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Caatinga herbaceous stratum dynamics under grazing intensities by goats in a semi-arid region of Brazilian Northeast[1]

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(Caatinga herbaceous stratum dynamics under grazing intensities by goats in a semi-arid region of Brazilian Northeast) – A native grassland Caatinga has been submitted to three grazing intensities (GI) by goats (1981-84) to verify the effect of these GI on vegetation degradation. Treatments varied from 1 doe/1 ha to 1 doe/3 ha, including Exclusion (without grazing) by occupying seven areas which ranged from 15 to 45 ha. Rainfall was 484.8, 364.4, 552.8, and 605.3 mm in October/80-September/81, 1981-82, 1982-83 and 1983-84, respectively. The effect of GI on the frequency of herb species and on the density of woody seedling (height < 0.5 m) has been evaluated by using 1 m² (2 x 0.5 m) quadrats in each year of research. Neither the herb species frequency nor the woody seedling density was influenced by GI. Frequencies of 31 herb species were evaluated by considering the effect of precipitation; these were divided into three groups. Group 1 (17 species) and group 2 (12 species) were influenced by precipitation and have had their highest frequencies in 1984 and 1983, respectively. *Selaginella convoluta* and *Herissantia crispa*, which comprised the third group, were not influenced by precipitation. Rainfall has also influenced the density of woody seedlings ($P < 0.05$), with the 1984 density (3.005) being superior to 1983 and 1982 densities (2.055 and 1.895 plants/m², respectively). Considering the year of 1981, the mean density in this period was 2.401 plants/m², excluding seedlings of the tree *Tabebuia spongiosa*, to which 18.9 plants/m² in 1983 was excluded from analysis. In conclusion, high GI by goats during three years was not sufficient to cause Caatinga herbaceous stratum degradation. Precipitation was the most important factor.
Key words: Caatinga, grazing intensities, herbaceous stratum.

(Dinâmica do estrato herbáceo de uma Caatinga submetida a intensidades de uso por caprinos em uma região semi-árida do nordeste brasileiro) – Uma pastagem nativa de Caatinga foi submetida a três intensidades de uso (IU) por caprinos (1981-84) para verificar o efeito que elas exercem na degradação da vegetação. Tratamentos variaram de 1 cabra/1 ha a 1 cabra/3 ha, além da Exclusão (sem pastejo), ocupando sete áreas variando de 15 a 45 ha. Precipitação pluviométrica foi de 484,8, 364,4, 552,8 e 605,3 mm, para outubro/80-setembro/81, 1981-82, 1982-83 e 1983-84, respectivamente. Avaliou-se o efeito da IU sobre a frequência das espécies herbáceas e sobre a densidade das plantas novas (altura < 0,5 m) das espécies lenhosas, usando-se quadratos de 1 m² (2 x 0,5 m) uma vez anualmente. Nem a freqüência das espécies herbáceas e nem a densidade das plantas novas foram influenciadas pela IU. Freqüências de 31 herbáceas foram avaliadas sob o efeito da precipitação e compuseram três grupos. Grupo 1 (17 espécies) e grupo 2 (12 espécies) foram influenciados pela precipitação e tiveram suas freqüências mais altas em 1984 e 1983, respectivamente. Grupo 3 (2 espécies - *Selaginella convoluta* e *Herissantia crispa*) não foi influenciado pela precipitação. A densidade das plantas novas das espécies lenhosas também foi influenciada ($P < 0,05$) pela precipitação, sendo a densidade em 1984 (3,005) superior às densidades de 1983 e 1982 (2,055 e 1,895 plantas/m², respectivamente). Considerando 1981, a densidade média no período foi 2,401 plantas/m², excluindo plantas da árvore *Tabebuia spongiosa*, que com 18,9 plantas/m² em 1983, foi excluída das análises. Em conclusão, altas IU por caprinos durante três anos não foram suficientes para causar degradação do estrato herbáceo da Caatinga. Precipitação foi o fator mais importante.
Palavras-chave: Caatinga, intensidades de pastejo, estrato herbáceo.

