Global Scientific JOURNALS

GSJ: Volume 7, Issue 11, November 2019, Online: ISSN 2320-9186

www.globalscientificjournal.com

EPIPHYTIC BRYOPHYTES OF *Syagrus coronata* (Mart.) Becc. (LICURI) IN BOQUEIRÃO DA ONÇA - BAHIA, BRAZIL

Elaine Mayara Bonfim Nunes, Maria Jaciane de Almeida Campelo

ABSTRACT

Bryophytes are considered pioneer organisms, since they were the first to inhabit inhospitable places and to transform them into favorable environments to the emergency of other species. The aims of the current research are to investigate epiphytic bryophytes of *Syagrus coronata* (Mart.) Becc. (Licuri) under the effect of yearly seasonality, based on the interaction between abiotic microhabitat factors (phorophytes) and bryophytes, as well as to investigate the reproductive biology of common species found in the analyzed phorophytes. Boqueirão da Onça comprises an area of 820,000 hectares in Northern Bahia State, where the Ministry of Environment plans to make the largest conservation unit in the Caatinga biome . Botanical material was collected in 50 organisms (georeferenced) of *S. coronata*, in two regions: sheath and stem (stipe). The association between species diversity and proximity to environment with waterbodies and to ruderal environment were calculated based on Pearson correlation coefficient (r). Analysis of variance (ANOVA) used factorial analysis replication to compare two treatments (sheath and stem), three blocks (dry-rainny-dry) and five repetitions (sampling units), as well as to evaluate the reproductive system in the. BioEstat 5.0 software. Shannon diversity (H') and Equitability (J') indices were used to compare species diversity and equitability between epiphyte incidence regions under the influence of yearly seasonality. Data were analyzed in the Alpha diversity indices software. Six species distributed in six genera and families, respectively, were indentified. The inventory comprised five mosses and liverwort species. The identified moss species comprised *Leucobryum albicans* (Schwaegr.) Lindb., *Fabronia ciliaris* (Brid.) Brid. var. *polycarpa* (Hook.) W.R.Buck, *Helicophyllum torquatum* (Hook.) Brid., *Leucoloma cruegerianum* (Müll. Hal.) A. Jaeger and *Tortella humilis* (Hedw.) Jenn. The liverwort species recorded in the current study was *Frullania ericoides* (Nees) Mont. Overall, it was possible proving the association noticed during epiphyte collection and sorting procedures: species are more abundant in sheaths than in stems ($F= 4.2985$; $p <0.05$). Thus, there were not statistically significant changes in the number of species ($F=1.7015$; $p < 0.20$) between 2013 and 2014.In addition, there was not change in the number of species when sheath/stem and interaction with seasons were analyzed together ($F=0.6269$; $p < 0.54$). Thus, the sheath region (H'=1.141; 1.002 ± 1.256) recorded higher especies diversity index than the stem region (H'=0.443; 0.3501 ± 0.5242). Similar equitability data were observed for the sheath (J'=0.636; 0.5594 ± 0.7008) and stem (J'=0.639; 0.5051 ± 0.7563) regions. Moss species *H. torquatum* preferred type of reproduction was identified based on its intense sporophyte production. Thus, sporophytes were abundant during the dry season, but scarce during the rainny season (97.2% vs. 2.8%, respectively. N =1,139; G=9.88; P=0.015). Therefore, it is possible stating that such analyses enabled better understanding the epiphyte bryophyte community living in the Caatinga.

Keywords: Cryptogams. Epiphyte. Community structure. Caatinga.

INTRODUCTION

Bryophytes are small plants of simple organization. They are cryptogams (without flowers), archegony (with archegons), embryophytes (develop embryo from zygote) and avascular (BRITO; PÔRTO, 2000). These cryptogams comprise a group of plants that share several features such as haploid generation dominance, poikiloidria, reproduction through spores and different asexual diaspores (LONGTON; SCHUSTER, 1983; SANTOS; SILVA; OLIVEIRA, 2015; SHAW, 2000).

Bryophytes are considered pioneer organisms, since they were the first individuals to inhabit rocks, degraded areas, among other places, as well as to turn them into environments favorable to the emergence of more demanding plant species (LISBOA; TAVARES; COSTA-NETO, 2006). They are bioindicators, since the presence or absence of a given species provides important information about the quality of the air or even about disturbances deriving from urbanization processes (CÂMARA; TEXEIRA, 2003).

