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Reproductive and population characteristics of *Padina gymnospora* (Dictyotales, Ochrophyta) in a tropical beach of Brazil

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Abstract. Many uses of *Padina gymnospora* (Ochrophyta) have been developed, such as the biosorption of heavy metals, a bio-indicator for climate changes and ocean acidification, and as a resource of potential nutritional compounds. Despite the wide distribution of *P. gymnospora*, studies concerning population attributes are rare. This study aimed to understand how the reproductive and population characteristics (cover/density; frond height/width) of *P. gymnospora* are influenced by rainy/dry (RS/DS) seasons and reef microhabitats (tidal pools/TP; protected reef region/PRR; frontal reef region/FRR) in a tropical beach of Brazil (12º56'22"S × 38º19'41"W). Beds were found throughout the sampling period in TP and PRR, but not FRR. Density was higher in TP during DS, while PRR presented more fronds during RS. Cover was higher during RS than DS, and the cover of PRR was higher during RS. The dominant height size interval was 0.5-3.9 cm. For the width, intervals of 0.5-3.9 and 4.0-7.9 cm dominated equally. Infertile thalli were predominant, followed by tetrasporic and oogonial thalli. Antheridial thalli were not found. These results assist in the understanding of the seasonal patterns of *P. gymnospora* in a tropical reef environment, expanding upon the knowledge concerning its population and reproductive aspects.

Key words: Brown Algae, Cover, Density, Population Parameters, Reproduction.

Resumo. Características reprodutivas e populacionais de *Padina gymnospora* (Dictyotales, Ochrophyta) em uma praia tropical do Brasil. Muitos usos de *Padina gymnospora* (Ochrophyta) têm sido desenvolvidos, como biossorção de metais pesados, bioindicadora para mudanças climáticas e acidificação dos oceanos, e como recurso para potenciais compostos nutricionais. Apesar da ampla distribuição de *P. gymnospora*, estudos relacionados aos seus atributos populacionais são raros. Este estudo teve como objetivo compreender como as características reprodutivas e populacionais (cobertura/densidade; altura/largura da fronde) de *P.*

gymnospora são influenciadas pelas estações chuvosa/seca (RS/DS) e microhabitats recifais (poças de maré/TP; região protegida do recife/PRR; região frontal do recife/FRR) em uma praia tropical do Brasil (12º56’22"S × 38º19’41"W). Os bancos foram encontrados durante toda a amostragem em TP e PRR, mas não na FRR. A densidade foi maior em TP durante a DS, enquanto PRR apresentou mais frondes durante RS. A cobertura foi maior na RS do que na DS, sendo a cobertura da PRR maior na RS. O intervalo de tamanho de altura dominante foi de 0.5-3.9 cm. Para largura, os intervalos de 0.5-3.9 e 4.0-7.9 cm dominaram igualmente. Talos inférteis foram predominantes, seguidos pelos tetraspóricos e oogoniais. Talos anteridiais não foram encontrados. Esses resultados auxiliam na compreensão dos padrões sazonais de *P. gymnospora* em um ambiente recifal tropical, expandindo o conhecimento sobre seus aspectos populacionais e reprodutivos.

Palavras-chave: Alga Parda, Cobertura, Densidade, Parâmetros Populacionais, Reprodução.

Introduction

The genus *Padina* Adanson (Dictyotales, Ochrophyta) is widely distributed in tropical to temperate seas (Guiry & Guiry 2020). Studies using *Padina* species for different approaches have been developed, such as the biosorption of heavy metals (Karez & Pereira 1995, Amado-Filho *et al.* 1997, Amado-Filho & Pfeiffer 1999, Kaewsarn & Yu 2001, Andrade *et al.* 2002, Kaewsarn 2002, Nassar & Yoneshigue-Valentin 2006), as a bio-indicator for evaluating the effects of climate change and ocean acidification/decalcification (Gil-Díaz *et al.* 2014, Poloczanska *et al.* 2016), and as a resource of potential nutritional compounds or substances with antioxidant, anticholinesterase, and anticoagulant activities (Silva *et al.* 2005, Shanmuganathan & Devi 2016).

Most of the studies cited above used *Padina gymnospora* (Kützing) Sonder as a study organism. This species presents a thallus that are slightly to moderately calcified, attached by a rhizoidal base, can be gregarious, are 4-16 cm in height, and consist of an entire flabellate lobe or several lobes with inrolled margins. The life cycle of *P. gymnospora* is diplohaplontic and isomorphic, with sporangial sori arranged in concentric lines, growing in patches or isolated (Nunes & Paula 2000). *P. gymnospora* is reported as a common species in tidal pools, protected regions, and environments with high hydrodynamics (Széchy & Nassar 1989, Crispino 2000).

This taxon presents wide global distribution, occurring in the following regions: Asia, Indian Ocean Islands, Europe, North America, Central America, Caribbean Islands, Atlantic Islands, South America, Africa, Pacific Islands, Australia and New Zealand (Guiry & Guiry 2020). In Brazil, *P. gymnospora* also presents a wide distribution along the coast, with geographic limits between the Maranhão state in the Northeast (2º20’28"S × 43º15’00"W), and Rio Grande do Sul state in the South (33º41’32.56"S × 53º13’02.92"W) (Szechy & de Paula 2015).

