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Diversity and distribution Patterns of the infralittoral green macroalgae from Potiguar basin, Rio Grande do Norte, Northeastern Brazil

Adilma de Lourdes Montenegro Cocentino[1,4], Mutue Toyota Fujii[2], Thiago Nogueira de Vasconcelos Reis[1], Nathalia Cristina Guimarães-Barros[1], Marcia de França Rocha[3] and Sigrid Neumann-Leitão[1]

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RESUMO – (Diversidade e padrão de distribuição das macroalgas verdes da bacia Potiguar, Rio Grande do Norte, Nordeste do Brasil). Diversidade e padrão de distribuição das algas verdes do infralitoral da Bacia potiguar, RN, nordeste do Brasil foram analisados a partir de material coletado em profundidades que variaram de 2 a 100 m. As coletas foram feitas em dois tipos de dragas durante as quatro campanhas: julho de 2002, maio e novembro de 2003 e maio de 2004, em 43 estações. Chlorophyta está representada por 54 espécies, cinco variedades e três formas. A família mais representativa é Caulerpaceae e dentro da família, o gênero mais diverso é *Caulerpa*, com 11 espécies. Os resultados mostraram que muitos táxons são raros (89%) e 10% estão presentes em baixa frequência. A espécie mais freqüente foi *Caulerpa prolifera* (Forssk.) J.V. Lamour. ocorrendo em quase todas as estações das plataformas costeiras e internas, encontradas em todas as campanhas. A distribuição das espécies por intervalo de profundidades mostrou que o maior número de táxons ocorreu entre 10 a 20 m, e uma ampla distribuição vertical foi registrada para *Anadyomene stellata* (Wulfen in Jacq.) C. Agardh, *Chamaedoris peniculum* (J. Ellis & Solander) Kuntze, *Codium isthmocladum* Vickers, *Microdictyon* sp., *Udotea occidentalis* A. Gepp & E. Gepp e *Ventricaria ventricosa* (J. Agardh) J.L. Olsen & J.A. West. Quatro espécies, *Cladophora coelothrix* Kütz., C. *ordinata* (Børgensen) C. Hoek, *Caulerpella ambigua* (Okamura) Prud'homme & Lokhorst e *Halimeda simulans* M. Howe foram registradas pela primeira vez para o Rio Grande do Norte.
Palavras chave: padrões de distribuição, algas verdes, infralitoral, região tropical, Brasil

ABSTRACT – (Diversity and distribution patterns of the infralittoral green macroalgae from Potiguar basin, Rio Grande do Norte, Northeastern Brazil). Diversity and distribution pattern of the infralittoral green macroalgae at Potiguar basin, Rio Grande do Norte, Northeastern Brazil were analyzed from material collected at depths varying from 2 to 100 m. Collections were carried out with two types of dredges during four campaigns: July 2002, May and November 2003 and May 2004 at 43 stations. Chlorophyta is represented by 54 species, five varieties and three forms. The most representative family is Caulerpaceae, and the most diverse genus is *Caulerpa*, with 11 species. The results showed that most taxa (89%) are rare, and 10% are present at low frequencies. The most frequent species was *Caulerpa prolifera* (Forssk.) J.V. Lamour. occurring at almost all coastal and inner shelf stations, recorded in all campaigns. Species distribution by depth range showed that higher species number occurred on the inner shelf from 10 to 20 m, and a wide vertical distribution pattern was registered for *Anadyomene stellata* (Wulfen in Jacq.) C. Agardh, *Chamaedoris peniculum* (J. Ellis & Solander) Kuntze, *Codium isthmocladum* Vickers, *Microdictyon* sp., *Udotea occidentalis* A. Gepp & E. Gepp and *Ventricaria ventricosa* (J. Agardh) J.L. Olsen & J.A. West. Four species, *Cladophora coelothrix* Kütz., *C. ordinata* (Børgensen) C. Hoek, *Caulerpella ambigua* (Okamura) Prud'homme & Lokhorst and *Halimeda simulans* M. Howe, were recorded for the first time in Rio Grande do Norte.
Key words: Distribution patterns, green macroalgae, infralittoral, tropical region, Brazil

Introduction

It is widely recognized that macroalgae community structures display considerable change according to spatial and temporal scales. Temperate communities are highly seasonal and variable at different spatial scales (Underwood & Chapman 1998; Underwood 2000). Ecological processes such as herbivory, disturbance, predation, and recruitment, as well as oceanographic conditions have been shown to structure the communities (Menge & Branch 2001). In the tropics, macroalgal communities may also vary through time. However, the processes driving community dynamics are not well understood and it is not clear how algal communities vary at different spatial and temporal scales.

Macroalgae are diverse and well distributed on the tropical western Atlantic continental shelf, where a generally well-illuminated infralittoral and moderate nutrient loadings can be optimal environments for the development of macroalgae (Pereira *et al*. 1981).

The marine macroalgal resources along Rio Grande do Norte coast have been studied since the sixties by Câmara Neto (1966, 1971a, 1971b), Pinheiro-Vieira & Ferreira (1968), Pinheiro-Vieira & Ferreira-Correia (1970), Ferreira *et al*. (1981), Pereira *et al*. (1981), Oliveira-Filho (2002), although little is known about their distribution patterns. These patterns vary according to the local algal communities since they are related to photosynthetic pigments specialized in capturing light energy over a broad range of the visible spectrum present in each group of algae. Green macroalgae possess photosynthetic pigments similar to those of higher plants and they also store the same reserve product - starch (Levinton 1995). In general, they respond rapidly to nutrient enrichment and tend to dominate in shallow water environments.

