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Original Research

Mesquite Pod Removal by Cattle, Feral Hogs, and Native Herbivores☆

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ABSTRACT

The dispersal of woody plant seeds by livestock has been implicated as one of the causes of woody plant encroachment in semiarid ecosystems worldwide. In the southern Great Plains, United States, cattle are suspected to have increased encroachment of the woody legume honey mesquite (*Prosopis glandulosa* Torr.) because they are effective consumers of mesquite pods and pass viable seed from those pods through their digestive systems. Since other animal species also consume or gather mesquite pods and seeds, our objective was to compare the removal of mesquite pods by cattle, other vertebrate herbivores, and insects. Mature pods were collected from trees in late summer and placed within each level of a hierarchical exclusion design using fences and cages that blocked cattle; other large vertebrates (deer, feral hogs); smaller vertebrates (rabbits, birds, rodents); and insects at replicate sites in north and south Texas locations. Pod removal was quantified during 60-d trials in the fall of each of 3 yr. The treatment that allowed cattle to have access to pods had the greatest or tied for the greatest pod removal at trial end in all trials. Final pod removal in the feral hog and white-tailed deer treatments was numerically lower but statistically similar ($P \leq 0.05$) to cattle. However, the rate of pod removal during the first 20 d in several of the trials was greatest ($P \leq 0.05$) in the cattle treatment at both locations. Pod removal by rodents was high in 1 yr at both locations, which we attributed to high growing season precipitation at both locations during that year. Results may have implications regarding seed-centric grazing management decisions and keeping cattle out of pastures when mesquite pods are abundantly present on the ground.

Introduction

In many arid and semiarid grasslands and savannas worldwide, the consumption and subsequent defecation of viable seeds of woody species by livestock (i.e., endozoochory) are partially responsible for the increased distribution and density of woody plants (Bahre and Shelton, 1993; Cox et al., 1993; D'Odorico et al., 2012; Lonsdale, 1993; Tews et al., 2004). In the southern Great Plains (SGP), United States, cattle and other domestic livestock may have played a role in increasing distribution of the woody indehiscent legume honey mesquite (*Prosopis glandulosa* Torr.) in the past 150 yr (Archer and Pyke, 1991; Brown and Archer, 1987, 1989). Because mesquite pods are indehiscent, relatively large (15−20 cm long), and smooth textured, seed dispersal is dependent on endozoochory via pod consumption by large mammals, or the caching of individual seeds by rodents or insects, often after seeds have been deposited in large mammal feces (Duval et al., 2005; Weltzin et al., 1997). Mesquite pods (and seeds within) are too large to disperse by wind or water, or by attachment to animal fur or bird feathers.

Mesquite pods are sweet to the taste and favored by cattle, regardless of forage grass availability (Glendening and Paulsen, 1955). Pod sugar content of mesquite and similar *Prosopis* species ranges from 27% to 32% (Del Valle et al., 1983; Felker, 1981; Marangoni and Alli, 1988). Passage through the cattle digestive system separates seeds from pods, scarifies the seed coat, and enhances germination of surviving seed (Campos and Ojeda, 1997; Peinetti et al., 1993). A greater percentage of seeds remain viable after passing through cattle than through sheep or goats (Kneuper et al., 2003). Mesquite seedlings readily establish from seeds that are in cattle dung pats (Brown and Archer, 1987; Kramp et al., 1998).

A limited suite of native SGP herbivores also can pass viable mesquite seed through their digestive systems, including white-tailed deer *(Odocoileus virginianus)* and coyotes *(Canis latrans)* (Kramp et al., 1998). No data exist for feral hogs *(Sus scrofa)*, a recent exotic invader in the SGP; however, Lynes and Campbell (2000) determined in Australia that viable *Prosopis pallida* seed passed through feral pigs. Most other native herbivores destroy mesquite seeds when they consume them, including lagomorphs (Bahre and Shelton, 1993) and rodents (Duval et al., 2005). Birds defecate viable seeds from many

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small-seeded rangeland species, including *Opuntia* and *Juniperus* (Ansley et al., 1995; Dean and Milton, 2000; García et al., 2010; Horncastle et al., 2004), but mesquite seeds are too large to survive passage through bird digestive systems. Insects, mainly bruchid beetles (*Algarobius* spp.) and conchuela (*Chlorochora ligata* Say), can destroy significant portions of *Prosopis* spp. seed crops (Kingsolver et al., 1977; Lerner and Peinetti, 1996; Smith and Ueckert, 1974; Van Klinken and White, 2011; Zimmermann, 1991) mostly after pods have fallen to the ground (Watts et al., 1989).