Introduction

Caatinga, a thorny deciduous dry woodland that covers most of the Brazilian Northeast, is dominated by woody plants, and may be the native pasture with the highest density of shrubs and trees in the world. Native pastures in Africa (Kelly & Walker, 1976), in USA (Rippel *et al.*, 1983), and in Australia (Walker *et al.*, 1986), had shrub and tree densities lower than densities in Caatinga. All papers of a symposium held in Africa, which was devoted exclusively to the ligneous stratum as source of forage (Le Houérou, 1980), registered densities lower than that found in Caatinga. Most of the Caatinga types are shrub dominated, although as quoted by Sampaio (1995), some authors have claimed that most of the Caatinga area was originally covered with trees. Most of the ligneous species are deciduous and the dried leaves are an important source of forage in the dry season (Kirmse *et al.*, 1987). The paucity of grasses is one of its characteristics (Cole, 1960), in comparison to other biomes, such as Cerrado and Pantanal, but there is evidence that Caatinga invaded some formerly more open areas covered by grasses (Smith, 1974), a situation analogous to those in USA and Australia, in which overgrazing resulted in establishment of woody plants (Herbel, 1985; Harrington & Hodgkinson, 1986).

In spite of being less sensitive to overgrazing than pastures dominated by herbaceous stratum, Caatinga has also been degraded (Vasconcelos Sobrinho, 1949; Andrade-Lima, 1981), but there is no evidence that degradation was caused by overuse by livestock. It was caused probably by shifting cultivation and wood harvest, because the Caatinga-covered region is densely populated.

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Table 1. Rainfall from October 1980 to September 1984 and historical mean (Oct. 1963-Sep. 2003). Bebedouro Experimental Station (ca. 6 km from study site). Petrolina, PE.

Month	Precipitation (mm)				
	1980-81	1981-82	1982-83	1983-84	Historical mean
Oct.-Nov.	56.0	14.6	0.0	62.8	61,3
Dec.	34.0	90.7	82.2	7.2	76,6
Jan.	20.3	10.4	90.0	20.5	77,8
Feb.	4.8	20.6	166.4	3.9	79,8
Mar.	340.3	79.1	205.2	314.2	129,2
Apr.	20.5	97.4	0.8	122.9	79,2
May	0.5	1.4	0.0	44.6	19,7
Jun.-Sep.	8.4	50.2	37.6	29.2	28,7
Total	484.8	364.4	552.8	605.3	552,3

Cattle and goats are the main livestock species in the São Francisco lower-middle zone, and in most properties, both species are reared together. This region has the highest concentration of goat herds in Brazil. Goats have a higher surviving capacity in degraded lands (Devendra, 1978), and have been used to control woody weeds (Davis *et al.*, 1975; Green *et al.*, 1979), but they have been also suspected to cause degradation. Annual stocking rate is the most important factor in maintaining the stability of a native pasture, although in woody species dominated pastures, a high stocking rate might not have a damaging effect on woody plants, as observed by Kelly & Walker (1976). In Caatinga pastures, 15 ha/head of cattle is usually recommended (Banco do Nordeste do Brasil, 1971), while for goats, stocking rate might be around 1.3 ha/adult goat.

As there is lack of information on which stocking rates by goats could cause degradation on herbaceous stratum of Caatinga, a research was conducted in the period 1981-84 pursuing this objective.

MATERIALS AND METHODS

Experimental Area

The research was conducted at the Caatinga Experimental Station (9°21' S Lat.; 370 m altitude) of EMBRAPA-Agricultural Research Center for the Semi-Arid Tropics (Embrapa Semi-Árido), in Petrolina municipality, Pernambuco State. The area, 2.780 ha, was fenced in 1976 by Embrapa, and was kept free of grazing until the beginning of the research. Prior to fencing, the area was kept under communal grazing by small goat and cattle raisers, under undefined stocking rates. The area has flat topography and yellow podzolic soils with the following characteristics: pH = 5.8; $Ca^{2+} + Mg^{2+}$ = 3.3 m.e.; Al^{3+} = 0.07 m.e.; P = 3.5 ppm. Annual potential evaporation is 2.630 mm (Amorim Neto, 1985), and mean annual rainfall is 552 mm (Table 1), 80% of it concentrated in the period December-April, the time of highest evapotranspiration. The vegetation is an arboreous-shrubby Caatinga with the tree stratum dominated by *Mimosa tenuiflora* (Wildd.) Poir. Tree stratum covers 88.1% of the area, and *M. tenuiflora* contributes to 50.4% (Albuquerque & Bandeira, 1995). Shrub stratum is dominated by five species: *Lippia microphylla* Cham., *Croton rhamnifolius* (Kunth em.) Muell. Arg., *Calliandra depauperata* Benth., *Cordia leucocephala* Moric., and *Bauhinia cheilantha* (Bong.) Steud. They contribute to 96.5% of this stratum cover. The lower stratum is dominated by the terrestrial bromeliaceae *Neoglaziovia variegata* (Arr. Cam.) Mez, and the forbs[2] *Herrissantia crispa* (L.) Briz. And *Selaginella convoluta* Spring.