Rio Grande do Norte littoral is located in the tropical region of Brazil and corresponds to the Oriental zone proposed by Oliveira-Filho (1977); it is characterized by oligotrophic waters, abundant hard substrate available for development of a diverse flora of marine algae (Horta *et al.* 2001). Oliveira-Filho (1977) was first to present the number of infrageneric taxa of marine macroalgae known for Brazil, reporting 504 taxa, with 327 Rhodophyta, 113 Chlorophyta, and 64 Phaeophyta. Later, Horta *et al.* (2001) updated this macroalgal diversity database to 642 taxa distributed in 388

[1] Universidade Federal de Pernambuco, Departamento de Oceanografia, Recife, PE, Brazil
[2] Secretaria do Meio Ambiente do Estado de São Paulo, Instituto de Botânica, São Paulo, SP, Brazil
[3] PETROBRAS - Gerência de Segurança, Meio Ambiente e Saúde, Natal, RN, Brazil
[4] Author for correspondence: adilmamc@hotmail.com

Rhodophyta, 166 Chlorophyta, and 88 Phaeophyta. More recently data on number of marine macroalgae in Brazil were summarized by Fujii *et al.* (2008) revealing 774 infrageneric taxa, including subspecies, varieties, and forms, corresponding to 482 Rhodophyta, 191 Chlorophyta, and 101 Phaeophyta. In this account, Rio Grande do Norte state appears with less than 30% (57 taxa) of all Chorophyta known for Brazil, making clear the scarcity of studies in this area.

The aim of this paper is to improve understanding of the diversity of Chlorophyta and its distribution patterns on the infralittoral of Potiguar basin, a tropical region in Northeast Brazil.

Materials and methods

Study area - The Rio Grande do Norte continental shelf extends 30-40 km from shore; the slope begins at 50-60 m depth and the morphology is irregular, with an average gradient of 1:1,000. The shelf underwent strong vertical tectonism during the Meso-Cenozoic, and grabens and horsts that dominate the Potiguar basin play an important role in sedimentation and shelf morphology (Testa 1997). A series of submerged points and banks exist alongside the shelf, constituting very rough relief. The most common facies is composed mainly of calcareous algae, such as *Lithothamnion* Heydr., *Lithophyllum* Phil., and *Halimeda* J.V. Lamour. (Mabesoone & Coutinho 1970). Siliciclastic sands are present in shallow waters near the coast, while carbonate sands are present offshore; mud occurs at the mouths of the rivers and in the filling channels on the shelf (Vital *et al*. 2005).

Sampling strategy - On the Rio Grande do Norte continental shelf, sampling was carried out during four campaigns: July 21-30, 2002 (Campaign 1), May 12-30, 2003 (Campaign 2), November 14-23, 2003 (Campaign 3), and May 17-31, 2004 (Campaign 4), by the CENPES/PETROBRAS Project "Potiguar Basin Environmental Assessment". Potiguar Basin is an area of oil and gas exploitation where the research center (CENPES) of the Brazilian oil company PETROBRAS is carrying out an extensive program of environmental assessment. Macroalgae were sampled at daytime at up to 43 stations along 9 transects perpendicular to the Rio Grande do Norte coast (lat. 4º-5º S, long. 36º-37º W), in depths varying from 2-100 m (Fig. 1). Collections were made using Charcot dredges with about 50 L collecting capacity (stations over 8 m deep) and Agassiz dredges (coastal stations less than 8 m). After collection, samples were fixed in 4% formalin/seawater. In the laboratory, Chlorophyta was identified to species level, analyzing external and internal morphology. Transverse and longitudinal hand-sections were made with a stainless steel razor blade under a Zeiss, Stemi 2000C stereomicroscope (Göettingen, Germany), stained with 0.5% aqueous aniline blue solutions acidified with 1 N HCl (Tsuda & Abbott 1985). Observations were done with a Zeiss-Axiostar plus microscope (Göettingen, Germany). Voucher specimens are deposited in the herbarium of the Universidade Federal de Pernambuco, Recife (UFP). Herbarium abbreviations follow the on-line *Index Herbariorum* (http://www.nybg.org/bsci/ih/ih.html).

Taxonomic nomenclature and classification system was based on Wynne (2005), except where otherwise indicated. The frequency of occurrence was defined as the number of stations in which each species occurred. Cluster analysis was performed on a presence-absence matrix with the Sorensen index using NTSYS PC 2.10 Exeter Software© 2000 by Applied Biostatistics, Inc.

Results

Chlorophyta was present in 37% of the samples and corresponded to 54 species, five varieties and three forms as listed below. In all campaigns higher species concentrations occurred from 10-20 m depth (Table 1, Fig. 2). Four orders (Ulvales, Cladophorales, Bryopsidales and Dasycladales) and twelve families were identified. The families Caulerpaceae (11 species, four varieties and two forms), Udoteaceae (seven species, one variety and one form), Cladophoraceae (seven species), Halimedaceae (seven species) and Siphonocladaceae (five species) had highest taxonomic diversity (Fig. 3). *Caulerpa* (11 species, four varieties and two forms) and *Halimeda* (seven species) presented greatest species number. In *Caulerpa*, *C. prolifera* was most frequent and abundant. Of the identified species, 52% (27 species) were rare, occurring only in the study area.