Despite this wide distribution of *P. gymnospora*, studies incorporating ecological, reproductive, and population characteristics are rare. One of the pioneering studies was that of Thivy (1959) in India, in which the morphology of the gametophytic generation of *P. gymnospora* was investigated. The only study carried out in Brazil was that of Széchy & Nassar (1989), in which the phenological aspects of *P. gymnospora* were addressed.

Thus, the aim of this study was to understand how the reproductive and population characteristics of *P. gymnospora* are influenced by rainy/dry seasons and reef microhabitats in a tropical beach in the Northeast of Brazil.

Materials and Methods

Study Site and Sampling: The field sampling was conducted on Stella Maris beach (12º56’22"S, 38º19’41"W), located in Salvador City, Bahia State, Brazil (Fig. 1), where *P. gymnospora* forms beds on the reef. Stella Maris beach presents reef composed of a Precambrian metamorphic basement and Quaternary beach rock with a calcareous crust (Leão 1996). The climate in the coastal region of Bahia ranges from humid to sub-humid, with an average annual rainfall of 1500 mm and 200 days of sunshine/year. Air temperatures vary between 14 and 33 ℃, and sea surface temperatures between 20 and 27 ℃ (Maida & Ferreira 1997; Leão *et al.* 2016). In this region, the rainy season lasts from March to August, and the dry season from September to February. Abiotic factors that potentially affect population and reproductive aspects, such as air temperature, insolation, humidity, and precipitation,

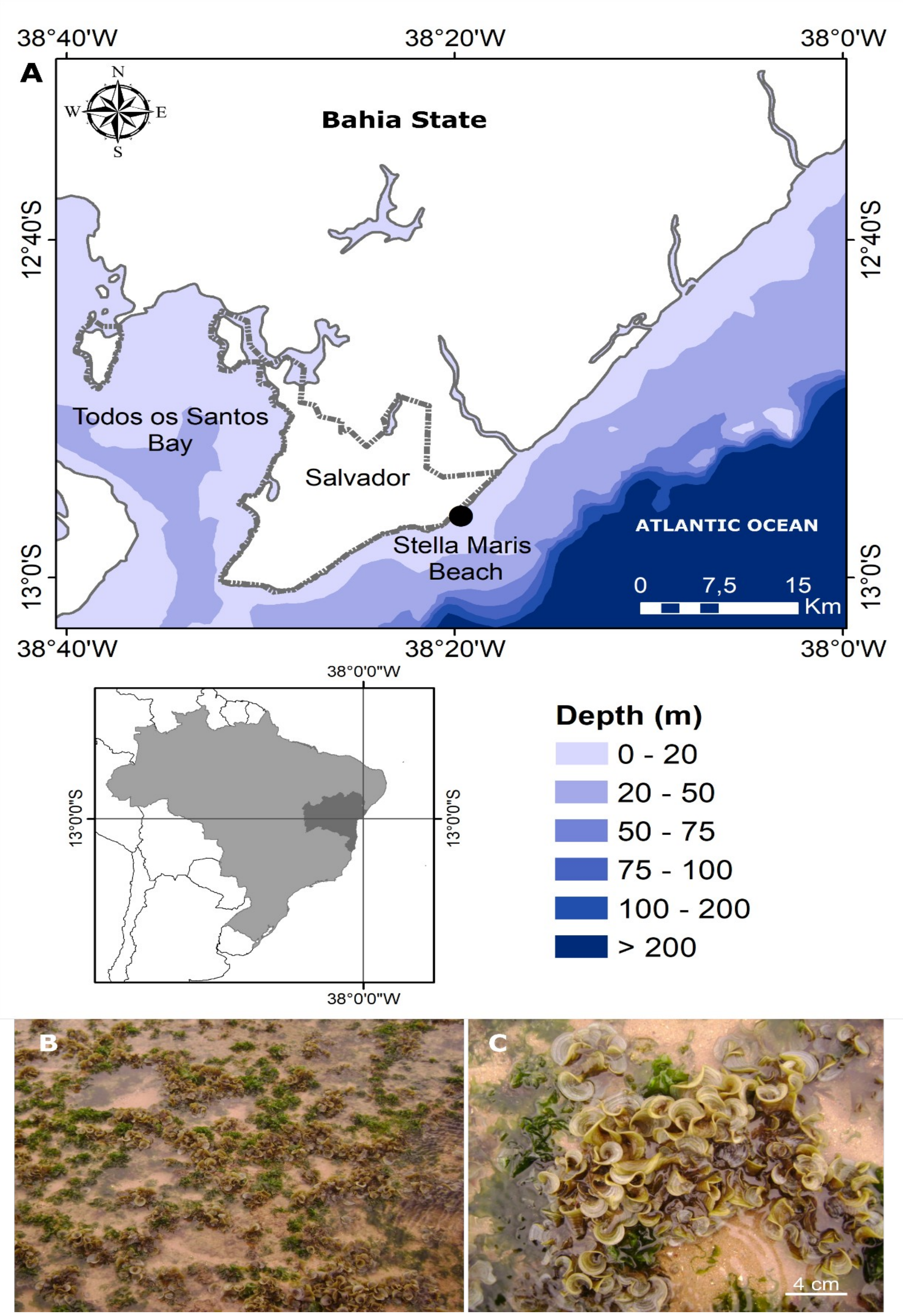

Figure 1. A. Map locating the collection site at Stella Maris, Salvador City, Bahia State, Brazil. **B-C.** General appearance and detail of *Padina gymnospora* bed, respectively.

were provided by the National Meteorological Institute (INMET 2020).