Research

It was conducted from May 1981 to May 1984, and four grazing intensities (GI) were tested: heavy grazing (H), 1 doe/ha; moderate grazing (M), 1 doe/2 ha; light grazing (L), 1 doe/3 ha; exclosure (Excl.), without use. Except Exclosure, the other GI had two replications, totaling seven paddocks. As 15 does were used per replication, areas have varied from 15 to 45 ha, totaling 220 ha, with the Exclosure of 40 ha.

The first evaluation of the herbaceous stratum was done in May 1979, before animals had been introduced into the paddocks. Macro plots (100 m^2) were marked systematically in the paddocks, in the following number: 6 macro plots in GI-heavy (RI and RII), GI-moderate (RI), GI-light (RI) and Exclosure, and 12 macro plots in GI-moderate (RII) and GI-Light (RII). In each macro plot, frequency of herbaceous species and seedlings density of ligneous species (height < 0.5 m) were determined once annually in May by randomly placing five 1-m^2 (2 x 0.5 m) quadrats.

Data on frequency of herbaceous species and on woody species seedlings density were submitted to analysis of variance, considering the effect of grazing intensities and of years.

Data on new plants of the tree *Tabebuia spongiosa* Riz. were not included in Tables 4 and 5 because there was

[2] Editor's note: Forb is any herb other than grass.

an intensive germination in 1983 (mean = 18.9 plants/m^2). The causes of this high germination are unknown. The same occurred in Albuquerque (2003) (mean = 22.1 plants/m^2), and a significant ($P < 0.01$) positive linear relation was detected between tree and new plants densities.

RESULTS AND DISCUSSION

There were 31 herbaceous species which occurred with an average frequency higher than 3%, considering the means calculated over 5 years, including 1979, and the 7 experimental units. Plant types were distributed as follows: pteridophyte, 1 species; monocotyledonous, six species (5 grasses and 1 sedge); and dicotyledonous, 24 species. The limit of 3% has been chosen arbitrarily. Other five species were not considered for analysis. Two of them had identification problems. *Cleome rotundifolia* (Mart. e Zucc.) Iltis., *Crumenaria decumbens* Mart. and *Solanum aculeatissimum* Jacq. had mean frequencies of only 0.48%, 0.62%, and 2.68%, respectively.

There was a remarkable variation in frequency of most of the herbaceous species through the years. This was probably due to variation in precipitation. Based on this aspect, these species were divided into three groups (Table 2). In Group 1 the species frequencies were strongly influenced by rainfall. However, the highest frequency occurred in 1984. Group 2 had the same reaction of Group 1, but its highest frequency was in 1983. Group 3 was little influenced by rainfall. In Group 1, the frequency of its 17 species was remarkably influenced by precipitation (Table 3) and a linear correlation was detected between precipitation in the period February-April and their mean frequency (Fig. 1), considering in this analysis the data collected in 1979. These data of Group 1 are in accordance with data obtained on cattle research (Albuquerque, 1999). In this research, species were also divided into three groups, although Group 1 had only 16 species. Another coincidence is the list of species presented in this group in both researches, with the exception of *Microtea scabrida* Urb. and *Diodia teres* Walt., which in Albuquerque (1999) belonged to Groups 2 and 1 respectively, and of *Piriqueta* sp., which is present in this research and absent in the former one. This means that the herbaceous species have maintained the same behavior in both areas, although they have been grazed by different herbivores. In another Caatinga area, Araújo Filho (1985) detected that herbaceous plants reacted more to fluctuations in rainfall than to livestock use. Group 3, which was not influenced by rainfall, was comprised of two very important Caatinga forbs, *Selaginella convoluta* and *Herissantia crispa* (Table 2). *S. convoluta* is a revivescent pteridophyte that passes the dry season completely desiccated, i.e. in air dried stage with a saturation deficit of up to 72-74% (Morello, 1954). These two species were important, since on a small ranch near the experimental site they provided 70% of the herbaceous phytomass at the end of the dry season (Leal, 1996).

