Influence of Secondary Succession on Honey Mesquite Invasion in North Texas[1]

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Highlight

Quantitative vegetational relationships are reported for an exclosure protected from domestic livestock since 1941. Only 14 percent of the honey mesquite (*Prosopis glandulosa* Torr. var. *glandulosa*) stand recorded in 1941 remained in 1968. Age estimation indicated that no honey mesquite plants established after 1959. Average height of surviving honey mesquite plants was 0.5 m. Herbaceous vegetation within the exclosure is presently dominated by tobosa (*Hilaria mutica* (Buckl.) Benth.), buffalograss (*Buchloe dactyloides* (Nutt.) Englem.) and vine-mesquite (*Panicum obtusum* H.B.K.). An adjacent, grazed area where the honey mesquite has been removed by hand periodically during the last 27 years is dominated by annual herbs and tobosa.

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La Influencia de Sucesion Secundaria Sobre la Invasion de Mezquite en Texas Norte

Resumen

El estudio se llevó a cabo en la estación experimental de la Universidad de Texas A & M cerca de Spur, Texas, E.U.A. Se encontró que el número de plantas de mezquite (*Prosopis glandulosa* Torr. var. *glandulosa*), dentro de una exclusión protegida de pastoreo desde el año 1941, fué solo 14% del número original. Conforme los análisis de edad de los árboles de mezquite, no hubo plantas nuevas desde el año de 1959. Los zacates buenos aumentaron en abundancia y es posible que su competencia impidiera el establecimiento de plantas nuevas de mezquite.

Honey mesquite (*Prosopis glandulosa* Torr. var. *glandulosa*) is estimated to infest more than 56 million acres of natural grasslands in Texas. It rapidly invades overgrazed rangelands due to wide dispersal of seeds by lagomorphs, rodents, wind, water, and especially by domestic livestock (Fisher, 1950).

Man and his grazing animals must be integrated into the aggregate of forces acting upon a range ecosystem (Dyksterhuis, 1958). After removal of grazing by domestic livestock from a range ecosystem, secondary succession normally becomes operative. Existing vegetation, soil, and climatic variables influence the rate of vegetation change. Prevalence of woody plants in the disclimax community can hinder return of herbaceous dominants.

Data present in this paper were taken from a study initiated on the Texas A&M University Agricultural Research Station at Spur, Texas in 1941. Data taken since the establishment of the study has been reported periodically since 1941 (Fisher, 1950; Fisher et al., 1946; Robison et al., 1968). The research area is located on the west edge of the Rolling Plains physiographic province about 50 miles from the abrupt rise to the High Plains of Texas. The Rolling Plains occupies about 24 million acres of northcentral Texas (Gould, 1969). Seasonal precipitation is variable with an annual average of 22 inches in this western portion. Honey mesquite is an invader in this region when natural vegetation is altered by overgrazing.

Heavy rainfall, well distributed throughout the growing season following two years of below normal rainfall and good seed crops in 1939 coupled with a sparse cover of perennial native grasses apparently favored germination and establishment of a high mesquite seedling population near Spur, Texas in 1941 (Fisher, 1950). Previous reports either stressed the ability of honey mesquite to invade rangelands or control of the species. The present objective was to study the mesquite population and compare secondary succession in the exclosure, after protection from grazing by domestic livestock for 27 years, with the vegetation of an adjacent, grazed area.

Materials and Methods

The study area is a gently undulating upland site. The soil is Abilene clay loam having pH 8 and 2.9 percent organic matter. Tobosa (*Hilaria mutica* (Buckl.) Benth.) and buffalograss (*Buchloe dactyloides* (Nutt.) Englem.) are the dominant perennial grasses. In April 1941 all honey mesquite plants, except seedlings, that emerged in 1941 were removed from a 160 acre pasture. A fence was constructed around approximately 1.2 acres to exclude all domestic livestock. However, no effort was made to control the movement of rodents and lagomorphs from adjacent honey mesquite infested grasslands.