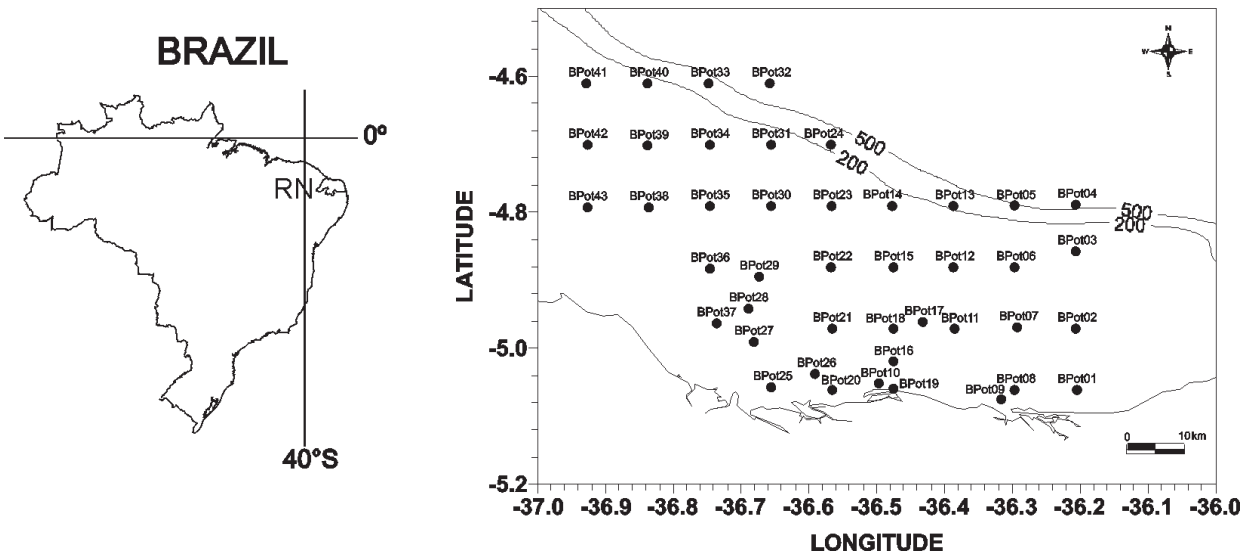

Figure 1. Area and sampling stations studied at Potiguar basin (Bpot), Rio Grande do Norte state, Brazil.

Table 1. Chlorophyta depth distribution at Potiguar basin, Rio Grande do Norte (Brazil), in July 2002, May and November 2003 and May 2004.

Species Depth	<10 m	10-20 m	20-30 m	30-40 m	40-50 m	>50 m
Acetabularia calyculus	x	x				
Anadyomene stellata	x	x	x	x	x	x
Anadyomene sp.	x	x				
Avrainvillea longicaulis		x	x	x	x	x
A. nigricans	x					
Boodleopsis pusilla		x				
Bryopsis pennata	x					
Caulerpa cupressoides var. *lycopodium*	x					
C. cupressoides var. *lycopodium* f. *disticha*		x				
C. cupressoides var. *serrata*	x	x	x	x	x	
C. kempfii		x	x	x	x	x
C. lanuginosa	x					
C. mexicana	x	x				
C. prolifera	x	x	x			
C. pusilla		x	x	x	x	
C. racemosa	x					
C. racemosa var. *peltata*						x
C. serrulata	x					
C. sertularioides	x	x				
C. sertularioides f. *longipes*		x				
C. verticillata		x				
Caulerpa sp.		x				
Caulerpella ambigua			x			
Chaetomorpha antennina		x				
Chaetomorpha sp.		x				
Chamaedoris peniculum	x	x	x	x	x	x
Cladophora coelothrix		x				
C. dalmatica	x					
C. ordinata		x				
C. vagabunda		x				
Cladophora sp.		x				
Codium decorticatum		x				
C. isthmocladum	x	x	x	x	x	x
Codium sp.	x	x	x	x	x	
Dasycladus vermicularis		x	x	x	x	
Dictyosphaeria cavernosa	x	x	x	x	x	
D. versluysii	x	x	x	x		
Halimeda discoidea		x	x	x	x	x
H. gracilis	x	x	x			
H. incrassata	x	x	x	x		
H. opuntia		x				
H. simulans	x					
H. tuna		x	x			

Continue

Table 2. Continuation.