There was no effect of grazing intensities on frequency changes of herbaceous species in Groups 1 and 2 (Table 3). However in Group 3, the mean frequency change was significantly higher ($P < 0.05$) in light grazing treatment than in the other treatments, this being an indication that light grazing benefited species composing this group. It might have been some influence of a local factor because in a 220 ha area it might there be enough variation among experimental units. Regarding *S. convoluta*, Albuquerque *et al.* (2001) detected a positive linear relation between this species and *N. variegata* frequencies. Both species of Group 3 presented in light grazing in 1981 the lowest frequencies of the whole experimental period, with means of 20.6% and 10.0% for *S. convoluta* and *H. crispa*, respectively; these 1981 data served as reference to calculate latter changes in frequency. So, if there was influence of local factor, and light grazing in 1981 presented the lowest frequency values, there would be always the chance that the changes in the following years in relation to 1981 would be high, producing this significant influence, that would be mostly the result of a coincidence.

Frequency data might not have been sensitive enough to measure the effects of grazing intensity. Hacker (1984b), in a semi-arid Australian range, came to the same conclusion in relation to the forbs, which in the present research are the majority. On the other hand, in a dense vegetation with a forage phytomass of ca. 1.000 kg/ha, distributed equally in both herbaceous and woody strata (Albuquerque & Bandeira, 1995), goat diets were made up of herb and shrub leaves, decreasing the grazing pressure on the lower stratum. Goat preference for the ligneous stratum species has been registered a long time ago (Edwards, 1948). In addition, among the three livestock species, goats make more use of the ligneous stratum in comparison to cattle and sheep (Harrington, 1978; Squires, 1982). In a Caatinga at Sobral municipality, Ceará State, the ligneous stratum during the rainy season was significantly more present in goat diet than in sheep diet (40.5% vs. 22.1%) (Pfister & Malechek, 1986), while in another Caatinga submitted to thinning and slashing, the participation of the ligneous stratum in goat diet during the rainy season was significantly higher in native Caatinga in comparison to that submitted to thinning and slashing (Schacht & Malechek, 1990). On the other hand, the high density of *N. variegata*, and the presence of other thorny species in the lower stratum such as *Bromelia laciniosa* Mart., another terrestrial bromeliaceae and some cactus species could form micro-sites, protecting the herbs from overuse, and providing them the opportunity to set seed.

Of the 31 herbaceous species in analysis, 13 occurred less frequently in the Exclosure, the same trend referred by Albuquerque (1999). This data might be the effect of resting that tends to make Caatinga denser, decreasing the space for the herbs. Most of the research on grazing in native pastures has been done in USA, where ranges are dominated by grasses and forbs, and resting in this type of pasture favors the return of the existing plants before disturbance. Dyksterhuis (1949) based his work on such pastures, and

Table 2. Frequency of herbaceous species in 3 groups (Group 1 = very influenced by rainfall but with highest frequency in 1984; Group 2 = same as Group 1 but with highest frequency in 1983; Group 3 = little influenced by rainfall), in the period 1979-84 (except 1980).

