TERRESTRIAL CACTI ASSEMBLAGE IN EXTREME SOUTH OF BRAZIL (RS, BRAZIL)

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INTRODUCTION

The Cactaceae Juss. is a Neotropical endemic and threatened family which plays an important role in conservation meanings in South America (Hunt, 1999; Oldfield, 1997). Its occurrence in extreme south of Brazil is well represented by terrestrial species distributed across its southern state, which is considered, together with its neighbor's countries, one of the most important cacti diversity and endemism centers in the world (Ortega - Baes & Godínez - Alvarez, 2006).

The fields from southern part of Rio Grande do Sul (RS) are significant to embrace conservation goals, since it concentrate a high number of endemic, non - endemic and threatened taxa as the one classified into the Tribes Notocacteae, the genera *Parodia* and *Frailea*, and Trichocereeae, the genus *Gymnocalycium* (Oldfield, 1997).

IUCN (International Union for Conservation of Nature) already pointed out that even basic information, as overall Floras, are missing at state level for larger countries of South America as Brazil. It highlights that field surveys are needed to assess the taxonomic and conservation status of these taxa and to investigate the possibilities for in situ conservation (Oldfield, 1997). However, for this specifically region there are a descriptive survey promoted by the government and a set of studies about cacti pollinators (Schlindwein, 1995a; Schlindwein, 1995b; Schlindwein, 1998).

These taxa rocky outcrops habitats are under strong anthropogenic pressure mainly promoted by agricultural activities, overgrazing, illegal collection for international trade market and more recently been aggravated by the conversion of open landscapes into exotic forests because of the large scale silviculture. Beside this, there is a lack of protected areas to guarantee that at least "minimum viable population" can be preserved, reinforcing the urgency to know how the cacti are in nature. These are some of others reasons that justify this preliminary study as so essential.

Thereby, understand how this family is ecologically structured is fundamental to support priority conservation actions, once it is one of the criteria requirement from IUCN Red List at Regional Level (Ginsburg, 2001). Informations containing basically ecological traits are still scarce, especially those concerning about the way how cacti occur and are structured naturaly in this part of Brazil. Fact that corroborates to increase conservation efforts directed for this region.

OBJECTIVES

This work aims to describe how the terrestrial cacti are ecologically organized and structured in extremely south (southernmost) Brazilian rocky outcrop fields, quantifying it through important ecological community measures that include cacti species richness, relative abundance (RA) and diversity-reflecting both number and relative abundances of species (Morin, 1999; Begon *et al.*, 006). How many species can be found in southernmost RS? Do they differ in abundance? Are they randomly distributed? Are the outcrops dissimilar in species composition and abundance? How diverse are outcrops?

MATERIAL AND METHODS

Study Area

The data were collected on the southern of Rio Grande do Sul state (31^0 53' S,53^0 38'W), more specifically in the rocky outcrop from livestock fields between Pedras Altas and Herval do Sul cities, from may 2008 to may 2009. The study landscape at this area is delineated by soft hills covered mostly by grassland matrix permeated by rocky outcrops, with altitudes varying around 200 m. The geological substrate is characterized by the transition of a geomorphologic unit (Serra do Sudeste), mostly constituted with a complex of Pre - Cambrian rocks (Radambrasil, 1986). This region is influenced by subtropical climate.

Field Survey

At first, to sample designing, 15 outcrops were chosen by randomly draw from a previous set at landscape level. In each of these were plotted linear transects with contiguous samples of 1m2, inside of which the cacti species presence - absence (1=present, 0=absent) and its number of individuals were registered. The transects were north oriented, always trying to follow the outcrop longer axis. Species classification followed Hunt (1999). The samples had different sizes and were standardized by considering the minimum of 25 samples or at least 40 individuals.

Data processing

The relative abundances (RA) were estimated for each species to normalize sampling. Each outcrop was considered as independent sample units. To verify if there is any change in the cacti community structure exploratory multivariate non - parametric ordination analyses (NMDS) was applied using raw RA values and the Bray - Curtis distance index to verify the species composition. For a better configuration from the ordination diagram, the STRESS (Standardized Residual Sum of Squares) were measured to check how much the ordination diagram differ from original distances, all this via the program Past v.1.87 (Hammer & Harper 2008).

To see if there are similarities between outcrops in the way how cacti occur in each one, a Cluster Analysis based on similarities measures was made, being analyzed through Ward's Method algorithm and moderated Euclidian Distance, trying to minimize the intra - group variation and to maximize the variation between groups.

The Null Models of species co - occurrence were used to experiment the null hypothesis of random structure in the cacti assemblage. The metric used was C - Score index and the number of checkerboard. The totals were maintained constant in rows (species) and columns (outcrops), keeping the values of original matrix for both (Gotelli, 2000). The observed matrices were randomly 5.000 times for each analysis and the degenerated matrices were discarded because there aren't any empty row or column and because of fixed - fixed constraints. For all the analysis the program EcoSim v.7.72 were used (Gotelli & Entsminger, 2001).

