

Biodiversity of Tamaulipan Thornscrub in Relation to Fragmentation¹

Enrique Jurado²
Gerardo Cuellar²
Mercedes Flores²
Ignacio González³

Abstract—Tamaulipan thornscrub has often been removed in northeastern Mexico to give way to agriculture and induced grasslands for cattle. This results in over 90% of thornscrub being either removed or severely modified, with a few remaining fragments varying in size and distance to nearby fragments (isolation). Fragment size ranges from isolated trees in induced buffel grasslands to 300 ha of “continuous vegetation”.

Remaining fragments are by no means conserved, as they are over-utilized for grazing goats, extraction of timber, fuel-wood and medicinal plants. Ecosystem fragmentation and isolation of fragments has an impact on the dynamics of thornscrub by reducing population sizes, promoting genetic erosion, and perhaps local extinction of species with large habitat requirements.

In here we present some measurements of plant, bird, ants, and beetles diversity, as well as some implications on seed parasitism, removal and dispersal. Results contrast species richness under isolated *Prosopis* and *Ebenopsis* trees and thornscrub fragments from less than 10 to over 100 ha. Preliminary results imply that fragment size is not related to species number, but to ecosystem function. Seed removal rates were slower under isolated mesquite trees than under similar trees in continuous vegetation. Seed production was higher for isolated mesquite trees than for similar size ones inside continuous vegetation. Seed parasitism (while still inside the vines) was higher for the latter.

Imminent loss of biological diversity and the risk of the acceleration of this loss, brings out the need to objectively evaluate the role of biodiversity in ecosystem function, productivity and stability (Aizen and Feisinger 1994; Didham et al. 1996; Grime 1997). The effect of biodiversity in ecosystem viability requires sophisticated equipment, perhaps as a result of this it is only being considered in few studies (Richardson and Cowling 1993; Hooper and Vitousek 1997; Tilman et al. 1997). The effect that an enriched CO₂ atmosphere and climate change might have on biodiversity is still elusive due to varying models of prediction. Fragmentation, however of most of the plant communities around the world has an impact on species composition that has been increasingly documented in tropical forest (Lawrence

1990; Robinson et al. 1992; Adler 1994), temperate forest (Bright 1993; Heske 1995; Fitzgibbon 1997) and grasslands (Herkert 1994). These studies show a relationship between fragment size of remaining vegetation and species composition similar to island theory (a larger area will include more species). Results so far, deal mainly with birds (Askins et al. 1992), mammals (Fonseca and Robinson 1990; Foster and Gaines 1991) and occasionally invertebrates (Kruess and Tschardt 1994).

Tamaulipan Thornscrub has often been removed in northeastern Mexico to give way to agriculture and induced grasslands for cattle. This results in over 90% of thornscrub being either removed or severely modified with a few remaining fragments varying in size and distance to nearby fragments. Fragment size ranges from isolated trees in induced buffel grasslands to 300 ha of “continuous vegetation”.

Remaining fragments are by no means conserved, as they are over-utilized for grazing goats, and extraction of timber, fuel-wood, and medicinal plants. The impact per fragment is on the increase as fragments are reduced in size, quality and number while human population keeps growing.

Ecosystem fragmentation and isolation is likely to impact the dynamics of thornscrub by reducing population size, promoting genetic erosion, and perhaps inducing local extinction of species with large-habitat requirement (McCoy and Mushinsky 1994; Murcia 1995).

This paper presents preliminary results of a broad study on the effects that fragmentation of Tamaulipan Thornscrub has on species diversity, and ecosystem processes⁴.

Methods

This study was conducted in Linares, Nuevo Leon, Mexico (24° 47' N., 99° 32' W. 360 m.a.s.l.). Linares has a mean annual rainfall of 810.6 mm, which falls mainly in the summer (Cavazos and Molina, 1992). Mean annual temperature is 22.4 °C, with 41.1 °C and -2.3 °C being the mean maximum and mean minimum daily temperatures (Cavazos and Molina, 1992). The highest temperatures occur on July and August; the lowest precipitation also occurs at this time (Cavazos and Hastenrath, 1990).

Tamaulipan thornscrub is dense vegetation with an average height of shrubs and trees (mainly legumes) of 4 m (Reid et al. 1987; Jurado et al. 1998). This vegetation has been

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²Enrique Jurado is an Ecology Professor, Gerardo Cuellar and Mercedes Flores are Master's students at Facultad de Ciencias Forestales, University of Nuevo Leon, Mexico. A.P. 41. Facultad de Ciencias Forestales. UANL Linares, N.L. 67700 Mexico. email: ejurado@ccr.dsi.uanl.mx

³Ignacio González is a PhD student at Facultad de Ciencias Biológicas UANL.

