number of stems and main branches, height, canopy cover, mean distance between trees, and firewood volume.

Density, canopy cover, relative frequency, and average distance between trees were obtained according to Muller-Dombois and Ellenberg (1974).

A permanent plot of 162 m x 492 m (7.97 ha) with dominant mesquite woodland vegetation was established. Twenty-six trees of different size were randomly selected in the plot in order to determine gum and pod yield from a stand base.

Exuding gum was removed from existing wounds on the tree using a sharp knife and then cleaned and weighted with an electronic scale. Similarly, fallen dry pods were collected on the ground and evaluated for each of the selected trees.

Gum and pod yield were statistically described (i.e., mean, standard deviation, confidence intervals). Single regression analyses were carried out for both gum and pod production, and other tree variables (i.e., total height, canopy cover, size diameter).

Associations of gum collectors, honey bee producers, brick makers, firewood cutters, and woodworkers were interviewed in the region to determine the amount of resources that were required to fulfill each need.

Results

Structure of Vegetation

The structural analysis indicated that the mesquite stands in Llanos de Angostura have an average density of 248 trees ha⁻¹, arranged in a prominent contagious distribution. In this locality, 11 size classes were identified, but dominant size-class diameters were 0–4.9 and 5.0–9.9 cm with frequencies of 43% and 27%, respectively (figure 2). On average, the mesquite canopy covers 48% of the sampled area, tree height ranged between 3 to 7 m, and

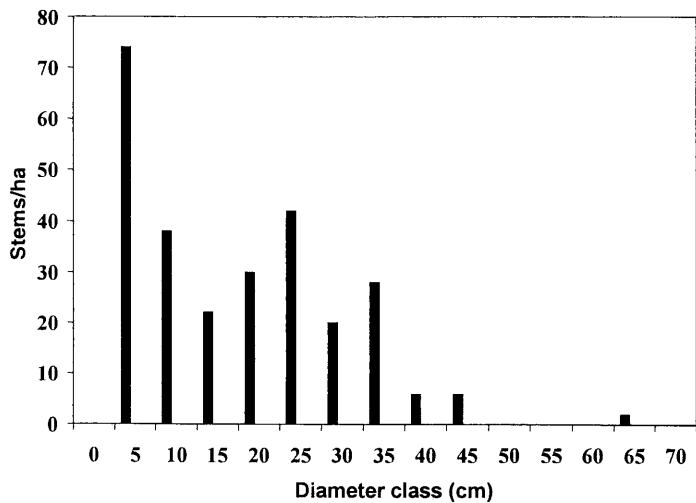


Figure 2. Diameter-size distribution of a mesquite woodland stand in "Llanos de Angostura", Rioverde, San Luis Potosi, Mexico.

mean distance between trees was 11.6 m. Tree density (610 trees ha⁻¹) was comparatively higher in the Pozo del Carmen stand, and tree height fluctuated between 5 to 8 m with a basal diameter of 30.5 to 140 cm.

Size-class diameter distribution, apparently was influenced by the capability of mesquite trees to coppice, as evidenced by the dominance of young trees mostly from resprouts.

Gum Production

Gum production per tree has been monitored for three consecutive years (1997, 1998, and 1999). In 1997, gum production was greater in August and lowest or none in November. No significant gum production was measured in 1998 at the study site, and it has been relatively low during the present year (January-April of 1999) (table 1).

Gum production does not occur simultaneously on all trees. Some trees may start exuding early during the drought season, some during the late drought season and some never produce. Only, about 50% of the sampled trees could be classified as gum producers.

Regression analyses did not show any significant relation ($p \geq 0.05$) between gum production per tree (dependent variable) and height, canopy cover, or basal diameter (independent variables). Gum production may be less in large vigorous trees as compared to smaller size weaker trees. Likewise, gum production is higher at sites with shallow soils having gypsic or petrocalcic diagnostic horizons, usually showing low water holding capacity as compared to deeper soils. Natural wounds due to insects or other biotic or abiotic factors enhanced by dry weather conditions, stresses the tree, which favors gum secretion. Once gum has been removed by natural or artificial means, gum secretion continues appearing through the dry period.

In the same region, gum production may change significantly from one place to another. In 1998, it was not detected a measurable amount of gum in the study site, however, in other places of the same region a total amount of 1.0 metric ton of gum was reported. Previous reports

Table 1. Gum production for the years 1997, 1998, and 1999 from selected trees of "Llanos de Angostura, Rioverde, S.L.P. Mex.