Species Depth	<10 m	10-20 m	20-30 m	30-40 m	40-50 m	>50 m
Halimeda sp.	x	x	x	x		
Microdictyon sp.	x	x	x	x	x	x
Penicillus capitatus	x	x	x	x	x	
Siphonocladus tropicus		x				
Udotea cyathiformis var. *cyathiformis* f. *cyathiformis*	x	x	x	x		
U. flabellum	x	x	x	x	x	
U. occidentalis	x	x	x	x	x	x
Udotea sp.		x				
Ulva compressa	x	x	x	x		
U. fasciata	x					
U. lactuca	x					
Valonia aegagropila		x	x	x	x	x
V. macrophysa		x	x	x	x	x
Valonia sp.		x				
Ventricaria ventricosa	x	x	x	x	x	x

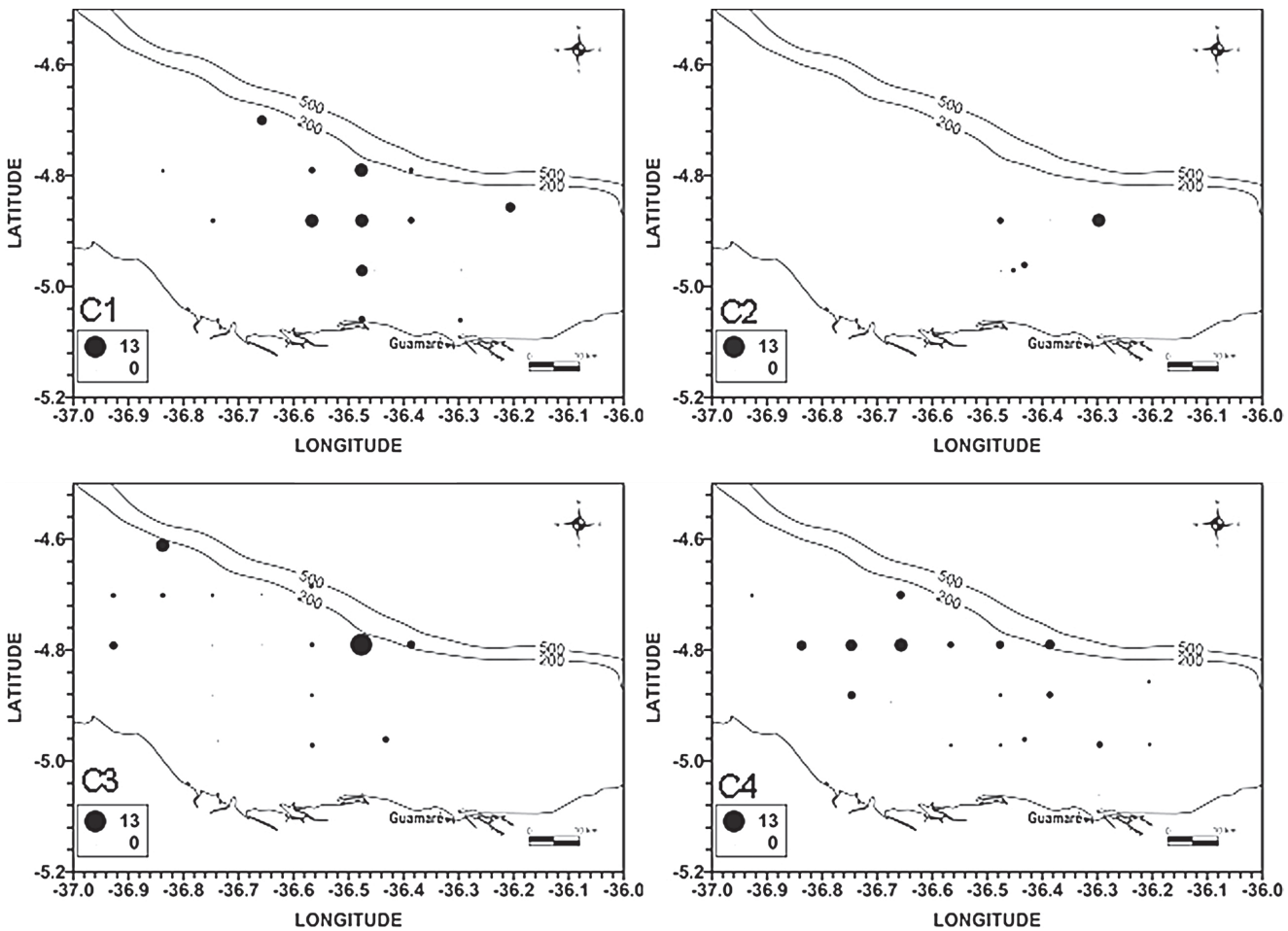

Figure 2. Chlorophyta distribution in Rio Grande do Norte (Brazil), in July 2002 (Campaign 1), May 2003 (Campaign 2), November 2003 (Campaign 3) and May 2004 (Campaign 4).

Species of Chlorophyta at Potiguar basin, Rio Grande do Norte (Brazil), in July 2002, May and November 2003 and May 2004:

Ulvophyceae
- Ulvales
  - Ulvaceae
    - *Ulva* L., 1753
    - *Ulva compressa* (L.) Nees
    - *Ulva fasciata* Delile
    - *Ulva lactuca* L.
- Cladophorales
  - Anadyomenaceae
    - *Anadyomene* J. V. Lamour., 1812
    - *Anadyomene stellata* (Wulfen in Jacq.) C. Agardh
    - *Anadyomene* sp.
    - *Microdictyon* Decne., 1841
    - *Microdictyon* sp.
  - Cladophoraceae
    - *Chaetomorpha* Kütz.,1845
    - *Chaetomorpha antennina* (Bory) Kütz.
    - *Chaetomorpha* sp.
    - *Cladophora* Kütz., 1843
    - *Cladophora coelothrix* Kutz.
    - *Cladophora dalmatica* Kutz.
    - *Cladophora ordinata* (Borgesen) C. Hoek
    - *Cladophora vagabunda* (L.) C. Hoek
    - *Cladophora* sp.
  - Siphonocladaceae
    - *Chamaedoris* Mont., 1842
    - *Chamaedoris peniculum* (J. Ellis & Solander) Kuntze
    - *Dictyosphaeria* Decne. ex Endl., 1843
    - *Dictyosphaeria cavernosa* (Forssk.) Børgesen
    - *Dictyosphaeria versluysii* Weber Bosse
    - *Siphonocladus* F. Schmitz, 1879
    - *Siphonocladus tropicus* (P. Crouan & H. Crouan in Schramm & Mazé) J. Agardh
    - *Ventricaria* J. L. Olsen & J. A. West, 1988
    - *Ventricaria ventricosa* (J. Agardh) J. L. Olsen & J. A. West
  - Valoniaceae
    - *Valonia* C. Agardh, 1823
    - *Valonia aegagropila* C. Agardh
    - *Valonia macrophysa* Kütz.
    - *Valonia* sp.
- Bryopsidales
  - Bryopsidaceae
    - *Bryopsis* J. V. Lamour., 1809
    - *Bryopsis pennata* J. V. Lamour.
  - Codiaceae
    - *Codium* Stackh., 1797
    - *Codium decorticatum* (Woodw.) M. Howe
    - *Codium isthmocladum* Vickers
    - *Codium sp*.
  - Caulerpaceae
    - *Caulerpa* J. V. Lamouroux, 1809
    - *Caulerpa cupressoides* var. *lycopodium* Weber Boss
    - *Caulerpa cupressoides* var. *lycopodium* f. *disticha* Weber Boss
    - *Caulerpa cupressoides* var. *serrata* (Kütz.) Weber Bosse
    - *Caulerpa kempfii* A. B. Joly & S. Pereira
    - *Caulerpa lanuginosa* J. Agardh
    - *Caulerpa mexicana* Sond. ex Kütz.
    - *Caulerpa prolifera* (Forssk.) J. V. Lamouroux
    - *Caulerpa pusilla (*Kützing) J. Agardh
    - *Caulerpa racemosa* (Forsskal) J. Agardh
    - *Caulerpa racemosa* var. *peltata* (J. V. Lamour.)
    - *Caulerpa serrulata* (Forssk.) J. Agardh
    - *Caulerpa sertularioides* (S. G. Gmel.) M. Howe
    - *Caulerpa sertularioides* f. *longipes* (J. Agardh) Collins
    - *Caulerpa verticillata* J. Agardh
    - *Caulerpa* sp.
    - *Caulerpella* Prud' homme & Lokhorst, 1992
    - *Caulerpella ambigua (*Okamura) Prud' homme & Lokhorst
  - Halimedaceae
    - *Halimeda* J. V. Lamour., 1812
    - *Halimeda discoidea* Decne
    - *Halimeda gracilis* Harv. ex J. Agardh
    - *Halimeda incrassata* (J. Ellis) J. V. Lamour.
    - *Halimeda opuntia* (L.) J. V. Lamour.
    - *Halimeda simulans* M. Howe
    - *Halimeda tuna* (J. Ellis & Sol.) J. V. Lamour.
    - *Halimeda* sp.
  - Udoteaceae
    - *Avrainvillea* Decne., 1842
    - *Avrainvillea longicaulis* (Kütz.) G. Murray & Boodle
    - *Avrainvillea nigricans* Decne
    - *Boodleopsis* A. Gepp & E. Gepp, 1911
    - *Boodleopsis pusilla* (Collins) W. R. Taylor, A.B. Joly & Bernat.
    - *Penicillus* Lamour., 1813
    - *Penicillus capitatus* Lamour.
    - *Udotea* J. V. Lamour.,1812
    - *Udotea cyathiformis* var. *cyathiformis* f. *cyathiformis* Decne
    - *Udotea flabellum* (J. Ellis & Sol.) J. V. Lamour.
    - *Udotea occidentalis* A. Gepp & E. Gepp
    - *Udotea* sp.
- Dasycladales
  - Dasycladaceae
    - *Dasycladus* C. Agardh, 1828
    - *Dasycladus vermicularis* (Scop.) Krasser
  - Polyphysaceae
    - *Acetabularia* J. V. Lamour.,1812
    - *Acetabularia calyculus* J. V. Lamour. in Quoy & Gaimard

Four species, *Cladophora coelothrix* Kütz., *C. ordinate* (Børgensen) C. Hoek, *Caulerpella ambigua* (Okamura) Prud'homme & Lokhorst and *Halimeda simulans* M. Howe were recorded for the first time in Rio Grande do Norte.

Frequency of occurrence for four campaigns is shown in Figure 4. *Caulerpa prolifera* was the most frequent followed by *C. cupressoides* (H. West in Vahl) C. Agardh var. *serrata* (Küz.) Weber Bosse, *C. mexicana* Sond. ex Kütz., *Halimeda incrassata* (J. Ellis) J. V. Lamour. and *Ventricaria ventricosa* (J. Agardh) J. L. Olsen & J. A. West.

The dendrogram including all species identified consisted of three groups. Group 1 associated five species that occurred only in campaign 1. Group 2 had the most frequent species, and Group 3, with nine species, occurred mainly during campaigns 3 and 4. *Caulerpa verticillata* did not group, occurring once during campaign 3 (Fig. 5).