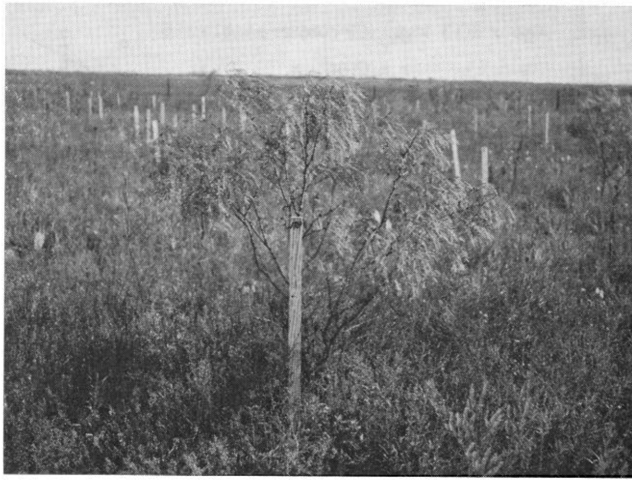

Fig. 1. Honey mesquite plant in exclosure established in 1941 in North Texas. Photographed May 15, 1969.

In the summer of 1968, study areas were re-established and each honey mesquite tree labeled. The number of plants, basal stems per plant and plants with new sprouts were recorded in July 1968. At the same time, 40 honey mesquite plants near the perimeter of the plots in the exclosure were excavated to six inches below the soil surface. Honey mesquite ages were estimated by growth ring counts of stems at approximately two inches below the soil surface. Ring counts were made after the cut stem surface was stained with a one percent solution of safranin-O in methanol. The circumference of this basal portion of each trunk was also recorded.

In September 1968, July 1969, and September 1969, foliar cover was estimated from 40 inclined 10-point frame samples taken along two diagonal transects across the exclosure. Forty, 2 by 4-ft quadrats were clipped at ground level, the herbage oven-dried and weighed. Three transects, 100 ft long, were established in an acre of cleared and grazed area adjoining the exclosure. Foliar cover and herbage yields were estimated from these transects at the same time as the measurements within the exclosure occurred.

Results and Discussion

In 1941, about 2950 honey mesquite seedlings per acre were recorded in the exclosure (Fisher, 1950). In the adjacent grazed area, which was cleared of all honey mesquite in 1941, new plants were removed periodically and the number recorded (Robison et al., 1968). Since 1959, this adjacent area has been grazed moderately from May through October.

In the exclosure, the number of honey mesquite seedlings had decreased to about 400 plants per acre in 1968 or 14 percent of the original population. Fisher (1950) reported 1250 honey mesquite plants per acre or about 42 percent of the original population. Honey mesquite plants in the exclosure ranged from 0.2 to 1.5 m in height in 1968 with an average of 0.5 m (Fig. 1). The average growth in height since 1941 has been

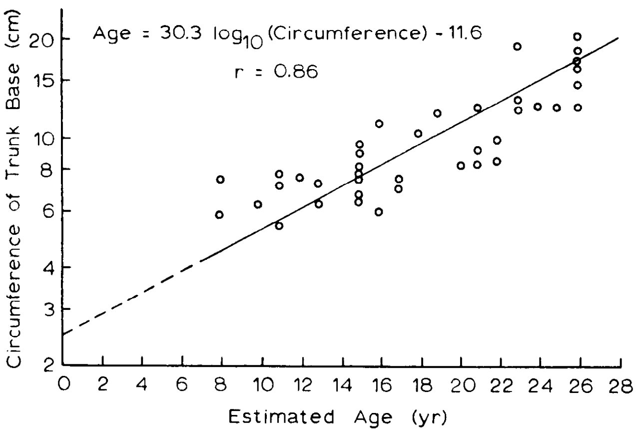

FIG. 2. Relationship between estimated age by growth ring counts and circumference of the basal trunk of 40 honey mesquite plants in the exclosure protected from grazing since 1941 near Spur, Texas.

about 2 cm per year. Thus, small honey mesquite plants regarded as seedlings may be several years old.