Four sampling periods occurred between February 2010 and February 2011, with two during the rainy season and two during the dry season. Samples were collected from the intertidal zone during low spring tides. The reef was divided into microhabitats based on their hydrodynamic characteristics, in accordance with Nunes & Paula (2002). The microhabitats were classified in three groups: TP- a region composed of tidal pools of varied depths, shapes, and sizes; PRR- a protected reef region, which emerged during low tide and was protected from direct wave action; FRR- a frontal reef region, which was a region of higher hydrodynamics, subject to direct wave action. In each sampling, one transect (20 m) was arranged parallel to the coastline in each microhabitat. We have obtained the following number of samples per transect/collect: Density - 10 samples; Cover - 10 samples; and Size structure/Reproductive aspects – five samples.

Population Parameters: The sampling was performed using nondestructive and destructive techniques based on the adapted methodology of Riosmena-Rodríguez & Ortuño-Aguirre (2009). We analyzed two population parameters, cover and density. We carried out the sampling using 0.20 × 0.20 m quadrants with 5 × 5 cm squares for cover, and without squares for density. In each microhabitat, 10 quadrants were randomly placed along the transect over the *P. gymnospora* beds. For the cover, the estimates were conducted by counting the interception points with each holdfast of the species. For the density, we counted the total number of fronds within the quadrant. For the size structure and reproductive aspects, five quadrants were randomly placed along the transect in each microhabitat. All specimens inside the quadrants were collected with a spatula. The results of these parameters are expressed as: Density – average number of fronds/Number of fronds per m²; Cover - percentage; Size structure/Reproductive aspects - total number of fronds.

The samples collected were fixed in 4% formalin and processed in the laboratory using the methods of Nunes (2010). Then, the specimens were identified based on Nunes & Paula (2000). Subsequently, 60 fronds were randomly chosen to measure the height and width to assess if these parameters had a relationship with algal development. For the same fronds, the reproductive phases were determined under a stereomicroscope (Leica ZOOM®2000) to evaluate the ratio between the vegetative and reproductive fronds.

Statistical Analyses: To analyze the occurrence of significant differences in *P. gymnospora* density, cover and reproductive phases among the reef microhabitats during the dry and rainy seasons, we tested the normality and homoscedasticity of the data using Shapiro-Wilk and Levene tests, respectively. If the prerequisites for a parametric test were not met, the analysis of variance will be performed using the Kruskal-Wallis test, followed by the multiple comparison of p values ($p < 0.05$), The Bray-Curtis similarity analysis was used to generate clusters of the cover and density of the species among the microhabitats, for which the data were log transformed (X + 1). Analyses were carried out using R software (R Core Team 2018).

Results

Padina gymnospora beds were found throughout the sampling period in the tidal pools (TP) and protected reef region (PRR), highlighting the persistence in these microhabitats during the study. We did not find fronds of this species in the frontal reef region (FRR), which presents higher hydrodynamics. Additionally, we identified some specimens of *P. boergesenii* Allender & Kraft and *P. antillarum* (Kützing) Piccone that were associated with the *P. gymnospora* beds.

The abiotic variables obtained for the collection site during the rainy and dry seasons are show in Table I. The dry and rainy seasons demonstrated well-delimited environmental variables. The dry season showed 66% (180 h) more insolation than the rainy season, while the rainy season presented 306.7% (377 mm) more precipitation than the dry season. The mean humidity of the rainy season was 8% higher than that of the dry season. The mean air temperature of the dry and rainy seasons was 27.4 and 24.5 ℃, respectively.

Population parameters: Regarding the density of *P. gymnospora* in the beds throughout the study (Fig. 2), this was higher in TP during the dry season (average of 21.6 fronds/540 fronds m^{-2}) compared to PRR (average of 18.5 fronds/462.5 fronds m^{-2}). We observed the inverse for the rainy season, in which PRR showed a higher number of fronds (average of 36.3 fronds/915 fronds m^{-2}) than TP (average of 21.6 fronds/540 fronds m^{-2}). The rainy season exhibited a higher density, with 43% more fronds than the dry season. Unless were not significantly different ($p > 0.05$) among microhabitats and seasons, PRR exhibited 28% more fronds than TP.