According to Pharo and Zartman (2007), bryophytes' features such as fast colonization and extinction rates, fast generation time, high substrate specificity and dominant haploid generation make them an ideal plant group to evaluate ecological and evolutionary impacts of habitat fragmentation. These features can be used in experiments to test predictions based on the metapopulation theory and on population genetics (ZARTMAN; SHAW, 2006). Bryophyte colonies tend to be distributed as small patches that are separated from each other in the environment; they behave as subpopulations of a single metapopulation (SÖDERSTRÖM; HERBEN, 1997). According to Maciel-Silva (2011), exclusively female or male populations of dioecious species are likely to be found; their level of isolation from other populations affects female individuals' chances of fertilization and sporophyte formation.

Studies about epiphytic bryophytes in tree gradients in Brazil were restricted to the Atlantic Forest ecosystem; they were carried out in forests undergoing different succession stages (COSTA, 1999) or in forest fragments at different conservation states (ALVARENGA; PÔRTO; OLIVEIRA, 2009; SILVIERO; LUIZI-PONZO, 2015). Thus, studies about of such bryophytes can enable a more comprehensive inventory of the flora in a given area (BASTOS, 2015; RISTOW; SHAFER-VERWIMP; PERALTA, 2015; TAVARES-MARTINS; LISBOA; COSTA, 2014).

Alvarenga and Pôrto (2007) have indicated that epiphyllous and epiphytic bryophytes found in the assessed areas presented negative response to habitat fragmentation, either by decreasing in abundance (epiphyllous bryophytes) or in richness (epiphytic bryophytes). In addition, fragmentation overall leads to increased number of representatives in larger niches (generalists), whereas the number of species in smaller niches decreases (microhabitat specialists) (CARMO; GASPARINO; PERALTA, 2015).

© GSJ

GSJ: Volume 7, Issue 11, November 2019
ISSN 2320-9186

Yano; Andrade-Lima (1987) have performed an inventory of bryophytes deriving from several Caatinga-ingrown wetlands (regionally called swamps) in Pernambuco State. It is also worth mentioning the study by Pôrto (1990), who listed 107 species in Brejo dos Cavalos, Caruaru County - PE. Subsequently, studies by Pôrto et al. (1994) observed 16 bryophyte species (14 belonging to class Bryopsida and 02 to belonging to class Hepaticopsida) in the caatinga region of Agrestina County - PE. Bryaceae and Fissidentaceae were the families recording the highest specific representation in the area. Most collections have indicated prevalence of terricolous and saxicolous species, which were followed by corticicolous and epixylic species; thus, there was not preference for the cortex of phanerogamous plants.

The literature about the Caatinga in Bahia State remains insipient. Brito (2010) has conducted a study focused on investigating the bryophyte flora in Chapada Diamantina, based on herbarium collections and samples; he listed 29 species - 18 of them were exclusive to the investigated ecosystem, although they were found on different substrate types.

Given the low expressiveness of studies focused on investigating bryophyte species in the Caatinga, the aims of the present study were to investigate the community of epiphytic bryophytes belonging to species *Syagrus coronata* (Mart.) Becc. (Licuri), under the effect of early seasonality, based on the interaction between abiotic microhabitat factors (phorophytes) and bryophytes, as well as to assess the reproductive biology of species often found in Boqueirão da Onça, Bahia State. Thus, the current research is expected to contribute to the scientific knowledge about the epiphytic bryoflora in the Caatinga ecosystem.

MATERIALS AND METHODS

Study site

Boqueirão da Onça Park - newly created by Decree N. 9.336, from April 5, 2018 - is located in Northern Bahia State and encompasses counties such as Campo Formoso, Juazeiro, Sento Sé, Sobradinho and Umburanas. It has prevalence of Caatinga vegetation, but it also presentes plant species belonging to biomes such as Rupestrian Grassland, Cerrado, Amazon and Atlantic Forest. Besides the rich biodiversity, the region has archaeological sites and caves, which have great potential for ecotourism and for unprecedented scientific research.

Eutrophic Litholic Neossol is the prevalent soil of the region; it is typical of rugged-terrain regions that are rich in ridges and mountains, and often associated with rocky outcrops (EMBRAPA, 2006). According to Köepen classification, the climate in the region is Bswh, which corresponds to a very hot semiarid region. The mean annual temperature is 24.1ºC - minimum temperature of 19.6 ºC and maximum temperature of 33.4ºC (NIMER, 1972). Its incredible scenic beauty is portrayed in the most diverse landscapes, where it is possible finding extensive dry palm marshes, dry or wet estuaries and extensive plateaus (SCHUNCK et al., 2012).