Several studies have addressed mesquite seed viability, germination, or establishment after passage through cattle or other animals (Bush and Van Auken, 1990; Campos et al., 2011; Kneuper et al., 2003; Kramp et al., 1998; Peinetti et al., 1993). However, few studies have compared the rate of pod consumption (or removal) among coexisting animal groups in a natural setting (Villagra et al., 2002; Weltzin et al., 1997), and no studies that we know of have compared cattle with native herbivores. It likely would be easier for a large-mandible species like cattle than it would for smaller herbivores to rapidly consume whole pods. Janzen (1982) found in Costa Rica that cattle were very effective at consuming large indehiscent guanacaste *(Enterolobium cyclocarpum)* pods. We have observed cattle rapidly consuming clusters of mesquite pods on the ground (Ansley, unquantified observation). In addition, the larger energy requirements of cattle and greater body mass per unit land area, which is a function of body mass × stocking rate, could cause more rapid pod consumption by cattle than by native herbivores in any given area. Somewhat contrary to this hypothesis, Kneuper et al. (2003) found that the presence or absence of livestock (cattle, sheep, or goats) did not affect disappearance rates of mesquite seed pods in one pasture when compared with another pasture that contained only native herbivores (mainly white-tailed deer).

The animal guilds that now exist within mesquite savannas in the SGP are different than when Europeans first settled the area. There are now more deer (Wolverton et al., 2007), and feral hogs were not present until the 1980s. However, a better understanding of consumption of pods by cattle and other animal groups would offer more insight regarding the factors that may have led to mesquite expansion in the SGP and could potentially affect livestock management decisions today. Our objective was to compare the removal of mesquite pods by cattle, other vertebrate herbivores, and insects.

Methods

The study was conducted on private ranches at two locations 520 km apart: near Vernon in north central Texas and near Uvalde in south Texas (hereafter Vernon and Uvalde are referred to as "locations"). Three 3-ha replicate sites were established near Vernon (Vernon 1, Smith Walker Ranch 34°01′N, 99°14′W, elevation 374 m; Vernon 2, Peach Orchard Pasture 33°55′N, 99°04′W, elevation 340 m; Vernon 3, Ninemile Pasture 33°51′N, 99°25′W, elevation 382 m), and two replicate sites (hereafter "replicates") were located near Uvalde (Uvalde 1, Harris Ranch 29°19′N; 100°05′W; elevation 333 m; Uvalde 2, Turkey Creek Ranch, 29°04′N; 100°01′W; elevation 253 m). All five replicates were randomly located within mesquite-dominated rangeland communities.

At the Vernon replicates, the 30-yr mean annual precipitation is 653 mm and mean annual air temperature is 16.9°C, with the peak in July (29.2°C) and low in January (3.8°C) (NOAA-NCDC, 1997). Growing season is typically from early March through October (~240 d). Soils at each Vernon site were fine, mixed, superactive, thermic Vertic Paleustolls of the Tillman clay loam series with 0 – 1% slopes (USDA-NRCS, 2014a), and vegetation consisted of a dominant mesquite overstory, lightly scattered lotebush (*Ziziphus obtusifolia* [T.&G.] Gray) shrubs, and grasses Texas wintergrass (*Nassella leucotricha* [Trin. & Rupr.] Pohl), buffalograss (*Bouteloua dactyloides* [Nutt.] J.T. Columbus), vine mesquite (*Panicum obtusum* Kunth), and sand dropseed (*Sporobolus cryptandrus* [Torr.] A. Gray) (USDA-NRCS, 2014b).