The similarities among the microhabitats were also evaluated using the density data through grouping analysis. Our results showed that there is no pattern for the samples grouping according to seasons and/or microhabitats, with exception for the D2 period. In the Figure 3 it is possible to observe two clusters, both with approximately 80% similarity: GI – comprising five samples with an

Table I. Environmental variables provided by National Institute of Meteorology (INMET) recorded at the Salvador Station (Bahia State, Brazil) for the 30 days before each collect.

Seasons	Months	Total insolation (h)	Accumulated precipitation (mm)	Mean air temperature (°C)	Mean monthly humidity (%)
Dry	February/2010 (D1)	213.9	19.5	28.6	75.6
Rainy	June/2010 (R1)	151.3	144.1	25.5	83.3
	July/2010 (R2)	121	355.8	23.6	86.8
Dry	February/2011 (D2)	238.8	103.4	26.3	81.9

average density ranging from 10.2 (PRR/D1) to 24.7 fronds (PRR/D2); and GII – consisting of TP (average of 6.3 fronds) and PRR (average of 8.3 fronds), both from the D2 period. Only TP/R1, with average of 5.7 fronds, presented a low similarity and did not associate to the other samples.

We found not significant ($p > 0.05$) differences between the two seasons regarding the cover of *P. gymnospora* in the reef. But the rainy season demonstrated a higher cover (60%) than the dry season (48%). Furthermore, TP did not show significative differences regarding the cover between the dry and rainy seasons, with 52% and 57%, respectively, while that of PRR was 43% higher during the rainy season (Fig. 4).

As observed for density, the grouping analysis using cover data also did not show the formation of clusters associated to seasons and/or microhabitats (Fig. 5). Thus, the three formed clusters grouped samples from distinct reef regions and seasons, as following: GI (68% similarity) – including TP/D1 (61%), PRR/D2 (65.6%), and a subgroup (95% similarity) composed of PRR/R2 and TP/R2, with 83.7% and 88%, respectively; GII (80% similarity) - containing PRR/R1 and TP/D2, ranging from 42.5% to 43.8%, respectively; and GIII (80% similarity) – incorporating PRR/D1 and TP/R1, which presented the lowest cover values during the study of 22.5% and 25%, respectively.

To analyze the population size structure, we defined three categories for height and width: a) small fronds, with 0.5 to 3.9 cm; b) intermediate fronds, with 4.0 to 7.9 cm; and c) large fronds, with 8.0 to 12.0 cm. The dominant height size interval throughout the study was 0.5-3.9 cm (small fronds), with total of 317 fronds (Fig. 6A). The 8.0-12.0 cm size interval (large fronds) only occurred during the dry season. Regarding the seasons, the small size interval was slightly more frequent during the rainy, while the intermediate category showed a similar occurrence between seasons. In the microhabitats, the small category in TP presented a similar occurrence to that in PRR during the two seasons. For PRR/D2, only one category of height

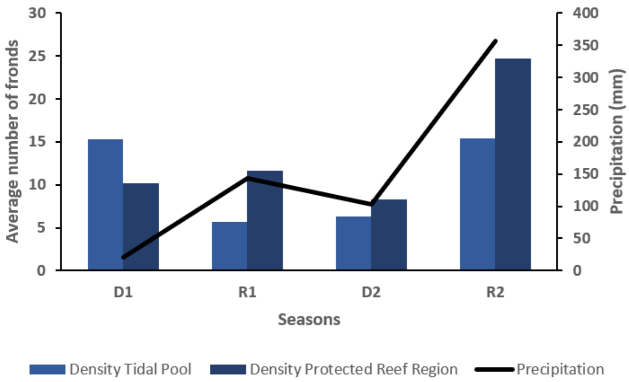

Figure 2. Density (average number of fronds) of *Padina gymnospora* in the microhabitats and accumulated precipitation (30 days before collect) at Stella Maris beach, Salvador/Bahia, Brazil. TP: Tidal Pools; PRR: Protected Reef Region; D1 (Feb/2010) and D2 (Feb/2011): sampling in the dry season; R1 (Jun/2010) and R2 (Jul/2010): sampling in the rainy season; Blue bar: density in tidal pool; Dark blue bar: density in protected reef region; Black line: precipitation.

measurements occurred (0.5-3.9 cm), which differs from all other sampling sites/periods as they presented at least two size intervals.

Regarding the width, the samples were equally dominated by small (0.5-3.9 cm) and intermediate (4.0-7.9 cm) intervals during the study (Fig. 6B). The 8.0-12.0 cm size interval occurred only in five samples, differing from that observed in the height data. As well as for the height size, for PRR/D2, only one class of measurements were observed for the width (0.5-3.9 cm). Regarding the seasons, the 0.5-3.9 cm interval predominated during the dry (total of 146 fronds) and rainy seasons (total of 122 fronds). In the microhabitats, the highest number of fronds for the small category occurred in PRR during the dry season, while for the intermediate category the most fronds were also found in PRR but during the rainy season. The large category was more common in TP during the dry season and PRR during the rainy one.