No new seedlings were observed in the exclosure or grazed area from July 1968 through October 1969. Based on the regression equation developed from ring counts and circumference of the trunk base (Fig. 2), establishment of mesquite plants in the study area has evidently not occurred since 1959 (Fig. 3). Published reports show that 401 honey mesquite per acre became established on the grazed area adjoining the exclosure from 1941 to 1964 (Robison et al., 1968). It appeared that most of the mesquite plants remaining in the exclosures in 1968 originated from the 1941 crop and additional emergence in 1952 (Fig. 3).

Total annual precipitation was high in 1941, but not in 1952. These data indicated that the amount of annual precipitation for a given year was not indicative of a "good year" for the establishment of honey mesquite irrespective of condition of grass cover on ranges. Temperature is of importance as interrelated with available moisture for germination of honey mesquite seeds (Scifres and Brock, 1969). Assuming a plentiful seed supply, a third factor becomes important. The presence or absence of climax perennial grasses and associated species must be extremely influential in honey mesquite establishment.

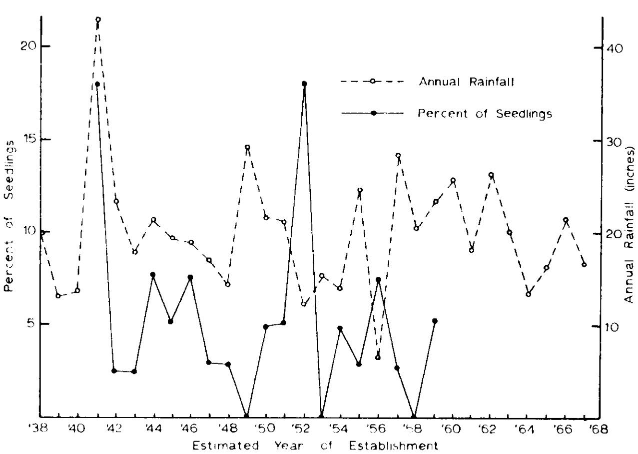

FIG. 3. Relationship between total annual precipitation and estimated year of establishment of honey mesquite plants since 1941 in an exclosure in North Texas.

Table 1. Percentage composition (C) and frequency (F) of the dominant grasses on September 17, 1968 in an exclosure after 27 years as compared to an adjacent, grazed area in north Texas.

Species	Exclosure		Grazed area	
	C	F	C	F
Buffalograss	13	21	4	7
Tobosa	61	67	91	71
Vine-mesquite	19	10	0	0
Others	7	—	5	—

Tobosa was the most frequent perennial grass in the area regardless of grazing treatment (Table 1). Foliar cover was essentially the same on both areas, 94 percent in the exclosure and 98 percent in the grazed, hand-grubbed pasture, but buffalograss was more abundant in the exclosure than in the grazed area. However, utilization by grazing animals was not measured. Grazing evidently reduced buffalograss production since about three times as much was recorded in the exclosure (Table 2). Vine-mesquite (*Panicum obtusum* H.B.K.), a native, perennial mid-grass and unquestionably a part of the climax vegetation for the site, was not recorded in the grazed pasture. However, its production in the exclosure exceeded that of buffalograss. The total herbage yield of grasses was about the same in the two areas (2300 lb./acre). Yield was determined after some grazing of the range adjacent to the exclosure. However, when forbs were included, the total herbage production from the exclosure was about 4000 lb./acre as compared to 2700 lb./acre from the grazed area. Thirty-nine percent of the herbage from the exclosure was com-

Table 2. Oven-dry herbage (lb./acre) of three species on September 20, 1968 in an exclosure protected from grazing for 27 years and an adjacent, grazed area in north Texas.

Species	Exclosure	Grazed area
Buffalograss	317	105
Tobosa	1492	2209
Vine mesquite	468	0
Total	2277	2314

Table 3. Distribution of honey mesquite growth forms based on number of branches at ground level and the percentage of plants within a form sprouting from the base in 1968.