Group/Species	Plant class	Frequency (%)					
		1979	1981	1982	1983	1984	**Mean**
Group 1 (17 species)							
Paspalum scutatum Nees ex Trin.	Grass	0.26	5.04	0.74	0.48	9.16	**3.13±3.9**
Eragrostis ciliaris (L.) R.Br.	Grass	2.40	5.48	0.00	4.05	6.23	**3.63±2.5**
Piriqueta sp.	Forb	0.00	1.19	2.16	9.52	9.65	**4.51±4.7**
Hyptis suaveolens (L.) Poit.	Forb	0.00	9.31	0.48	7.14	7.16	**4.82±4.3**
Polygala brizoides St. Hil.	Forb	1.43	11.49	3.87	10.56	18.10	**9.09±6.6**
Marsypianthes chamaedrys (Vahl.) Kuntze.	Forb	0.00	0.00	0.00	13.70	41.32	**11.00±18.0**
Mitracarpus frigidus K. Schum.	Forb	0.95	24.98	0.24	10.91	20.06	**11.43±11.1**
Microtea scabrida Urb.	Forb	0.00	12.06	0.00	16.21	31.52	**11.96±13.1**
Borreria ocymoides DC.	Forb	0.00	18.16	0.71	5.97	40.17	**13.00±16.8**
Gymnopogon rupestris Ridley	Grass	7.21	19.87	6.99	26.47	41.19	**20.35±14.3**
Cuphea sp.	Forb	2.14	36.47	1.43	15.58	48.94	**20.91±21.1**
Turnera pumilea L.	Forb	0.71	23.42	10.61	40.71	53.18	**25.73±21.4**
Cyperus uncinulatus Schrad. ex Nees	Sedge	0.95	34.61	20.61	24.00	49.09	**25.95±17.8**
Phyllanthus niruri (L.) Müell. Arg.	Forb	3.38	41.86	0.74	37.55	59.20	**28.55±25.5**
Schwenkia americana Roy ex L.	Forb	8.10	39.89	4.78	38.44	58.64	**29.97±22.9**
Centratherum punctatum Cass.	Forb	20.35	50.76	7.14	31.19	64.42	**34.77±23.0**
Panicum trichoides Sw.	Grass	20.35	59.59	0.48	52.79	79.10	**42.46±31.6**
Mean		**4.01**	**23.19**	**3.59**	**20.31**	**37.48**	**17.72±14.3**
Group 2 (12 species)							
Macroptilium martii Benth.	Forb	0.00	0.95	0.24	10.52	5.24	**3.39±4.5**
Croton glandulosus (L.) Müell.Arg.	Forb	0.00	0.97	4.07	15.11	4.57	**4.94±6.0**
Pavonia cancellata (L.f.) Cav.	Forb	1.90	2.38	1.90	16.25	7.21	**5.93±6.2**
Portulaca oleracea L.	Forb	0.00	0.78	0.00	16.95	11.65	**5.87±7.8**
Diodia teres Walt.	Forb	0.50	8.12	2.64	10.26	9.55	**6.21±4.4**
Croton lobatus (L.) Müell. Arg.	Forb	0.00	3.33	1.43	15.37	14.26	**6.88±7.3**
Brachiaria mollis (Sw.) L. Parodi	Grass	4.11	0.48	2.40	38.33	18.12	**12.69±15.9**
Triumfetta sp.	Forb	6.23	10.87	12.7	25.71	18.23	**14.66±7.5**
Bernardia sinoides Müell. Arg.	Forb	0.48	6.95	14.48	33.70	21.67	**15.45±12.9**
Althernanthera brasiliana (L.) Kuntze	Forb	8.05	20.91	16.21	29.87	27.12	**20.43±8.7**
Hybanthus calceolaria (L.) G.K. Schulze	Forb	1.90	27.29	4.55	46.75	40.63	**24.23±20.4**
Corchorus argutus H.B.K.	Forb	14.44	38.68	7.66	59.05	58.38	**35.64±24.0**
Mean		**3.13**	**10.14**	**5.65**	**26.49**	**19.72**	**13.03±9.8**
Group 3 (two species)							
Herissantia crispa (L.) Briz.	Forb	25.04	16.91	24.61	29.37	27.75	**24.74±4.8**
Selaginella convoluta Spring.	Pteridophyte	40.35	50.17	52.32	48.51	58.10	**49.89±6.4**
Mean		**32.70**	**33.54**	**38.47**	**38.94**	**42.93**	**37.31±4.2**

recognized that rest in woodlands does not lead to range dominated by herbaceous plants, but to denser wood vegetation, diminishing the space of the herb species. On the other hand, 11 species presented highest frequency in moderate grazing RI (1 doe/2 ha). This might be explained by the browsing that opens the ligneous stratum, leaving space for the herbs, but it might also be explained again by local factor, because only two species showed highest frequency in moderate grazing RII. If the effect was of grazing that would open the bush, both areas would present approximately the same number of species with highest frequency.

In Caatinga vegetation, the first evidences of degradation caused by overgrazing would appear in the lack of regeneration of woody species, that is, in the disappearance of seedlings of theses species. Seedlings density was affected by grazing intensities and by years (Table 4). The relative

mean density in the period 1982-84 was higher in moderate grazing (1 doe/2 ha), being superior ($P < 0.05$) to Exclosure, and this fact takes to the conclusion that the effect might not has been due to GI. As occurred with herb species, it might be that Caatinga in rest tends to suppress the appearance of seedlings. If there had been harmful effect of GI, relative density would have been higher in Exclosure. On the other hand, Exclosure had only one repetition, putting it in disadvantage in relation to the other treatments.