PHOROPHYTE SELECTION

Phorophyte selection was carried out in sampling sites comprising environments with water-bodies and ruderal environments (places subjected to direct anthropic intervention), which were georeferenced with the aid of a Garmin Etrex® GPS receiver. It was an important demarcation in the random collection of phorophytes belonging to species *Syagrus coronata* (Mart.) Becc. (Licuri) in Boqueirão da Onça, BA. The selected area covers 01 ha (100x100m^2), all phorophytes in this area were approximately 1 m apart from each other.

The biological material was collected from 50 phorophytes, with five repetitions (sites) of 10 individuals per área, in the following periods: dry season I, rainny season and dry season II. Bryophytes were removed from two *S. coronata* regions: sheath and stem (stipe). The region known as sheath is the basis of older leaves' sheaths arranged in a spiral, whereas the stem (stipe) is the portion below the sheaths, the stem itself.

MATERIAL STOWAGE AND IDENTIFICATION

© GSJ

Specimens (approximately 10 cm^2) from epiphyte populations found in each phorophyte were collected with the aid of a spatula. Samples were placed in paper bags (26 x 10.5 cm) to enable recording data about place, date, collector, microhabitat features, height level, region (sheath or stem), collection time among other ecological data. Material collection and preservation methodologies were based on Yano (1984).

The collected material was subjected to taxonomic identification under stereomicroscope and optical microscope, based on specialized literature, at the Ecological Restoration Laboratory of the Reference Center for the Recovery of Degraded Caatinga Areas - CRAD / UNIVASF (BUCK, 1983,1998; DELGADILLO; CÁRDENAS, 1990; GRADSTEIN; PÓCS, 1989; PÔRTO et al., 1993; RICHARDS, 1984; SCHOFIELD, 1985; SEHNEM, 1970; SHARP et al., 1994; VALDEVINO et al., 2002; YANO, 1994). Life forms were identified based on Mägdefrau (1982) and Richards (1984), who described and illustrated their different growth forms, namely: cushion-like, dendroid, fan-shaped, pendant, weft-like, carpet-like or woven-like and in tuffs.

EVALUATION OF REPRODUCTIVE STRATEGIES

Gametangia and sporophytes belonging to the most frequent species were investigated in detail basd on stereomicroscopic observations, which took into conderation sporophytes' presence and maturation stage; as well as on light microscope evaluations focused on confirming and counting male (antheridia) and female (archegonia) gametangia. Sporophytes were individually counted per sample (10 cm^2), whereas gametangia were counted based on sex branch.

Collected samples were classified based on the following parameters: a) presence of antheridia b) presence of archegonia, c) presence of sporophytes and d) sterile (LONGTON; GREENE 1969). Sporophytes' maturation stage was also identified; they were classified into the following phenophases: immature (non-expanded capsule), mature I (mature capsule, although with operculum - indehiscent) and mature II (open capsule - dehiscent), per season. Data about gametangia (antheridia and archegonia) and sporophyte (phenophases: immature, mature I and mature II) production were analyzed in separate.

STATISTICAL DESIGN

Distance measurements in environemtns with waterbodies and ruderal environments were taken with the aid of the GPS Track Maker software. The diversity/proximity of environments ratio was calculated through the Pearson Correlation Coefficient formula (r).

The set of data obtained through Pearson Correlation Coefficient (r) was used to calculate the Simple and Multiple Linear Regressions, by adjusting the performed calculations and predicting the structuring model of epiphyte communities under the influence of both environments. Regressions were calculated through the following equations, basedon Demetrius (2002): Simple Linear Regression - $Yi = \beta 0 + \beta 1x1 + \varepsilon i$; Multiple Linear Regression - $Yi = \beta 0 + \beta 1x1 + \beta 2x2 + \varepsilon i$.

Analysis of variance (ANOVA) was used in the repetition factor analysis model, in which two treatments (sheath and stem), three blocks (dry - rainny - dry) and five repetitions (sampling sites) were compared. The BioEstat 5.0 software (AYRES et al., 2007) was used in the analyses.

The relative frequency of species was determined through the formula: F = n.100/N; wherein, n = number of times species X was recorded; and N = total number of individuals per phorophyte, multiplied by phorophyte height level. The following classes were determined: $F \leq 10\%$ = Sporadic; $10 < F \leq 30\%$ = Uncommon; $30 < F \leq 70\%$ = Frequent; and $F > 70\%$ = Very Frequent (DAJOZ, 1983).