Species distribution by depth range showed that higher species number occurred on the inner shelf, between depths from 10-20 m (Table 1). In depths over 50 m only 12 species were recorded. *Anadyomene stellata* (Wulfen in Jacq.) C. Agardh, *Chamaedoris peniculum* (J. Ellis & Solander) Kuntze, *Codium isthmocladum* Vickers, *Microdictyon* sp., *Udotea occidentalis* A. Gepp & E. Gepp and *Ventricaria ventricosa* occurred at depths from < 10 m to > 50 m, with wide vertical distribution in the area.

The coastal species and those occurring on the inner shelf were associated with fine to medium lithoclastic sands while species from the shelf break were related to coarse bioclastic sand.

Discussion

Green macroalgae identified in this paper represented 31.52% of Brazilian phycofloristic richness. This percentage corresponds to the same pattern as other tropical coastal areas in Brazil, and the species were similar to those in studies carried out on the northeastern coast (Oliveira-Filho & Ugadim 1976, Ugadim & Pereira 1978, Pereira *et al*. 1981, Ferreira *et al*. 1988, Cocentino & Pereira 1995, Pereira & Accioly 1998) and the southeastern coast (Pedrini *et al*. 1989, Bravin *et al*. 1999, Horta *et al*. 2001). Among the Chlorophyta the orders Cladophorales and Bryopsidales presented highest species number.

In this study, the number of identified species increased when compared to previous studies carried out in the same area by Pereira *et al*. (1981) who identified 32 chlorophycean species occurring from 10 to 45 m depth. However, of the 54 species, five varieties and three forms recorded in the present study 52% occurred only once, and one species (*Caulerpa prolifera*) showed wide distribution, corroborating previous

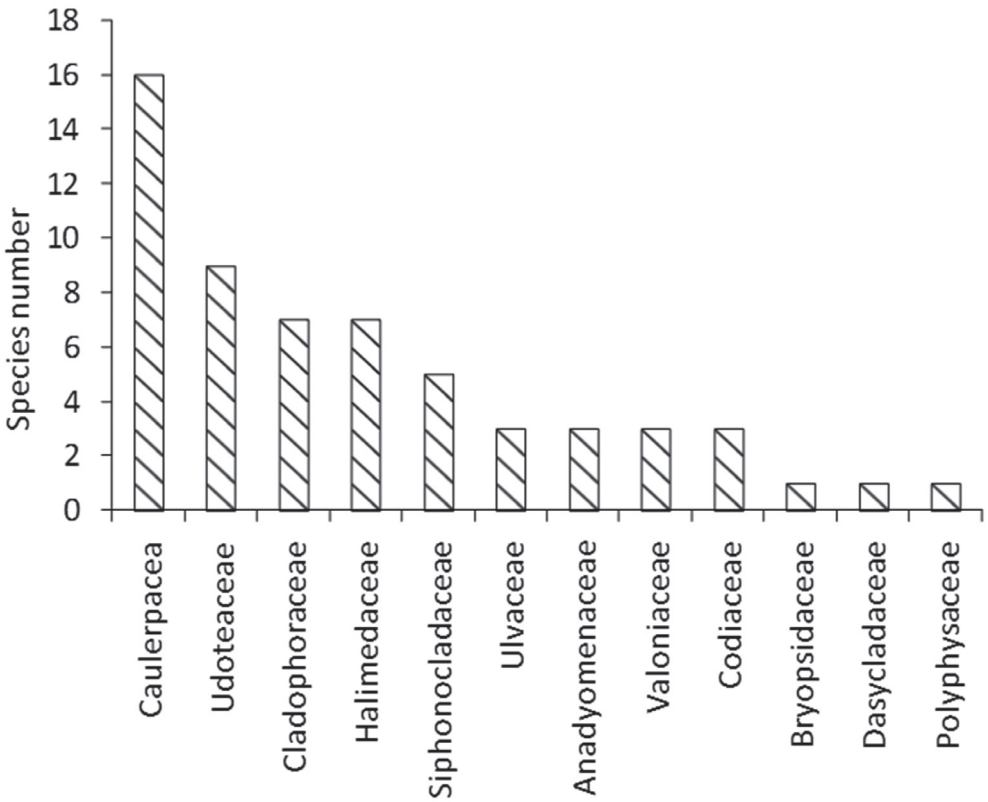

Figure 3. Number of Chlorophyta species by family at Potiguar basin, Rio Grande do Norte (Brazil), in July 2002, May and November 2003 and May 2004.

Figure 4. Frequency of occurrence of Chlorophyta at Rio Grande do Norte (Brazil) coastal area, from July 2002 to May 2004.

observations presented by Pereira *et al*. (1981). This species was also important in the infralittoral of Pernambuco state (Kempf 1970), southeast of the area under study.