In the dry season, goat diet in native Caatinga is similar to sheep diet, both livestock species making much use of the lower stratum, mainly of herbaceous parts (stems + leaves) and dried leaves. In a Sobral native Caatinga during the dry season, goats and sheep made more use of woody species leaf litter in comparison to herbaceous stems, although this was an important diet component throughout the study (Kirmse *et al.*, 1987). In the present study, it is probable that even in highest GI, that is, in heavy grazing (1 doe/1 ha), intake of leaf litter has been high, consequently decreasing intake of herbaceous stems including intake of seedlings stems, and decreasing the probability of destroying them. Friedel (1986), in the Australian semi-arid, detected the influence of overgrazing from sheep and rabbits on woody seedlings, and that the potential of disappearance of ligneous stratum in a long term was high. As in the dry season, goat browsing habits are similar to sheep, it is probable that a high grazing intensity by goats in a long term would cause destruction of woody seedlings and would degrade Caatinga ligneous stratum. On the other hand, Caatinga is dense vegetation and this aspect makes its ligneous stratum less susceptible to overgrazing, because these plants are not isolated the animals would have the tendency to browse all adult woody plants equally. In Australian ranges dominated by herbaceous stratum, isolated mid-storey shrubs were more susceptible to overgrazing in relation to shrubs under tree canopies, as detected by Hacker (1984a).

Another aspect is that in cattle research (Albuquerque, 1999), neither seedlings nor shrubs of *Spondias tuberosa* Arr. Cam. were found. In this present goat research, seedlings of that tree were found in 1983 in heavy grazing (RI and RII) and in 1984 in light grazing (RII); that is, among the three areas, two of them were under high intensive use. This is an indication that heavy grazing was not the cause of absence in cattle research. Another indication is that, even during the three dry seasons of the research period, there was no variation on does' body weight, in comparison to

Table 3. Mean variation in frequency in the period 1982-84 in relation to 1981, of three groups of herb species (Tab. 2), in a Caatinga under four GI by goats [heavy (H) = 1 doe/1 ha; moderate (M) = 1 doe/2 ha; light (L) = 1 doe/3 ha; Excl = Exclosure].[3]

Groups	Year				Grazing Intensity (GI)				Mean	CV(%)
	1981	1982	1983	1984	H	M	L	Excl.		
Group 1	100.0	14.8 C[1]	88.9 B	162.4A	91.4 a	88.0 a	84.7 a	92.6 a	88.7[2]	22.0
Group 2	100.0	54.4 C	268.8A	198.8 B	154.4 a	168.6 a	185.1 a	201.6 a	174.0	20.9
Group 3	100.0	118.6 A	123.3A	135.3 A	106.1 a	125.8 a	146.2 b	124.2 a	125.8	11.3

[1]Means within each factor, with same letter in the line do not differ (Duncan, $P < 0.05$); [2]Mean of both factors. To GI factor, mean is pondered because Excl. had only one repetition; [3]Data of this table also included in the paper "Dinâmica do estrato herbáceo de uma vegetação de caatinga do Sertão de Pernambuco, sob intensidades de uso por caprinos" (7 pages), published in CD-ROM of the 40ª Reunião Anual da Sociedade Brasileira de Zootecnia (SBZ). Santa Maria, RS, Brazil, July 2003.

Table 4. Density of woody species seedlings in the period 1981-84 in a Caatinga under four grazing intensities (GI) by goats [heavy (H) = 1 doe/ha; moderate (M) = 1 doe/2 ha; light (L) = 1 doe/3 ha; Excl. = exclosure], and mean alteration in density in the period 1982-84 in relation to 1981, taken as 100[4].

Year	Seedlings (height < 0.5 m) density (number/m^2)[1]							Mean
	H-RI	H-RII	M-RI	M-RII	L-RI	L-RII	Excl.	
1981	1.767	2.967	0.867	2.250	2.067	2.133	6.500[2]	2.650
1982	0.967	1.633	1.333	1.700	2.100	1.933	3.600	1.895
1983	1.233	2.033	1.100	2.283	1.534	2.633	3.567	2.055
1984	4.133	4.233	2.267	2.833	1.800	2.067	3.700	3.005
Mean	2.025	2.717	1.392	2.267	1.875	2.192	4.342	2.401
1981	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1982	54.7	55.0	153.7	75.6	101.6	90.6	55.4	83.8 b[3]
1983	69.8	685	126.9	101.5	74.2	123.4	54.9	88.5 b
1984	234.0	1427	261.5	125.9	87.1	96.9	56.9	143.6 a
Mean/R	119.5	88.8	180.8	101.0	87.6	103.6	55.7	105.3
Mean/GI	104.1 AB		140.9 A		95.6 AB		55.7 B	