Basal Diameter Class (cm)	Frequency (Trees ha ⁻¹)	1977			1999	
		February Gum Yield (g ha ⁻¹)	August Gum Yield (g ha ⁻¹)	^a November Gum Yield (g ha ⁻¹)	January Gum Yield (g ha ⁻¹)	April Gum Yield (g ha ⁻¹)
10.1-15	22	0.0	57.2	NC	29.7	0.0
15.1-20	30	54.2	0.0	NC	4.4	0.0
20.1-25	22	214.7	182.0	NC	91.3	20.5
25.1-30	20	22.74	169.0	NC	37.0	78.0
30.1-35	20	8.18	280.0	NC	14.5	4.82
35.1-40	8	22.4	10.8	NC	9.22	0.0
40.1-45	6	0.0	0.0	NC	9.0	0.0
45.1-50	0	0.0	0.0	NC	0.0	0.0
50.1-55	2	4.16	6.40	NC	0.0	0.0
Total	126	326.4	705.4	NC	195.1	103.3

^a NC: Non-Commercial, gum was present but in amounts too low to be quantified.

indicate a production from 3.0 to over 10 metric tons of gum for the region collected in a four-month period. Given the density of mesquite trees and gum production per tree, the study region has the potential to produce at least 60 metric tons per year.

Gum collectors in this region are able to gather from 5 to 7 kg per day of gum in a 10-hour period. The price of gum fluctuates from \$ 1.0 to 1.2 U.S per kg. The income earned from this activity represents more than a minimum local wage salary for a person.

Pod Yield

Mesquite pod yields vary considerable by year, species, site, and even among trees of the same species in a given site (Silbert 1988). Pod production has fluctuated in the study area from 10 to 22 kg per tree (Villanueva, 1985). Two years of observations (1997, 1998) have indicated pod yields from 560 to 902 kg ha⁻¹ yr⁻¹ (table 2). Pod production is mainly used to manufacture concentrated livestock feedstuff, and the remaining is used for other purposes (Galindo and Moya 1986, Silbert 1988).

Table 2. Dry pod yields in 1997 and 1998 in a selected mesquite woodland stand located in Llanos de Angostura, Rioverde, S.L.P., Mexico.

Basal diameter class (cm)	Trees ha ⁻¹	Sampled trees per class	Pod yield (kg ha ⁻¹) 1997	Pod yield (kg ha ⁻¹) 1998
10.1 – 15.0	22	1	27.5	111.0
15.1 – 20.0	30	3	270.0	158.0
20.1 – 25.0	22	7	132.0	102.0
25.1 – 30.0	20	5	115.0	119.0
30.1 – 35.0	20	4	235.0	54.0
35.1 – 40.0	8	4	88.4	11.0
40.1 – 45.0	2	1	14.4	4.2
45.1 – 50.0	-	-	-	-
50.1 – 55.0	2	1	19.2	-
Total	126	26	901.5	559.0

Honey Bee Production

The flowering of mesquite in springtime represents an appreciable source of nectar for honey bees. To take advantage of this resource, rural people install beehives in mesquite woodlands to produce honey bee. Average honey bee production during the flowering period is 20 to 24 kg per beehive. However, the nectar of associated vegetation contributes with 10 additional kilograms after the rainy

season. Total production per beehive reaches 30 to 34 kg per year. Based on these values, the region has the potential to produce 945 metric tons of honey annually.

Firewood

The exploitation of mesquite woodlands for firewood purposes is one of the main uses provided to this vegetation type. Brick makers with a volume of 4,800 m³ per year and wood-only households with 2,000 m³ per year, are the greatest exploiters of mesquite firewood in the region. Mesquite wood represents an inexpensive source of energy for most of the rural people in the region. In other parts of the country, annual firewood demand averages 800 kg per capita (Evans 1984), being over 1.0 metric ton per capita on the region. Firewood collectors supply most of the firewood regional demand. However, due to firewood shortage, currently people are cutting not only dry wood but also green wood. This situation is generating a great negative impact on the preservation of mesquite woodlands in the region, currently being traduced in lower biomass production, poor tree conformation due to resprouting, and the presence of pests and diseases that affect mesquite tree growth.

Furniture

Mesquite wood is highly appreciated in the local furniture industry due to its beauty and durability. In colonial times, this activity was widely dispersed in central Mexico (Galindo and Moya 1986). However, encroachment of mesquite woodland populations due to deforestation for agricultural purposes and other land uses, is making more difficult to find suitable mesquite trees to carry this activity.

In the region, exists a woodworker association integrated by 100 members; 25% of them use mesquite wood for furniture. On average, 300 mesquite trees are cut annually in the region. Selected trees are the biggest ones, having good conformation and apparently sound wood. Considering an average timber volume of 2.0 m³ per tree, only 30% of that wood will be classified as suitable for furniture purposes, the rest (70%) is considered waste and is used as firewood. Carpenters exploit 600 m³ of wood per year in the whole area.

Watershed Management Implications

The mesquite woodland in San Luis Potosi, as part of the watershed, represents an important resource from an economical and ecological perspective. Intensive use of

this vegetation type, however, is leading to an accelerated degradation of this woodland ecosystem, as evidenced by reduced tree growth, soil loss, and the disappearance of fodder species.

Evaluations of annual pod yield, gum, honey bee, firewood, and wood production in native stands indicates that the mesquite woodland based on a sound management strategy represents a sustainable productive system for the region. Regulatory forest laws, however, based on both short- and long-term biomass production of these woodlands, should be enforced by SEMARNAP (Secretary of Environment, Natural Resources, and Fisheries) and implemented by the "ejidos" (communal lands owned and governed by the village residents) that are the owners and main users of the resource.

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