Caulerpa prolifera was epilithic in the low intertidal zone, and it is widely distributed in tropical and warm temperate seas as previously observed by Leliaert & Coppejans (2003). *C. prolifera* produces erect blades, rhizomes (stolons), and descending rhizoids with continuous cytoplasm throughout the plant (Dawes & Rhamstine 1967). The rhizomes allow horizontal expansion while the rhizoids attach in both unconsolidated and hard substrata (Dawes 1998). The species also regenerates easily from cut blades or rhizomes and exhibits clonal growth similar to some vascular plants (Collado-Vides 2002, Levi & Friedlander 2004). In general, *C. prolifera* looks like *C. racemosa* in forming a dense network of overlapping stolons, resembling a green web on the sea floor. We believe that the dominance of *C. prolifera* in Potiguar basin is a result of the same behavior by *C. racemosa*, that spreads by fragmentation (Ceccherelli & Piazzi 2001, Levi & Friedlander 2004, Capiomont *et al.* 2005) and sexual reproduction (Panayotidis & Zuljevic 2001), and has spherical branchlets (ramuli) that act as propagules (Renoncourt & Meinesz 2002). Long-range dispersal of *C. racemosa* and *C. prolifera* may be a consequence of human activities (e.g., disturbance by anchors, fishing). *C. prolifera*, like *C. racemosa*, can inhabit a wide range of subtidal substrata (sand, mud, rocks, dead matte of seagrass, from 0-50 m depth), and has the potential to expand its range over the entire coastline (Meinesz 1979). *C. racemosa* modifies density and diversity of the benthic communities (Argyrou *et al.* 1999, Piazzi *et al.* 2001, Dumay *et al.* 2002), and *C. prolifera* has the same behavior.

In the Potiguar basin, as in Florida (USA), *Caulerpa prolifera* is more abundant at greater depths while *Halodule wrightii*, the most abundant species of seagrass, often dominates in percentage cover at shallower water depths, suggesting that *C. prolifera* may be better adapted to low light conditions. Studies have demonstrated reduced light requirements for *C. prolifera* (Terrados & Ros 1992) and the production of longer fronds at reduced light levels (Collado-Vides 2002), indicating that the greater abundance and biomass at 80 m depth may be a result of favorable physiological performance at lower light levels. As with other coastal areas, seagrass cover has declined over the past several decades, and lower water quality (more specifically decreased clarity) contributes to greater light attenuation, due to the decline in seagrass cover. Given the invasive characteristics exhibited by members of the Caulerpales, and the tendency for *C. prolifera* to occur in greater abundance at depths where light levels are lower, there is concern that as water quality declines, shifts in community structure may occur, with *C. prolifera* replacing *H. wrightii* (Taplin *et al*. 2005) Chlorophyta vertical distribution in deeper waters is limited (Lobban & Harrison 1994). Thus, a tendency was registered for species richness to decrease from coastal area to shelf break. Higher richness at depths under 10 m was expected, however higher species numbers occurred at depths from 10-20 m. This is probably caused by the kind of dredges used in collecting the samples, which was underestimated due the calcareous sandy bottom characteristic. Ichthyofauna samples collected during the same project with a trawl net collected high macroalgae density under 10 m depth.

Genus *Caulerpa* distribution along Pernambuco and Fernando de Noronha Archipelago was studied by Bryner *et al*. (2008). *Caulerpa kempfii* A. B. Joly & S. Pereira was first identified for the Pernambuco coast by Joly & Pereira (1975), and now in the present study, but it was only registered during campaign 3 in the shelf break area.

Some species such as *Caulerpa prolifera* and *Halimeda incrassata* contained high biomass (personal observation), displaying their importance to the area, supplying food, shelter and reproduction sites for local fauna, as mentioned by Pereira *et al.* (1981). The green macroalgae have an important role in the Potiguar shelf system, favoring the occurrence of a rich fauna that depends on the algae to survive including species economically important to the region.

Pereira *et al*. (1981) identified 32 species from 10 m to 45 m depth from Paraiba state, next to Rio Grande do Norte, stressing the significant biomass of *Caulerpa* and *Halimeda* as characteristic of typical tropical flora. Fredericq, Phillips & Gavio (2000) reported nine species of Chlorophyta collected from 18-32 m depth during the monitoring cruise conducted on two midshelf banks in the northwestern Gulf of Mexico. The composition of chlorophycean flora found is somewhat different from the present, showing only *Bryopsis plumosa* and *B. pennata* in common with Potiguar basin flora.

Hernández-Gonzáles *et al*. (2004a, 2004b) studied the submerged plant communities of the Canary Islands from 5-30 m depth and identified seven species of Chlorophyta: *Ulothrix flacca* (Dillwyn) Thuret*, Ulva rigida* C. Agardh*, Anadyomene stellata, Chaetomorpha* sp., *Caulerpa mexicana, C. prolifera, C. racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman & Boudouresque*, C. webbiana* Mont. and *Codium intertextum* Collins & Herv. Although the number of species they have found is low, over 50% of the species was the same as found in the present study. Pereira, Ribeiro & Bandeira-Pedrosa (2007) studied seaweed flora from Gaibu Beach at Pernambuco coast to 30 m depth, and also identified seven species (*Anadyomene stellata*, *Caulerpa cupressoides*, *Caulerpa lanuginosa* J. Agardh, *C. peniculum*, *Cladophora* sp., *Halimeda gracilis* and *Penicilus capitatus*). They justified the low number of species found in that area due to low availability of nutrients and scanty consolidated substrate available for algae.