Contingency tables were used, and the G test was applied, to compare the total number of antheridia and archegonia between two collection periods (dry and rainny). The same test was used to compare the total number of sporophytes in all three phenophases between dry and rainny periods.

RESULTS AND DISCUSSION

BRYOPHITE RICHNESS AND ECOLOGICAL FEATURING

Six species were inventoried based on the specialized literature (BASTOS; YANO, 1994; BRITO; PORTO 2000; BUCK, 1983,1998; YANO, 1995; YANO; SANTOS, 1993), namely: Frullaniaceae (*Frullania ericoides* (Nees) Mont.); Dicranaceae (*Leucoloma cruegerianum* (Müll.Hal.) A. Jaeger); Leucobryaceae (*Leucobryum albicans* (Schwaegr.) Lindb); Pottiaceae (*Tortella humilis* (Hedw.) Jenn.); Helicophyllaceae (*Helicophyllum torquatum* (Hook.) Brid.) and Fabroniaceae (*Fabronia ciliaris* (Brid.) Brid. Var. *polycarpa* (Hook.) W. R. Buck).

The species recorded in the present study are taxa with wide geographical distribution; they are not exclusive to urban environments and present increased incidence in these environments. These species are primary colonists and/or opportunists, i.e., they benefit from bright light (CARMO; GASPARINO; PERALTA, 2015). This factor explains the record of the aforementioned six epiphytic species in licuri palms grown in the semiarid region of Bahia State. The exsiccates were incorporated in the collection of Vale do São Francisco Herbarium – HVASF.

The species found in the current study, such as the ones belonging to families Fabroniaceae and Pottiaceae, can be considered typically tolerant to the exposure to light and intense heat (VALENTE; PÔRTO; BASTOS, 2013).

According to Glime (2007), drought-tolerant species, such as most bryophytes - whose leaves have a single layer of cells containing chlorophyll directly exposed to light - are well-adapted to high light conditions.

Therefore, the epiphyte bryophytes recorded in the current study are often found in at least three of the six most representative Brazilian phytogeographic domains, a fact that evidences the plasticity and tolerance of these species (Table 1). It is worth highlighting the species *Leucoloma cruegerianum* (Müll.Hal.) A. Jaeger, which was collected in the study site, although it was first recorded in the Caatinga. *L. cruegerianum* specimens recorded corticicolous and rupicolous incidence in seasonal forest environments whose altitude ranges from 900 - 1100 m (BALLEJOS; BASTOS, 2010).

The incidence of the only liverwort species recorded in the study site - *F. ericoides,* which belongs to family Frullaniaceae - can be explained by environment features such as the open physiognomy of the vegetation that allows greater penetration of solar radiation. This feature opens room to the occupation of relatively xeric bryophyte families, such as Family Frullaniaceae, which have a large ecological range and are relatively common in exposed environments (VILAS BÔAS-BASTOS; BASTOS, 1998).

Family Leucobryaceae comprises species presenting morphological and physiological adaptations to high light intensity and desiccation conditions; thus, they are more likely to endure prolonged exposure to sunlight (GLIME, 2007; PROCTOR et al., 2007).

Species *L. albicans* has wide geographical distribution and it often grows on small-sized to significantly-long plants grown in several substrate and environment types, in regions subjected to different climate regimes (Costa 1988). On the other hand, *T. humilis* grows on tree trunks, rocks, humus, often in dry places, and on acidic and basic substrates (YANO, 1995). This species was recorded in the present study as licuri palm epiphyte.

H. torquatum grows mainly on smooth-bark tree trunks, isolated in the vegetation, or on sparse trees that receive plenty of sunlight and have reasonable humidity (YANO; SANTOS, 1993). Thus, as already reported in the literature, the species was often found during collections in the study site and was well-adapted to dry periods.

Finally, Fabroniaceae is well represented in urban areas by species capable of resisting pollution inherent to large cities (BASTOS; YANO, 1994). With respect to the total number of populations, family Fabroniaceae was the most representative, since it was collected in all phorophytes and in all seasons, although it presented a single species (*F. ciliaris* var. *polycarpa*).

There was exclusive incidence of species whose growth forms were weft-like (50%) and in tuffs (50%). Based on gametophyte morphology, bryophytes' growth forms are determined by genetic and specific environmental factors, which mainly comprise humidity and light in tropical forests (BRITO; PÔRTO, 2000).