The diversity between outcrops was estimated by using rarefaction based on individuals and calculated through Shannon index(H').

RESULTS AND DISCUSSION

In 1375 samples were recorded 1205 cacti individuals of eight different species from three genera. *Gymnocalycium denudatum* (Link & Otto) Pfeiff ex Mittler was the dominant specie, achieving 52% of sampled individuals, followed by *Parodia langsdorfii* (Lehmann) Hunt with 17%, *Frailea phaeodisca* (Spegazzini) Spegazzini with 12%, *Parodia mammulosa* (Lemaire) Taylor with almost 9% and *Parodia ottonis* (Lehmann) Taylor with 6%, while *Parodia concinna* (Monville) Taylor, *Frailea gracillima* Lemaire Britton & Rose and *Parodia scopa* (Spreng) Taylor obtained a little more than 1% each. Half of individuals were concentrated in a single genus of single specie, while the other half corresponded 41% in five species of Parodia and 10% in two species of *Frailea*.According with the red list of threaten flora species at state level, the less common *F.gracillima* is fitted in the endangered category just like *P.mammulosa*, while the common one *F.phaeodisca* and *G.denudatum* are critically endangered as the casually *P.concinna* and *P.scopa* do, being the *P.langsdorfii* and *P.ottonis* vulnerable.

G.denudatum, *P.concinna* and *P.scopa*, were already cited for this region as well as *Frailea* was. This last is considered restricted to the lowlands of southernmost of RS (Braun & Hofacker, 2006) and in this study seems to have an interesting contribution to the community structure, sometimes collaborating with abundance values and other increasing the species composition with low species abundance, maybe suggesting its tendency to rarity. But to confirm this, some aspects should first be identified to determinate its type and degree of rarity (Rabinowitz, 1981): geographic distribution, population density and habitat specificity. The tendency of many cacti species to be categorized as rare is related with their restricted distribution and consequently high endemism, represented in this case by the above cited species and from the other genera also.

A very well known pattern in community ecology is that few dominant species tend to be more common than others, playing an important role in schemes used to identify and categorize communities (Morin, 1999). The cacti abundance, as much as their distribution suffer important influence of several environmental factors acting at different levels (Ruedas *et al.*, 006). In this case, the *G.denudatum* dominance, for example, could be an implication of some intrinsic features as their flats globosely form that can give resistance, allowing it to relay under overgrazing and trample pressure or even reproductive strategies as pollination, seed production and recruitment success giving it population advantages. Usually dominant species are considered as better competitors, but depending of scale, dominant species could be reflecting other kind of patterns or process underlying the community structure. To assess what is true in this case it will be necessary more powerful methods to identify and to affirm which could be the factors that are acting over species abundance, remembering that those could be many, from many orders, occurring in different scales.

Analysing the community structure through non - parametric method was possible to observe that the species share similarities, specially those three dominant that together formed a group, constituted by the three genera. By the way, the diagram distances reflected the original distances (stress = 0,1925), because there was a basic species composition occurring in great part of outcrops by a similar way. Thus, to keep cacti community is interesting to reinforce the importance of these genera and species as essential elements for conservation goals.

The distances between outcrop dissimilarity were not large, what can corroborates to confirm that they share a basic structure incremented by common species and some other with different abundances, perhaps the rare one. Species with different distribution range can present particular treats as ecological generally and a high potential for colonization, enhancing their probabilities to be frequently found in several places (islands) (Paes & Blinder, 1995)

However, the species distribution in the community does not give a congruent pattern. The C - Score index observed for cacti matrix was almost equal to the estimated one (obs= 2,57143; exp= 2,21274; DP= 1,91712; P=0,0560), indicating that they are probably randomly distributed. Not even sign of competitive pattern were observed between cacti in the analyzed community, because there aren't any perfect pairs of checkerboard, it was non - significant (obs= 6; exp= 5,52840; DP= 0,51685; P=0,47020). Stressed habitats, where cacti can be found for example, are usually described as competitive environmental because of scarcely resource (Begon *et al.*, 2006). Despite of it, a recent study about cacti in the Sonoran Desert showed that they keep nurse relationships with other plants, been non - random distributed (Drezner, 2005).

The diversity ranges from 0,39 to 1,26, being the values reaching one very common throughout the outcrops. They do not presented a wide range of diversity like the one found in more productive ecossystems.

CONCLUSION

The total of species found in southernmost of RS are relativaly low, but important in conservation means since it embrace the three most important genera. This species occur with different abundances, but by a similar way among outcrops. However, the diversity values shows that the outcrops share proximal values. The species almost tend to co - occur, what can indicates that some process also need to be preserved after identified.

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