Guimarães *et al*. (2008) identified 15 species of Chlorophyta: *Anadyomene stellata*, *Caulerpa kempfii*, *C. pusilla*, *C. mexicana*, *Chamaedoris peniculum*, *Cladophora* sp., *Halimeda discoidea*, *H. gracilis*, *H. incrassata*, *H. opuntia*, *H. tuna*, *Microdyction* sp., *Udotea flabellum*, *Ventricaria ventricosa* and *Valonia aegagropila* from the northeastern coast of Brazil between Piauí and Alagoas states, from 42-166 m depth. The authors commented that the possible reason for such low numbers of species in as wide a sampling region as in the Potiguar basin could be related to the form of material storage during the expeditions, since they found many algae fragments in these samples.

Yoneshigue-Valentin *et al*. (2006), investigated macroalgae of the "Programa REVIZEE/SCORE-Central", and identified 103 species of Chlorophyta from Bahia, Espírito Santo, and Rio de Janeiro states. According to Horta *et al*. (2001) this high number of species can be related to two different phytogeographic zones, the tropical and subtropical ones that encompass the study areas.

Among the species indentified in the present investigation, some are considered unusual, infrequent or endangered (Oliveira Filho 2002), such as *Acetabularia calyculus*, which was classified as infrequent, *Avrainvillea longicaulis* and *A. nigricans*, both included in species threatened with extinction. Oliveira Filho (2002) also emphasized that these species were more frequent in the past than today.

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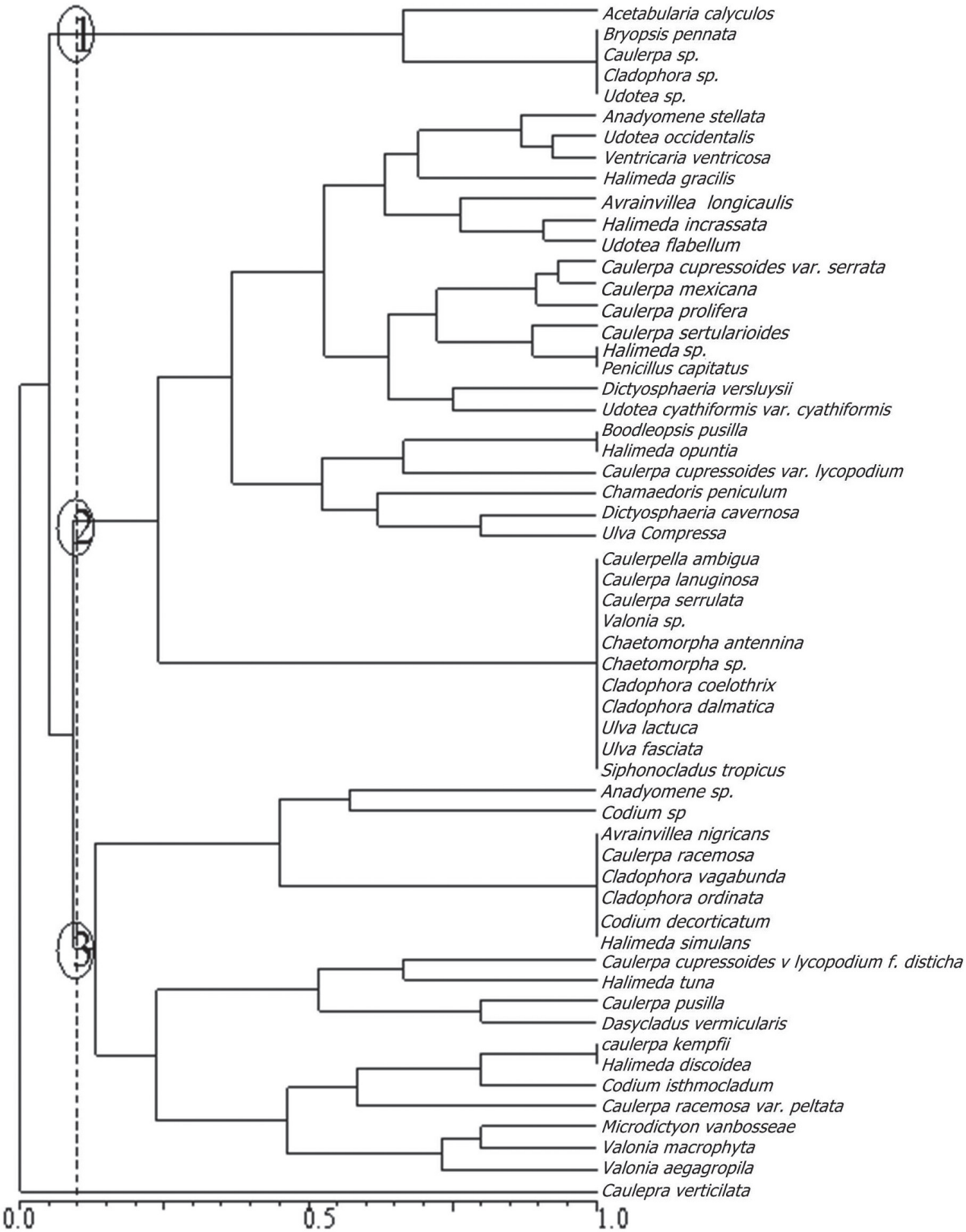

Figure 5. Dendrogram of green macroalgae species, Potiguar basin, Rio Grande do Norte (Brazil), in July 2002, May and November 2003 and May 2004. Sorensen index.

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