Woody Phreatophyte Infestation of the Middle Brazos River Flood Plain[1]

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Highlight

Sixty-four percent of the Brazos River flood plain upstream from Possum Kingdom Lake to the confluence of its Salt and Double Mountain forks is occupied by woody phreatophytes. Saltcedar dominated communities are found on 36% and mesquite on 17%. Saltcedar acreage increased significantly from 1940 to 1969, but mesquite did not. At 1969 densities, these two species used approximately 51,000 acre feet of water annually along this expanse of the river.

Robinson (1958) considered the largest source of reclaimable water in the southwestern United States to be the moisture used by phreatophytes. Phreatophyte vegetation has the ability to remove water from the water table or capillary fringe overlying it (Meinzer, 1923). Plants with this ability consume large quantities of water, often without producing usable products.

The purpose of this study was to inventory the phreatophyte vegetation occurring on the Brazos River flood plain. Specific objectives were to determine the distribution, history of spread, and foliage density of saltcedar (*Tamarix gallica* L.) and mesquite (*Prosopis glandulosa* var. *glandulosa* Torr.) and associated species.

Study Area and Methods

The study area includes all of the Brazos River flood plain between the confluence of the Salt and Double Mountain Forks and Possum Kingdom Lake (324 river miles) in Texas. The river cuts a wide, meandering path in all but the extreme eastern portion of the area. A narrow flood plain bordered by steep cliffs occurs in the eastern portion. Alluvial soils near the channel are frequently flooded, while soils on the outer flood plain are rarely flooded. It is typical of many rivers originating in the semiarid southwest.

The climate is characterized by wide variations in temperatures, low precipitation, and high evaporation. Conditions during the growing season are optimum for high evapotranspiration.

Aerial photographs were used to determine the areas and amounts of saltcedar and mesquite occurrence in 1940, 1950, and 1969, using interpretation techniques of Spurr (1948). The accuracy of photograph interpretation was checked by using aerial reconnaissance flights to check interpretations on 1969 photographs.

Flood plain locations of saltcedar and mesquite stands were determined on the 1940, 1950, and 1969 photograph sets. The relative stability of the communities was determined by measuring the distances from a point in the river channel (located on all corresponding photographs) to the first occurrence of light and dense saltcedar and mesquite in the flood plain.

If analysis of variance indicated that significant differences existed between acreages or locations, Duncan's multiple range tests (Duncan, 1955) were used to compare acreage increases and flood plain locations. All tests for significance were made at the .05 level.

The composition and volume density of the woody plant communities were determined by line intercepts through the woody vegetation on both sides of the channel. The amount of vegetation available for transpiration was computed as volume density, using the percent crown cover, maximum plant height, and optimum foliage depth determined by the community samples. Volume density times the acreage infested by a species equals the acreage infested at 100% volume density. This equivalent acreage is assumed to use water at a rate equal to the potential of the species (Gatewood et al., 1950).

Results and Discussion

Sixty-four percent of the river flood plain was occupied by one or more woody phreatophytes (Table 1). Saltcedar, mesquite, cottonwood

Table 1. Acreage and relative amounts of phreatophyte communities on the Brazos River flood plain upstream from Possum Kingdom Lake to the confluence of the Salt and Double Mountain Forks, 1969.

Communities and mixtures	Acreage	Percent of area infested
Saltcedar	13,216	28
Saltcedar-baccharis	2,527	5
Saltcedar-mesquite	1,456	3
Mesquite	8,079	17
Cottonwood	588	1
Cottonwood-saltcedar	411	1
Cottonwood-mesquite	982	2
Mixed	3,230	7
Total	30,489	64

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FIG. 1. Saltcedar forms dense stands adjacent to the river channel throughout the study area.

(*Populus* sp.) and a mixture of riparian species such as willow (*Salix* sp.), and hackberry (*Celtis* sp.) were the most common species. Saltcedar and mesquite communities occurred primarily as pure stands with occasional inclusions of the other species. Baccharis (*Baccharis* sp.), pecan (*Carya* sp.), and elm (*Ulmus* sp.) occurred infrequently as isolated stands or in mesquite or saltcedar communities.

Saltcedar was the most widespread and extensive community covering 28% of the flood plain. It dominated the flood plain adjacent to the river channel in all portions of the study area (Fig. 1). Along narrow areas of the flood plain, it was restricted to an area directly adjacent to the channel. Where the flood plain is wide, saltcedar grows on the outer flood plain also.

Mesquite, which is less flood tolerant than saltcedar (Bogusch, 1951), dominates the outer flood plain in all but the eastern portion of the study area (Fig. 2). In this area near Possum Kingdom Lake, the mesquite community has been replaced by a mixed riparian community due to frequent flooding and high water table maintained by backup water from the lake. Throughout the remainder of the study area, extensive mesquite stands occur on the wide portions of the flood plain. Along narrow portions, scattered mesquite are found between saltcedar stands and the flood plain boundaries. Little doubt exists that the mesquite growing on the flood plain act as phreatophytes.

Changes in Area Occupied by Mesquite and Saltcedar

The area occupied by mesquite did not change significantly from 1940 to 1969. The areas occupied by saltcedar increased, however. The only saltcedar discernable on the 1940 photographs occurred adjacent to mesquite communities on the outer flood plain. Saltcedar covered 18% of the flood plain in 1940, 28% by 1950, and 30% in 1969. Mesquite acreage increased only 1% during this period.

Measurement of the location of light saltcedar, dense saltcedar, and mesquite revealed that saltcedar has spread toward the river channel since 1940. Light stands of saltcedar found adjacent to the channel in 1969 averaged 308 ft distance from the channel on 1940 photographs. Dense stands of saltcedar were found an average of 44 ft from the channel in 1969 while they averaged 361 ft from the river channel on the 1940 photographs. Mesquite, on the other hand, did not change its relative location on the river plain.

Potential Water Use

The 13,216 acres of saltcedar in the study area was equivalent to 6,079 acres at 100% volume density. The mesquite in the river bottom was equal to 2,181 acres at 100% volume density. Actual water use rates of phreatophytes have not been determined in Texas but using

FIG. 2. Mesquite occurs in dense stands on the outer flood plain where flooding is infrequent.

the 7.2 and 3.3 acre-feet per year measured in Arizona (Gatewood et al., 1950) for saltcedar and mesquite growing at 100% volume density, we calculate an annual use of approximately 43,770 and 7,200 acre-feet of water by these two species on this expanse of the Brazos.

Saltcedar and mesquite use much valuable water and the area occupied by these plants produce little valuable forage. An increase in water yield downstream could be expected from a well planned reclamation program. Replacement of saltcedar and mesquite with valuable forage or browse species would increase the value of the flood plain resource.

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