Reproductive aspects: During the study, infertile thalli presented higher occurrence (total of 204

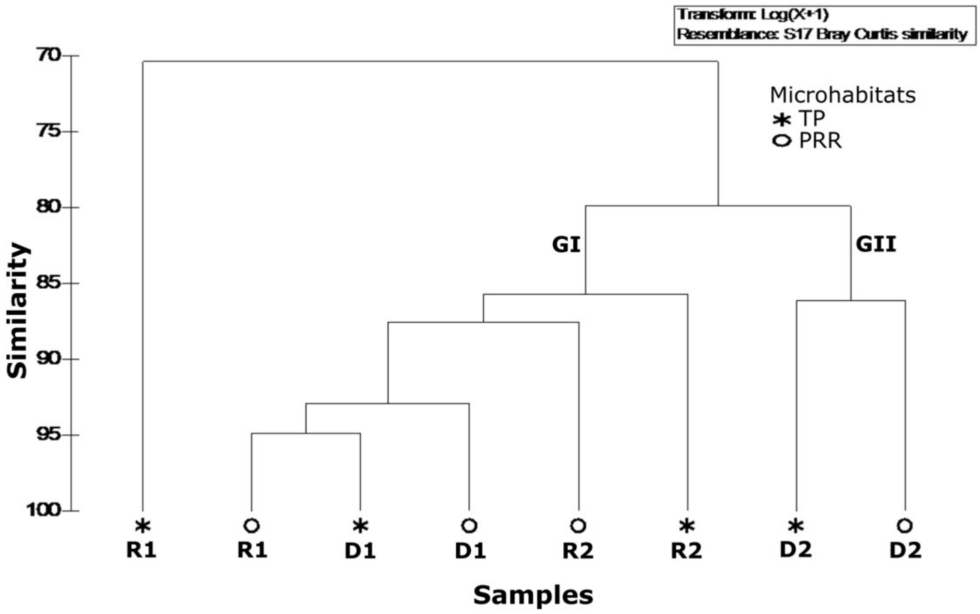

Figure 3. Dendrogram showing two groups (GI and GII) formed by density data of *Padina gymnospora* during dry and rainy seasons in the microhabitats at Stella Maris beach, Salvador/Bahia, Brazil. D1 (Feb/2010) and D2 (Feb/2011): sampling in the dry season; R1 (Jun/2010) and R2 (Jul/2010): sampling in the rainy season ⁎: Tidal Pools (TP); ○: Protected Reef Region (PRR).

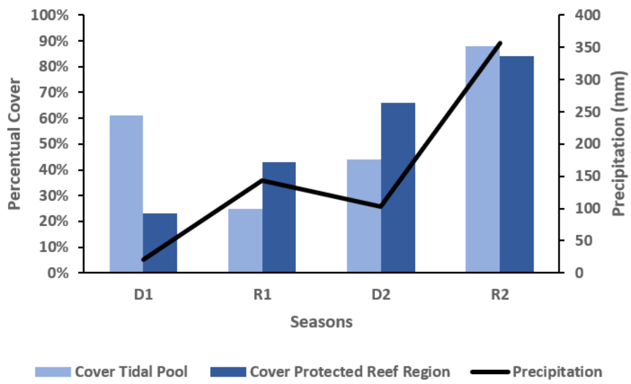

Figure 4. Cover (%) of *Padina gymnospora* in the microhabitats and accumulated precipitation (30 days before collect) at Stella Maris beach, Salvador/Bahia, Brazil. D1 (Feb/2010) and D2 (Feb/2011): sampling in the dry season; R1 (Jun/2010) and R2 (Jul/2010): sampling in the rainy season; Light blue bar: cover in tidal pool; Dark blue bar: cover in protected reef region.

fronds) among the reproductive fronds, followed by tetrasporic (total of 190 fronds) and oogonial thalli (total of 86 fronds) (Fig. 7). Among the phases of the haplodiplontic cycle of *P. gymnospora*, only antheridial thalli were not found during the study. The infertile thalli presented higher occurrence in the dry season (total of 130 fronds) and in the TP microhabitat (total of 107 fronds). Tetrasporic phase presented more fronds during the rainy season (total of 107 fronds) and in the PRR (total of 118 fronds). Almost the double number of oogonial fronds were observed during the rainy season (total of 59 fronds) compared to the dry season (total of 27 fronds) and was predominant in the TP (total of 61 fronds). Despite the differences among the total of fronds for each reproductive phase during the two seasons and in the three microhabitats, we did not find significant values in the statistical analysis ($p > 0.05$). All fronds collected in PRR during the second dry season were infertile.

The infertile fronds in TP and PRR predominantly presented the 0.5-3.9 cm size interval (97 and 87%, respectively), followed by a low percentage of fronds (9% - TP and 10% - PRR) in the 4.0-7.9 cm interval and rare plants included in the 8.0-12.0 cm size interval (1% for TP and 0% for PRR). For tetrasporic plants in TP, the predominant size interval was 0.5-3.9 cm, while in PRR a similar percentage was observed between the small and intermediate categories. As well as for the infertile plants, the tetrasporic fronds were rare in the 8.0-12.0 cm size interval of two microhabitats (1 and 4%, respectively). The diversity of the size categories for oogonial fronds was higher in TP, with 23, 28, and 10% for small, intermediate, and large intervals, respectively. For PRR, the small and intermediate categories presented similar percentages (11 and 14%, respectively), while no fronds from the large category were recorded.