At the Uvalde replicates, the 30-yr mean annual precipitation is 617 mm. Average annual maximum and minimum temperatures were 35.5°C and 13.7°C, respectively. Growing season can range from 250 to 365 d. Uvalde 1 has nearly level to gently sloping, deep, calcareous upland soils of the Knippa Clay series. Uvalde 2 has nearly level to gently sloping, deep, calcareous alluvial soils of the Uvalde silty clay loam series. Vegetation at both Uvalde sites consisted of a mixed thorn shrub community containing honey mesquite and liveoak *(Quercus virginiana)* trees, shrubs guajillo *(Acacia berlandieri)*, blackbrush *(Acacia rigidula)*, whitebrush *(Aloysia gratissima)* and pricklypear cactus *(Opuntia lindheimeri)*, and grasses red grama *(Bouteloua trifida)*, Wright's threeawn *(Aristida purpurea)*, common curly-mesquite *(Hilaria belangeri)*, buffalograss, and Texas wintergrass. A diverse forb cover varies with rainfall pattern and abundance.

Grass production was higher at the Vernon replicates (~3 000 kg· ha^{-1}) than the Uvalde replicates (~1 200 kg· ha^{-1}). Domestic cattle *(Bos taurus)* were grazed as cow-calf operations at all replicates; stocking rates were considered "moderate" with one animal unit (AU) to 10 ha at Vernon 1, one AU to 12 ha at Vernon 2 and 3, and one AU to 35 ha at Uvalde 1 and 2. Each replicate was visited by a different herd of cattle. No native herbivore population surveys were collected in this study. However, species that have been frequently observed at all 5 replicates were white-tailed deer, feral hogs, javelina, coyotes, jackrabbits, cottontail rabbits, raccoons, skunks, and numerous bird, rodent, and insect species. In addition, fresh dung pats and fecal pellets of cattle, deer, and hogs were observed at each of the sites. All replicates were > 20 km from one another, so it was probable that each replicate was visited by different individuals of each species, although this was not verified.

Each replicate contained a hierarchical series of fence and/or wire mesh barriers to progressively allow additional animal group access to mesquite pods (Fig. 1). Each exclusion level was referred to as a "treatment" and was numbered and labeled according to the next animal group (plus all previous animal groups) that was allowed access to mesquite pods (Table 1). The order of treatments progressed generally from smaller to larger animals and included 1) None—all animals excluded; 2) insects; 3) rodents, 4) birds, 5) rabbits; 6) white-tailed deer and raccoons; 7) feral hogs, javelin, and coyotes; and 8) cattle. The first three levels included tops on the cages or fences to prevent bird access.

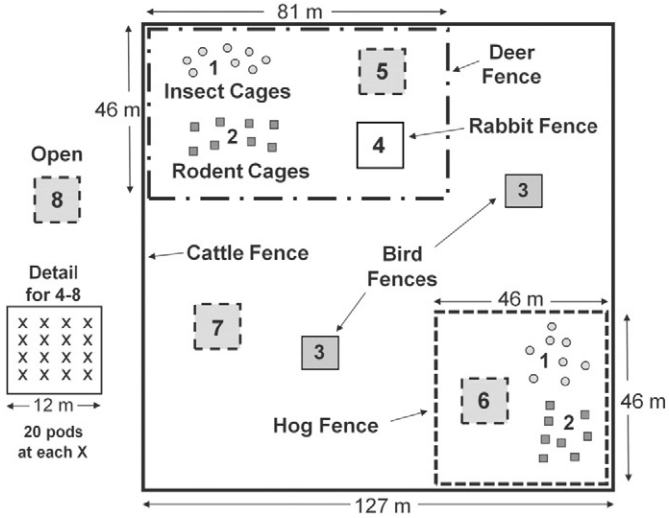

Figure 1. Treatment exclosure design for each replicate. Numbers correspond to the numbers in the left hand column of Table 1. A detail of the pod arrangement for levels 4 through 8 is shown on the left. Dashed line around squares 5-8 indicates either unfenced areas within a larger fence (5-7) or an unfenced area (8). For each area, 16 groups of 20 pods each were distributed in a 4 by 4 grid. In treatment 3 (bird), the 16 groups were divided into two groups of 8 each. For treatments 1 and 2 (insect and rodent cages) each cage included one 20-pod group randomly located throughout the deer or hog enclosures. They are shown here more clustered together than they actually were.

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