[1]Seedlings of the tree *Tabebuia spongiosa* Riz. are not included; [2]Data of the column already published in Albuquerque (1999); [3]Means with same lower case letters in the column, and with same capital letters in the line are not statistically different (Duncan; $P < 0.05$); [4] Data of this table also included in the paper "Dinâmica do estrato herbáceo de uma vegetação de caatinga do Sertão de Pernambuco, sob intensidades de uso por caprinos" (5 pages), published in CD-ROM of the 40ª Reunião Anual da SBZ. Santa Maria, RS, Brazil, July 2003.

Table 5. Mean density (number/m²) of woody species seedlings in the period 1981-84 in a Caatinga under grazing intensities by goats.

Woody species	Density
Shrub species	**0.607**
Bauhia cheilantha (Bong.) Steud.	
Cordia leucocephala Moric.	0.265
Croton rhamnifolius (Kunth em.) Müell. Arg.	0.207
Jatropha mollissima (Pohl.) Baill.	0.151
Argythamnia gardneri Müell. Arg.	0.109
A liana species ("cipó-branco")	0.104
Calliandra depauperata Benth.	0.102
Lippia microphylla Cham.	0.055
Croton sonderianus Müell. Arg.	0.032
Other shrub species	0.164
Tree species	
Mimosa arenosa (Willd.) Poir.	0.126
Commiphora lepthophloeos (Mart.) J.B. Gillet	0.126
Manihot pseudoglaziovii Pax & K. Hoffm.	0.125
Caesalpinia microphylla Mart.	0.095
Sapium lanceolatum (Müell. Arg.) Herbert.	0.047
Mimosa tenuiflora (Wildd.) Poir	0.015
Acacia piauhiensis Benth.	0.008
Cnidoscolus phyllacanthus (Pohl.) Müell. Arg.	0.005
Spondias tuberosa Arr. Cam.	0.003
Other tree species	0.011
General total (shrubs + trees)	**2.401**

wet seasons (Salviano & Guimarães Filho, 1987). Even in the dry season, there was some available forage and grazing pressure was not high. This observation on *S. tuberosa* is brought up because Santos *et al.* (1999) cite extensive grazing as one of the causes that has impeded the natural replacement of old plants by new ones, but for the author, there are no evidences of this fact. The lack of replacement of that tree is a worrying aspect, because *S. tuberosa* is one of the most important Caatinga fruit trees, providing employment for many people in gathering fruits during the two month fruiting season.

Regarding significant effect of year on new plants density, it was justly on areas under higher GI in which there was the highest increases in the last year, that is, in 1984 (Table 4). If there had been overgrazing, there was the tendency of its signals appearing with the passing of the years, that is, there would be the trend of density decreasing in areas under GI-heavy, in this case GI-heavy, and increasing density in areas under GI-light and in Exclosure, and this trend did not occur. Other factors might be involved. Albuquerque *et al.* (2001) detected a negative linear relation ($P < 0.01$) between *N. variegata* and new plants density in the period 1982-83, but not in 1984. This indicates a competition for moisture with *N. variegata* in drier years.

It is expected that seedling density by species (Table 5) would be more influenced by canopy cover than by density of adult plants, but in the present research tree and shrub strata were not evaluated. In Albuquerque & Bandeira (1995), 41% and 50% of shrub and tree stratum canopy covers were occupied by *C. rhamnifolius* and *M. tenuiflora*, respectively, and supposing that proportion also occurred in present research, this did not reflect on seedling density, because both species stayed in third and sixth places among shrub and tree species, respectively. Angevine & Chabot (1979), reviewing this matter, emphasized the deficiency of good studies on ligneous species germination in general, and on tropical species in special. Setterfield & Williams (1996) verified that post-dispersion conditions for germination and establishment are probably more important than seed supply.

From this research, the following conclusion might be drawn: high grazing intensities by goats were not sufficient to cause differences in frequencies of herbaceous species, and in densities of woody species seedlings, there is no vegetation degradation. Precipitation was the most important factor, as it has influenced the herbaceous species frequency and the young plants density.

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