⁴This research summarizes the work of many students and staff from the Ecology lab at Facultad de Ciencias Forestales: Carmen Medina, Marcelo Ávila, Monica Ibarra, Yadira Garza, Leonel Resendiz, Manuel Hernández, Guadalupe Ramírez

removed to give way to agriculture and induced grasslands and thus only 10% of its original area remains in isolated fragments.

All taxa were analyzed comparing at least three replicates for anyone treatment (i.e. size of fragment). Variables analyzed included number of species and diversity indexes (Shanon and Simpson). Since the patterns were similar only results dealing with numbers of species are presented here. In this study we compared species composition and diversity indexes among different fragment sizes using the same unit effort. We feel that the question of differences in species number due to larger area is rather uninteresting.

Plant Diversity

For this variable only adult perennial plants were considered, they were measured using 100 m by 4 m plots (Medina 1996). Plots were set in the center of each fragment, and a total of 10 fragments for each size category were used. Fragments were divided in two size classes those close to 10 ha, and those larger than 100 ha. These analyses were carried out in spring 1996.

Bird Diversity

Birds were monitored in two ways: (i) by direct observation, and (ii) by trapping with the use of mist nets. Both methods were done three days each month from sunrise till noon from July 1996 to June 1997. A total of 6 mist nets were used for each treatment (using two nets per replicate).

Ant and Beetle Diversity

Ants and beetles were trapped using pitfall-baited traps with additional openings at 5 cm depth for ants that rarely visit the soil surface (Ávila 1997). Each trap set included 5 traps separated 1 m from each other, there were three replicates for each fragment size. For this study we included isolated trees as the smallest possible fragment, these included three *Prosopis laevigata* (mesquite), and three *Ebenopsis ebano* (ebano), isolated from nearest fragments by at least 200 m. Replicates of the same tree species inside fragments were also considered.

Ants and beetles were initially identified as morpho-species, and later keyed with the aid of experts to the nearest possible taxa (genera and family for most cases). Invertebrates were sampled during two seasons, spring and autumn 1996. Further research on beetles is currently being conducted.

Seed Production

Seeds were estimated from number of estimated vines, for 20 mesquites. Three people simultaneously counted all the vines they could see in 5 minutes on different angles of the same tree (seed counters were set with their back toward the stem, so each one could see the third part of the crown). This was done selecting similar size trees, half of them immersed in continuous vegetation, and the rest isolated at least 200 m from the nearest thornscrub fragment. Seed

production has been determined only once, as this research is still in progress.

Seed Removal

Under the same trees used to estimate seed production, we provided seeds of ebano (the largest and most attractive seed in thornscrub) in Petri dishes. There were 10 seeds in each one of three replicates for isolated, immersed, and border trees. The latter were similar size trees that were growing on the edge of fragments.

Seed Parasitism

Parasites in seeds of mesquite were estimated by recording the presence of holes in vines collected from under isolated and immersed trees during seed production (Summer 1998).

Results and Discussion

The trend for more species (or higher diversity) found for larger fragments elsewhere was not supported here. For all taxa studied, species number, Shanon and Simpson diversity indexes were not different among different fragment sizes (Fig. 1). This result was consistent when considering different taxa, different seasons and different experimental designs.

To try to explain how fragment size did not affect number of species three options are discussed:

1. Habitat deterioration—it is possible that because thornscrub is highly impacted by logging and goat grazing, large fragments do not have the “pristine” vegetation quality, required to host large numbers of species.
2. Species crowding—Perhaps as a result of recent fragmentation, and lower competition due to an increased

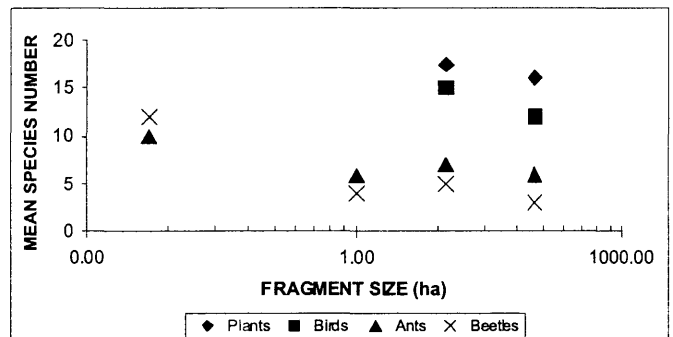


Figure 1.—Mean Number of species of plants, birds, ants and beetles. No trend for fewer species in smaller fragments was found for any taxa. Plants were measured in 100 m x 4 m plots, using ten replicate fragments for each size. Birds were trapped from sunrise till noon, during three days each month for one year using 2 mist nets per replicate and three replicates per fragment size. Ants and beetles were trapped with baited pitfall traps in spring and autumn, using three replicates per fragment size and 5 traps per replicate.