Only three species could have their reproduction system characterized (Table 1), since the others were found in small populations, a fact that did not allow analyzing their sexual reproductive structures. Species analyzed according to type of reproductive system and seasonal variation (dry and rainny seasons) were *F. ciliaris* var. *polycarpa* and *H. torquatum*.

© GSJ

Table 1 - List of species found and their occurrence in six geographic domains: 1-Caatinga, 2-Cerrado, 3-Mata Atântica, 4-Pantanal, 5-Campos Sulinos, 6-Amazônia

SPECIES	PHYTOGEOGRAPHIC DOMAINS					
Hepatophyta	1	2	3	4	5	6
Frullania ericoides (Nees) Mont.	X	X	X	X	X	X
Bryophyta						
Leucoloma cruegerianum (Müll.Hal.) A.Jaeger		X	X			
Leucobryum albicans (Schwaegr.) Lindb	X	X	X			X
Tortella humilis (Hedw.) Jenn.	X	X	X			
Helicophyllum torquatum (Hook.) Brid.	X	X	X	X	X	X
Fabronia ciliaris (Brid.) Brid. var. *polycarpa* (Hook.) W.R.Buck	X	X	X	X		X

With respect to the relative frequency of species, the current study observed the following categories: very frequent - *F. ciliaris* var. *polycarpa* (100% - specimens were observed in all collected samples) and *H. torquatum* (81%); frequent - *Leocoloma cruegerianum* (62%); Uncommon - *T. humilis* (26%) and *L. albicans* (13%); and sporadic - *F. ericoides* (1.5%).

According to Benzing (1990 and 1995), the incidence of few species with similar frequencies between crowns and stems reflects significant environmental differences between the two segments. Thus, the wide vertical distribution along the phorophytes depends on adaptations to enable high tolerance to light and humidity variations, which is common to few epiphytic species (BENZING, 1995; FRAM; GRADSTEIN, 1991).

Therefore, the value calculated through the sum of relative frequencies on crowns and stems summarizes the ecological information deriving from the differentiated occupation of these two segments (GIONGO; WAECHTER, 2004). In addition, Silva, Milanez and Yano (2002) have emphasized bryophytes' ecological aspects based on the conclusion that species' relative frequency is directly proportional to substrate variability. They also pointed out that Anthocerotophyta (hornworths) and Hepatophyta (liverworts) representatives are more selective as to substrate type than to Bryophyta (mosses).

DIVERSITY (H') AND EQUITABILITY (J') OF EPIPHYTIC BRYOPHYTES

Based on Shannon diversity index (H'), the sheath region recorded average diversity (H' = 1.141; 1.002 ± 1.256), whereas the stem region recorded low diversity, thus reflecting the low amount of species found in this region (H' = 0.443; 0.3501 ± 0.5242). Equitability was assessed based on Pielou Index; sheath and stem regions presented similar data (J' = 0.636; 0.5594 ± 0.7008) and (J' = 0.639; 0.5051 ± 0.7563), respectively; these values were higher than 0.5, a fact that indicated the uniform distribution of community species.

Species *F. ericoides*, *L. albicans* and *T. humilis* were only found in the sheath region. It happens because some species are specialists who only grow in one environment type, whereas others are generalists who can grow in both environments, depending on their ability to retain water (GLIME, 2013). It is Worth emphasizing that, unlike the specialist species, the generalist ones were collected throughout the study period.

Stem (stipe) features were not favorable to bryophyte development. It may have happened because the stem region did not enable organic matter and water accumulation, as seen in leaf sheaths, as well as because this region was subejcted to higher exposure to light and drought. Thus, during intense drought periods, this region is not favorable to the permanence of bryophyte communities, whereas the rainy season enables bryophyte communities to expand, colonize the entire phorophyte and even reach the soil.

COMMUNITY STRUCTURES

Based on Pearson correlation coefficient (r) applied to periods 'dry season I', 'rainny season' and 'dry season II' in the areas close to waterbodies, it was possible observing that the structure of bryophyte communities during the dry period comprised three species. The number of species remained constant in the distance range of 0.5 - 1.5 km from water environments, a fact that corroborated the association between bryophyte incidence and environments close to water sources. This association can be explained by the fact that areas close to aquatic environments, such as waterfalls, streams and lagoons, favor the maintenance of local humidity and allow epiphyte bryophytes to deveolp in *S. coronata*.