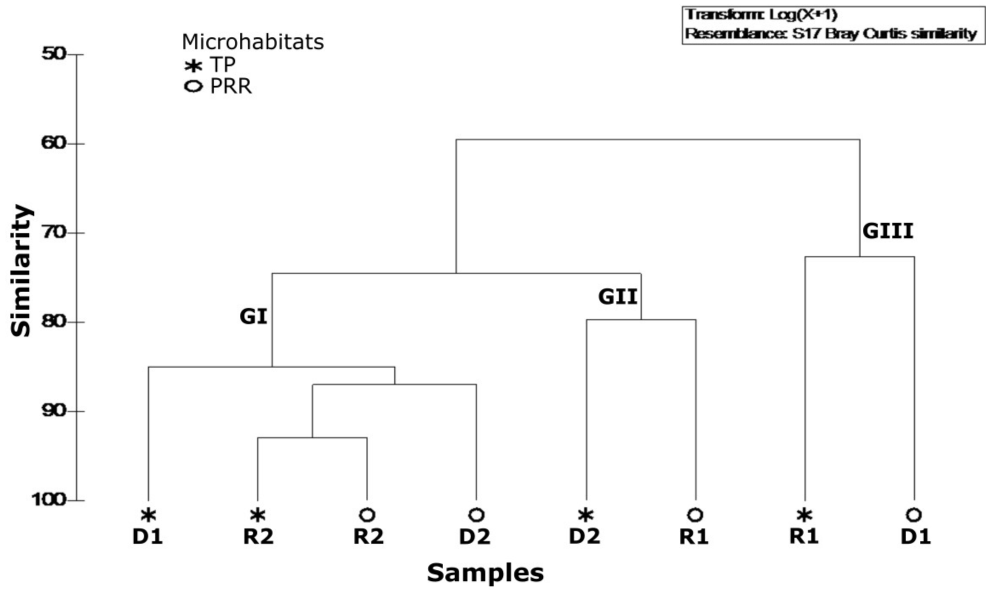

Figure 5. Dendrogram showing three groups (GI, GII and GIII) formed by cover data (%) of *Padina gymnospora* during dry and rainy seasons in the microhabitats at Stella Maris beach, Salvador/Bahia, Brazil. D1 (Feb/2010) and D2 (Feb/2011): sampling in the dry season; R1 (Jun/2010) and R2 (Jul/2010): sampling in the rainy season; ⁎: Tidal Pools (TP); ○: Protected Reef Region (PRR).

Discussion

In this study, we seek to identify the possible influences of dry and rainy seasons, as well as the microhabitat attributes on the reproductive and population characteristics of *P. gymnospora* in a tropical beach of Brazil. This species can be considered a perennial species, as noted in the present study, and also recorded by Agan & Lehman (2001). However, this differed from the results obtained by Széchy & Nassar (1989), who observed that *P. gymnospora* behaved as an ephemeral or non-seasonal annual, demonstrating some characteristics of an opportunistic species. These authors also reported that the biological-functional form of the species guarantees the rapid colonization of the available substrates, which we indicate as a possible explanation for the constant occupation in the reef environment of Stella Maris beach.

Despite *P. gymnospora* is reported as a common species in microhabitats with distinct hydrodynamism (Széchy & Nassar 1989, Crispino 2000), we did not find this species in the frontal reef region, which presents a higher hydrodynamism than the other evaluated regions. The force of the water current in this region can break fronds, as reported for *P. concrescens* by Riosmena-Rodríguez & Ortuño-Aguirre (2009). In addition, this strong water movement makes the establishment of reproductive structures on reefs difficult in this specific region.

The density and cover were higher in the protected reef region during the rainy season, which can be explained by the low intensity sunlight and high precipitation. A combination of these abiotic variables can reduce the environmental stress on *P. gymnospora* beds, which remain totally exposed during low tides in this region. On the other hand, the tidal pools showed a higher density throughout the dry season. These microhabitats generally maintain constant environmental conditions, and the beds are protected from the direct sunlight and low humidity during low tides. Thus, increased precipitation and greater water movement during the rainy season can perturb the stability of the environmental conditions with which the beds are acclimated in these specific microhabitats. Interestingly, the cover presented increments that followed almost the same pattern as the precipitation. The increase in the humidity and precipitation, associated with the reduction in sunlight and temperature during the change of seasons, could have contributed to the occupation of available substrates in the researched reef environment. Thus, from the collected data in our study, we consider the use of density and cover as good populational descriptors, which aligns with Riosmena-Rodríguez & Ortuño-Aguirre (2009). Furthermore, these parameters consist of non-destructive strategies, which can enable long-term analysis in the same beds.