Growth form class[a]	Percentage of population	Percentage with basal sprouts
Single-stemmed plants	30	2
Plants with 2 basal stems	34	11
Plants with 3 basal stems	18	23
Plants with 4 to 5 basal stems	13	50
Plants with 6 to 8 basal stems	5	76

[a] Number of mature stems originating at ground level.

posed of some 10 species of broadleaf plants, including common broomweed (*Xanthocephalum dracunculoides* (DC.) Shinners), common sunflower (*Helianthus annus* L.), lambsquarter (*Chenopodium album* L.), Russianthistle (*Salsoli kali* L. var. *tenuifolia*), heath aster (*Aster ericoides* L.) and goldenweed (*Croptilon divaricatum* (Nutt.) Raf.) and annual grasses such as puff dropseed (*Sporobolus vaginiflorus* var. *neglectus* (Nash) Scribn.), little barley (*Hordeum pusillum* Nutt.) and oldfield threeawn (*Aristida oligantha* Michx.).

Only 10 percent of the herbage yield from the grazed area was contributed by species other than tobosa, buffalograss and vine-mesquite. Common broomweed contributed most of the other herbage. Many of the species noted in the exclosure were not detected in the grazed area, probably due to removal by domestic livestock. As previously noted, about 10 species of broadleaf plants were encountered in September 1968 in the exclosure as compared to primarily common broomweed and plains pricklypear cactus (*Opuntia polyacantha* Haw.) in the grazed area. In May, 1969, there were 20 broadleaf species recorded in the grazed pasture and over 30 in the exclosure.

The growth form of honey mesquite in the exclosure was exemplified by a multi-stemmed or bushy plant type (Table 3). Variation in growth habit was reported by Fisher et al. (1946) but they encountered few single-stemmed plants in the same general area. Seventy percent of the honey mesquite plants in the exclosure had more than one stem arising from ground line. However, many of these were originally single-stemmed juvenile plants which incurred damage to the terminal stem (Fig. 4). It appears that once regrowth from the basal stem is stimulated, new growth is more likely to occur. Only about two percent of the single-stemmed trees had new basal sprouts in 1968 whereas 75 percent of the plants with 6 to 8 stems had basal sprouts.

Honey mesquite sprouts arise from the trunk base below ground line but above root tissue

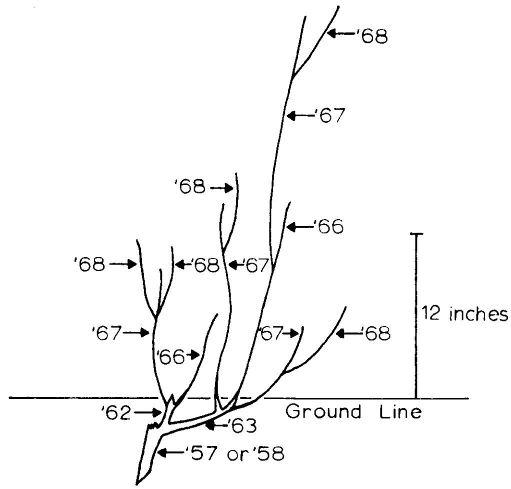

FIG. 4. Sketch of honey mesquite plant established in 1957 or 1958 in the exclosure. Numbers indicate year of branch formation. Note stump which indicates removal of the central stem when the plant was two or three years old.

(Fisher et al., 1946). Presumably, the honey mesquite seedlings in the exclosure were affected by some force such as frost, or top removal by insects, rodents or lagomorphs shortly after emergence and this stimulated the multiple-stemmed growth form. Fig. 4 shows the rate of new branch formation on one plant excavated from the exclosure. The plant was established in 1957 or 1958 and the main branch apparently was removed at ground line in 1960 or 1961. In 1968, there were five main branches arising at the ground line.

These data indicate apparent affects of secondary succession on rangeland as related to a disclimax in which the honey mesquite was widely established 27 years earlier. The environment of the study area is climatically and edaphically conducive to invasion of honey mesquite. The rate of invasion may be dependent on the factors associated with close grazing of the climax type of vegetation. Establishment and subsequent growth rate of honey mesquite seedlings is evidently greatly reduced by competition of herbaceous vegetation higher in secondary succession than the vegetation that characterized many ranges adjacent to the exclosure. Future observations should indicate if, in the absence of fire, there is a point at which mesquite will function as a part of a stable plant community of this site.

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