Based on data collected during the rainy season at the same distance range (0.5 - 1.5 km) from environments close to water sources, there was significant change in the number of inventoried species (six, in total), which decreased back to only three in the subsequent period (dry season II).

Based on Pearson correlation coefficient (r), dry season I (r = 0.3593) recorded weak positive correlation between number of species and proximity to water environments, whereas the rainy season recorded weak negative correlation (r = - 0.3551) and dry season II recorded moderate negative correlation to this parameter (r = - 0.7344). However, the evaluation of these coefficients did not allow inferring much about the correlation between proximity to water environments and increased number of species. Thus, the closer the phorophytes were to environments with waterbodies, the greater the species richness (Table 2).

Table 2 - List of species found with their respective life forms and classification of the reproductive system.

SPECIES	LIFE FORMS		REPRODUTIVE SYSTEM
Hepatophyta	TURF	MAT	
Frullania ericoides (Nees) Mont.		X	-
Bryophyta			
Leocoloma cruegerianum (Müll.Hal.) A.Jaeger	X		-
Leucobryum albicans (Schwaegr.) Lindb	X		-
Tortella humilis (Hedw.) Jenn.	X		Dioico
Helicophyllum torquatum (Hook.) Brid.		X	Dioico
Fabronia ciliaris (Brid.) Brid. var. *polycarpa* (Hook.) W.R.Buck		X	Monoico

The incidence of species prevailed in the altiture range of 1,142 – 1,173 m, a fact that showed direct and positive proportional correlation between altitude and number of species.

Phorophytes found at higher altitudes were observed in the area that has not been subjected to human managerial interference for several years; lack of human interference was a crucial factor enabling the record of increased number of species, who were able to enlarge their populations season after season (Table 3).

© GSJ

Table 3 - List of inventoried species present by sampled place.

EPECIES	PLACE				
Hepatophyta	1	2	3	4	5
Frullania ericoides (Nees) Mont.	X				
Bryophyta					
Leocoloma cruegerianum (Müll.Hal.) A.Jaeger	X	X		X	X
Leucobryum albicans (Schwaegr.) Lindb	X				
Tortella humilis (Hedw.) Jenn.	X				
Helicophyllum torquatum (Hook.) Brid.	X	X	X		X
Fabronia ciliaris (Brid.) Brid. var. *polycarpa* (Hook.) W.R.Buck	X	X	X	X	X

Thus, the Pearson correlation coefficient (r) has reinforced the degree of association between altitude and species richness. Thus, the analyzed variables recorded weak positive correlation to dry season I (r = 0.4676), weak negative correlation to the rainy season (r = - 0.3443) and moderately negative correlation to dry season II (r = - 0.5705). Unlike Pearson correlation coefficient, Simple Linear Regression did not show effective association between especies richness and altitude.

Simple Linear Regression revealed association between species richness and distance from environments near waterbodies in dry season II (R^2 = 0.5835), as well as between species richness and distance from ruderal environments in dry season II (R^2 = 5722); almost 60% of the dependent variable used in this analysis could be explained in the present model.

Based on the Multiple Linear Regression, when more than two variables – such as species richness, distance from waterbodies and from ruderal environments – were correlated to dry season II, significant values were recorded for the associated parameters and corroborated the proposed model ($p < 0.05$; p = 0.004; R^2 = 0.7899).

GSJ: Volume 7, Issue 11, November 2019
ISSN 2320-9186

CONSIDERATIONS

The evident species diversity recorded in the current study reinforces the key role played by *Syagrus coronata* in species conservation processes; this palm tree is a resistance icon and a biodiversity amplifier without which it would not be possible recording bryophyte species during intense and prolonged drought periods, whose conditions are not favorable for the maintenance and expansion of bryophyte communities.

The richness and diversity of epiphytic bryophytes in *S. coronata* palm trees is more expressive in sites close to waterbodies, located at high altitude and presenitng considerable conservation status. Rainfall is a determining factor for the development of epiphyte bryophytes in Boqueirão da Onça, BA. However, sporophyte production is intensified and spores are dispersed during the dry season.

The current study was the first to investigate the association between bryophytes and phanerogamous species *Syagrus coronata* in the Caatinga semiarid ecosystem. Thus, it makes an important contribution to the knowledge about the diversity and ecology of bryophyte groups in Boqueirão da Onça region, Bahia State. It is essential emphasizing that information about the biodiversity in this region is of paramount importance to support conservation policies to meet the significant need of creating conservation areas in the Caatinga. Boqueirão da Onça, Northern Bahia State, holds a potential well-conserved Caatinga area that remains unknown by scientists and that has great biological potential.