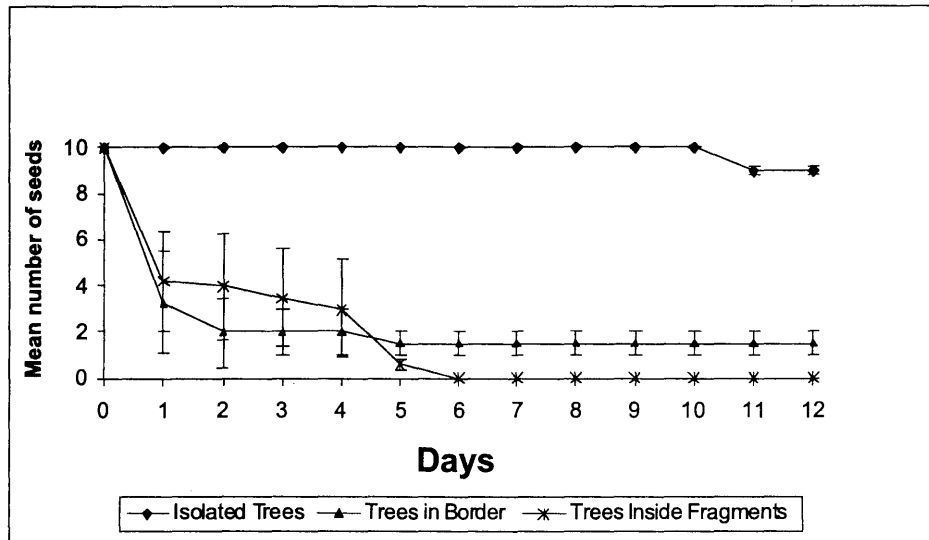


Figure 2.—Mean seed removal of seeds (*Ebenopsis ebano*) under 3 isolated, 3 immersed and 3 margin mesquites in a 12 day period in Summer 1998. Seed depots for each replicate included 10 seeds. Error bars represent confidence limits at $\alpha = 0.05$.

edge effect, very small fragments have more dense populations and hence diversity per unit area equals that of larger fragments.

3. Large fragments are too small—it is possible that remaining fragments are too small to represent original ecosystem properties (including diversity), and thus we are comparing between small and very small fragments.

Further and detailed studies are required to test for such potential causes of our preliminary results.

The rate of seed removal, however was affected by tree isolation, in that seeds under isolated trees were removed in lower number and at a slower pace than those in the

vegetation edge, and these in turn from those under trees inside fragments (Fig. 2). The implication for this is that seed removers (most likely rodents) are at a higher risk of being preyed at the vegetation edge, and even more so under isolated trees, than under continuous ornscrub. Considering seed removal alone, isolated trees have greater chances of establishing seedlings under their canopy, though perhaps a smaller chance of being incidentally dispersed. Further studies using different species of seeds are currently under way. Studies dealing with seedling establishment are in design.

The number of seeds produced by vine was similar for isolated trees (16.34 ± 1.3 mean \pm C.I. $\alpha = 0.05$) and trees in continuous vegetation (15.7 ± 2.36). Vine production, and hence seed production per tree, was significantly higher for isolated trees (Fig. 3). There were more seeds with parasites in the vines of mesquites in continuous vegetation (Fig. 3).

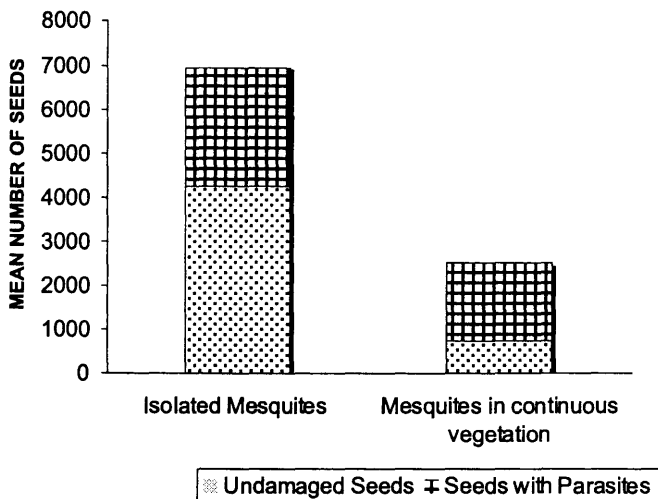


Figure 3.—Seeds of Isolated mesquites and mesquites immersed in continuous vegetation. Each mean represents the average of three trees. Means between isolated and immersed mesquites are different ($\alpha = 0.05$).

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