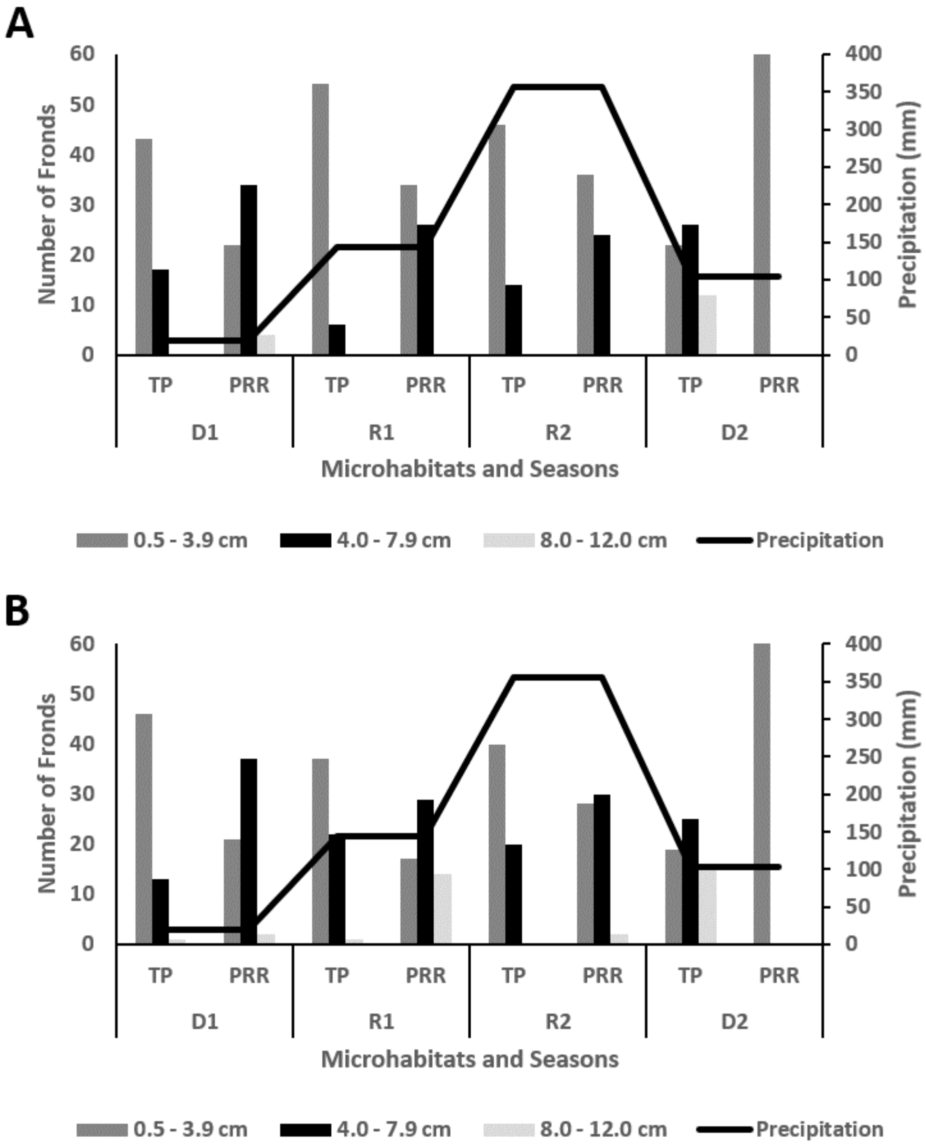

Figure 6. Total number of fronds for (A) height sizes intervals and (B) width sizes intervals of *Padina gymnospora* in the microhabitats and accumulated precipitation (30 days before collect) at Stella Maris beach, Salvador/Bahia, Brazil. TP: Tidal Pools; PRR: Protected Reef Region; D1 (Feb/2010) and D2 (Feb/2011): sampling in the dry season; R1 (Jun/2010) and R2 (Jul/2010): sampling in the rainy season. Dark gray bar: 0.5 - 3.9 cm size class; Black bar: 4.0 - 7.9 cm size class; Light gray bar: 8.0 - 12.0 cm size class; Black line: precipitation.

Regarding the height and width data, we observed that the fronds included in the 0.5-3.9 cm interval for both measures were dominant during the two seasons. A similar height size was observed for *P. gymnospora* by Széchy & Nassar (1989), in which the average was 4.6 cm. The fronds in this small size interval were predominantly infertile. King & Farrant (1987) discuss that the fertility of *P. tenuis* appeared to be related to the size, as the smaller plants exhibited reduced fertility.

The 0.5-3.9 cm size interval was also only present in the protected reef region in the second collection during the dry season (D2), in which the highest insolation rate was registered. As previously discussed, the fronds in this region remain exposed during low tides and experience a period of dryness that can restrict the growth of the thalli. Thus, the presence of small fronds can be a result of this growth restriction, or this specific size pattern can be more resistant to variations in environmental factors.