© GSJ

© GSJ

REFERENCES

ALVARENGA, L.D.P.; PÔRTO, K.; OLIVEIRA, J.R. Habitat loss effects on spatial distribution of non-vascular epiphytes in a Brazilian Atlantic forest. **Biodiversity and Conservation**, v.19, n.3, p 619-635, 2009.

ALVARENGA, L. D. P.; PÔRTO, K. C. Patch size and isolation effects on epiphytic and epiphyllous bryophytes in the fragmented Brazilian Atlantic Forest. **Biodiversity and Conservation**, v.134, p 415-427, 2007.

BALLEJOS, J.; BASTOS, C.J.P. Musgos acrocárpicos do Parque Estadual das Sete Passagens, Brasil. **Revista Brasileira de Botânica**, v.33, n.2, p. 355-370, 2010.

BASTOS, C.J.P. Padrões de reprodução vegetativa em espécies de Lejeuneaceae (Marchantiophyta) e seu significado taxonômico e ecológico. **Revista Brasileira de Botânica**, v.31, p 309-315, 2008.

BASTOS, C.J.P. *Cheilolejeunea yanoe* C. Bastos (Marchantiophyta, Lejeuneaceae), um novo nome para *Strepsilejeunea muscicola* Herzog. **Pesquisas.** Série Botânica, v. 67, p. 19-22, 2015.

BASTOS, C.J.P.; GRADSTEIN, S.R. Two new species of Cheilolejeunea (Spruce) Schiffn. (Lejeuneaceae) from Brazil: *C. lacerata* sp. nov. and *C. rupestris* sp. nov. **Journal of Bryology**, v. 28, p. 133-138, 2006.

BASTOS C.J.P.; YANO, O. Pycnolejeunea porrectilobula (Lejeuneaceae), a new species from Brazil. **Nova Hedwigia**, v. 74 p. 439-443, 2002.

BASTOS, C.J.P.; YANO, O. New records of Lejeuneaceae (Marchantiophyta) for the Brazil. **Acta Botanica Malacitana**, v. 29, p. 13-21, 2004.

BASTOS, C.J.P.; YANO, O. 2005. Notes on the occurrence of Cheilolejeunea paroica Mizut. (Lejeuneaceae: Marchantiophyta) in Neotropics. **Acta Botanica Malacitana**, v. 30, p. 7-10, 2005.

BASTOS, C.J.P.; YANO, O. O gênero Lejeunea Libert (Lejeuneaceae) no Estado da Bahia, Brasil. **Hoehnea**, v. 36, p. 303-320, 2009.

BASTOS, C.J.P.; YANO, O.; BOAS-BASTOS, S.B.V. Briófitas de campos rupestres da Chapada Diamantina, estado da Bahia, Brasil. **Revista Brasileira de Botânica**, v. 23, p 359-370, 2000.

BENZING, D.H. **Vascular epiphytes: general biology and related biota**. Cambridge: Cambridge University Press, 1990, 567p.

BENZING, D.H.The physical mosaic and plant variety in forest canopies. **Selbyana**, v. 16, p. 159-168, 1995.

BRITO, A. E. R. M.; PÔRTO, K. C. Guia de estudos de briófitas. **Briófitas do Ceará**. 1. ed. Fortaleza: Série didática - UFC, 2000. 68 p.

BUCK, W.R. A Synopsis of the South American taxa of *Fabronia* (Fabroniaceae). **Brittonia**, v. 35, p. 248-254, 1983.

BUCK, W.R. 1998. Pleurocarpous Mosses of the West Indies. **Memoirs of The New York Botanical Garden**, v. 82, p. 1-400, 1998.

© GSJ

CÂMARA, P.E.A.S., TEIXEIRA, R.; LIMA, J. Musgos Urbanos do Recanto das Emas, Distrito Federal, Brasil. **Acta Botanica Brasilica**, v.17, n.4, p 1-10, 2003.

CARMO, D.M.; GASPARINO, E.C.; PERALTA, D.F. Análise comparativa de Briófitas Urbanas da Região Noroeste do Estado de São Paulo com demais trabalhos em diferentes Fitofisionomias Brasileiras. **Pesquisas**. Série Botânica, v. 67, p.255-272, 2015.

COSTA, D. P. *Leucobryaceae* do Parque Nacional da Tijuca, no Estado do Rio de Janeiro (Brasil). **Revista Rodriguesia**, v.64, n. 41, p. 41-48, 1988.

COSTA, D.P. Epiphytic Bryophyte Diversity in Primary and Secondary Lowland Rain forests in Southeastern Brazil. **The Bryologist**, Londres v. 102, n. 2, p 320-326, 1999.

DAJOZ, R. **Ecologia Geral**. Rio de Janeiro: Vozes, 1983. 348 p.

DELGADILLO M., C. & CÁRDENAS S., A. 1990. **Manual de Briofitas.** 2 ed**.** Cuadernos Del Instituto de Biología 8. México: Universidad Nacional Autonoma de Mexico, 1990. 782 p.

DEMÉTRIO, C.G.B. **Modelos Lineares Generalizados em Experimentação Agronômica**, ESALQ/USP, Piracicaba, SP, 2002. Disponível em: <http://www.portalaction.com.br/analise-de-regressao> Acesso em: 20 fev. 2016.

EMBRAPA - CNPS: **Sistema Brasileiro de Classificação de Solos**. Brasília: Embrapa – SPI e Embrapa - Solos, 2006. 407 p.

FRAHM, J.P. Manual of tropical bryology. **Tropical Bryology**, v. 23, p 1-196, 2003.

© GSJ

FRAHM, J. P.; GRADSTEIN, S.R. An altitudinal zonation of tropical rain forests using bryophytes. **Journal of Biogeography**, v. 18, p. 669-678,1991.

GIONGO, C.; WAECHTER, J.L. Composição florística e estrutura comunitária de epífitos vasculares em uma floresta de galeria na Depressão Central do Rio Grande do Sul. **Revista Brasileira de Botânica**, v.27, n.3, p. 563-572, 2004.

GLIME, J.M. **Bryophyte Ecology and Physiological Ecology.** EUA: Michigan Technological University and the International Association of Bryologists, 2007.869 p.

GLIME, J. M. 2013. **Adaptive Strategies: Growth and Life form**. Bryophyte Ecology. Physiological Ecology. book patrocinado por Michigan Technological University y the International Association of Bryologists. Disponível em:

<http://www.bryoecol.mtu.edu/ > Acesso em: 14 fev. 2016.

GRADSTEIN, S.R.; COSTA, D.P.The Hepaticae and Anthocerotae of Brazil. **Memoirs of the New York Botanical Garden**, v. 87, p 1- 318, 2003.

GRADSTEIN, S.R.; MONTFOORT, D.; CORNELISSEN, J.H.C.Species richness and phytogeography of the Bryophyte flora of the Guianas, with special reference to the lowland forest. **Tropical Bryology**. v. 2, p 117-126, 1990.

GRADSTEIN, S.R.; PÓCS, T. Bryophytes. Pp.311-324. In: H. Lieth and M.J.A. Werger (Ed.), **Tropical Rain Forest Ecosystems**. Amsterdam: Elsevier, 1989. 1022 p.

GRADSTEIN, S.R.; CHURCHILL, S.P.; SALAZAR ALLEN, N. Guide to the Bryophytes of Tropical America. **Memories of the New York Botanical Garden**, v. 86, p 1-577, 2001.

GREENE, S. W. The maturation cycle, or the stages of development of gametangia and capsules in mosses. **Transactions of the British Bryological Society,** v 3, p. 736-745, 1960.

© GSJ

GSJ: Volume 7, Issue 11, November 2019
ISSN 2320-9186

KÜRSCHNER, H. Life Strategies and Adaptations in Bryophytes from the Near and Middle East. **Turkish Journal of Botany**, v.28, p. 73-84, 2004.

LISBOA, R.C.L.; TAVARES, A.C.C.; COSTA-NETO, S.V. Musgos (Bryophyta) e Hepáticas (Marchantiophyta) da Zona Costeira do Estado do Amapá, Brasil. **Boletim do Instituto de Botânica**, v. 18, p. 163-171, 2006.

LONGTON, R.E. 2006. Reproductive ecology of bryophytes: what does it tell us about the significance of Sexual reproduction? **Lindbergia**, v. 31, p.16-26, 2006.

LONGTON, R.E.; SCHUSTER, R.M. 1983. Reproductive Biology. *In:* **New manual of bryology** (R.M Schuster, ed.), Michigan: The Hattori Botanical Laboratory, 1983. 462 p.

© GSJ