The fronds in the 8.0-12.0 cm height size interval (large category) were uncommon and only occurred during the dry season, when the environmental impact of waves and precipitation is

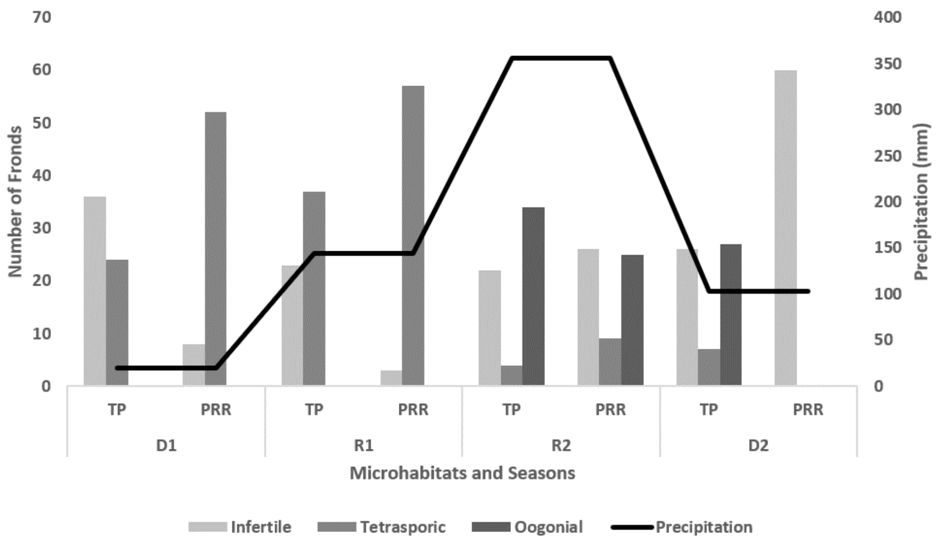

Figure 7. Number of *Padina gymnospora* fronds to each reproductive stage along the study. TP: Tidal Pools; PRR: Protected Reef Region; D1 (Feb/2010) and D2 (Feb/2011): sampling in the dry season; R1 (Jun/2010) and R2 (Jul/2010): sampling in the rainy season. Light gray bar: infertile fronds; Gray bar: tetrasporic fronds; Dark gray bar: oogonial fronds; Black line: precipitation.

the lowest. This size category was also higher in the tidal pools, where the abiotic variables are more stable. The strong water movement can break the thin and flexible fronds of *P. gymnospora*, which can justify the spatial and temporal occurrence of the large fronds.

We observed fertile fronds over the study period, which aligns with Széchy & Nassar (1989) who studied the same species. Among the phases of the haplodiplontic isomorphic life cycle of *P. gymnospora*, only the antheridial fronds were not observed. Thivy (1959) indicates the existence of periodicity in the development of gametes in *P. gymnospora*, and that antheridial and oogonial plants are less frequent in the environment. Széchy & Nassar (1989) also refer to reduced female and male gametophytes, as well as Allender (1977) who studied *P. japonica*. Hsiao & Druehl (1971) highlighted that in brown algae the gametangia are stimulated by low luminous intensity. During all our sampling periods, the insolation was considerably high, even during the rainy season, which can explain the absence of antheridial fronds.

Infertile thalli were dominant throughout the study, followed by a greater number of tetrasporic fronds. Széchy & Nassar (1989), Riosmena-Rodríguez & Ortuño-Aguirre (2009), and King & Farrant (1987) indicated that tetrasporic thalli were predominant for *P. gymnospora*, *P. concrescens*, and *P. tenuis*, respectively. For *P. japonica*, Allender (1977) indicated that the numerical superiority of the sporophyte generation is primarily attributed to the greater longevity of the thalli, because they are less prone to destruction by movement. In our study, the tetrasporic fronds predominated in the protected reef region, which presents more extreme environmental conditions.

The few oogonial plants presented high percentages of fronds in the large category and in tidal pools. Allender (1977) indicates that, for *P. japonica*, gametophyte thalli present an apical structure that is weaker to tear than sporophyte structures. Consequently, the gametophyte thalli would be more susceptible to destruction with water movement. In addition, the author highlights that the weaker sexual thalli can be removed by water movement, which can explain the lower proportion of gametophytes among the remaining substrate-attached individuals.

The spatio-temporal distribution of *P. gymnospora* depends upon the availability of a suitable substrate for the fixation of the reproductive elements and the subsequent growth of the plants (Széchy & Nassar 1989). In addition, the local environmental factors may cause oscillations within populations, but these variations are too small to affect the overall predominance of the asexual generation over the sexual generation, as observed for *P. japonica* by Allender (1977).

Padina gymnospora presents a large distribution in marine environments worldwide, which can make it a possible model organism for evaluating environmental changes over wide geographic ranges, as suggested by Gil-Díaz *et al.*

(2014) for *P. pavonica*, which can be implemented as a bio-indicator of ocean acidification over short and long time scales. Thus, our findings present a growth in the knowledge concerning the population and reproductive aspects of *P. gymnospora*, as well as a relevant basis for monitoring and conservation initiatives of biodiversity in tropical reef systems. In addition, marine biodiversity is included in the considerations of the United Nations Decade for Ocean Science for Sustainable Development, which aims for the generation of scientific knowledge and supply of data and information for the construction of future public policies and monitoring of marine environment conservation (United Nations Educational, Scientific, and Cultural Organization - UNESCO/ONU 2021-2030).

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